Organization of this Guide

The first chapters of this guide contain introductory information about two different, but not mutually exclusive, management approaches – integrated pest management (IPM) and organic. This is followed by general information on pesticide safety, sprayer use and calibration, and descriptions of the different materials used for pest management in tree fruits. Chapters are in the following order:

Integrated Pest Management
Organic Management
Safe and Legal Use of Pesticides
Effective Spraying
Characteristics of Crop Protectants

Following this are sections on managing diseases, insects and mites, weeds, and nutrient management and fertilizer recommendations for apple orchards.

Next, for each crop, is a section on *General Pest Management Considerations*. Each crop chapter begins with a Pesticide Spray Table, which lists specific products for the control of each disease, insect and mite pest of this crop, giving products (alphabetically by trade name), rates, re-entry and pre-harvest intervals, and comments keyed to specific sections of the written notes in the preceding *General Pest Management Considerations*. Addionally for apples, pears, and cherries, IRAC and FRAC resistance management codes and efficacy ratings are provided for each product. For each phenological growth and management stage of the crop, pests are addressed in the order of diseases followed by insect and mite pests. Within each pest group, individual pests are listed in alphabetical order. In some cases not every brand name pesticide product with the same active ingredient on the market is listed, and instead representative product(s) for that active ingredient are listed with a note that other products with the same active ingredient are available.

The spray table is followed by general pest management considerations. This section contains numbered comments keyed to the spray table on biology, cultural notes, monitoring, and pesticide use for each pest, in the following order:

CROP
- Diseases
  - Disease 1
    - Biology & Timing
    - Monitoring & Forecasting
    - Biological & Cultural Management
    - Pesticide Application Notes
    - Pesticide Resistance
  - Disease 2, etc.
- Insects and Mites
  - Insect 1, Etc.

Within each group (Diseases, Insects and Mites) pest are discussed in alphabetical order.

Lastly is an appendix of tables showing pesticide active ingredient common names, preharvest intervals, pesticide product brand names, EPA registration numbers, Restricted Entry Intervals, Personal Protective Equipment guidelines, and spray mixture compatibility suggestions for the materials included in this publication. This is followed by a list of other fruit reference publications, and directories of diagnostic services, Extension faculty and staff in each New England state.

The last page provides a key to the abbreviations and footnotes used in this publication.

1 Integrated Crop and Pest Management

1.1 Introduction

The purpose of this publication is to help growers make informed choices best adapted to the needs of their individual orchard. The best way to use this guide is to become familiar with it as a whole before using it to answer specific questions during the busy growing season.

Integrated Pest Management (IPM) is the guiding philosophy behind this publication. It is a multifaceted approach to maintain pest damage below economically damaging levels.

The word "Integrated" refers to the fact that individual management decisions are not isolated, but as much as possible take into account all aspects of the existing and potential pest situation in relation to the overall farm operation. Integration also applies to combining multiple tactics in a way that reinforces their efficacy. The word "Pest" refers to insects, mites, weeds, pathogens that cause disease, and vertebrates such as deer and voles.

Instead of focusing on how to eradicate pests, IPM considers pest biology and all feasible preventive and curative options, and brings them together into an overall management plan. This approach attempts to minimize problems of pollution and pest resistance while maximizing economic and environmental sustainability for the orchard.

1.2 Practicing IPM

IPM depends on growers, or their pest management advisors, understanding the biology of pests, when they are most active and most susceptible to treatment, and how the host plant, the fruit tree, responds to them. It is a truism in New England that every growing season is different. Staying on top of changes from year to year, or day to day, is critical. Understanding pest biology makes the most of management tools.

An IPM approach combines available management tools (see Figure 1.1.1) in a complementary way to create an overall management plan that is efficient, effective, and sustainable. By using multiple tactics, the chance of successful results is increased, and the chance that a pest population will adapt to a specific tactic is decreased. Horticultural practices, such as sanitation and habitat management, are a first line of defense in preventing many types of pest problems.

Using an IPM approach requires accurate identification and risk assessment of pest threats. Services in New England that provide insect and disease diagnosis and soil and tissue analysis are listed at the end of this publication. An understanding of pest biology and ecology, and of the influence of other factors such as weather and natural enemies on pest abundance, will aid in choosing management tactics.

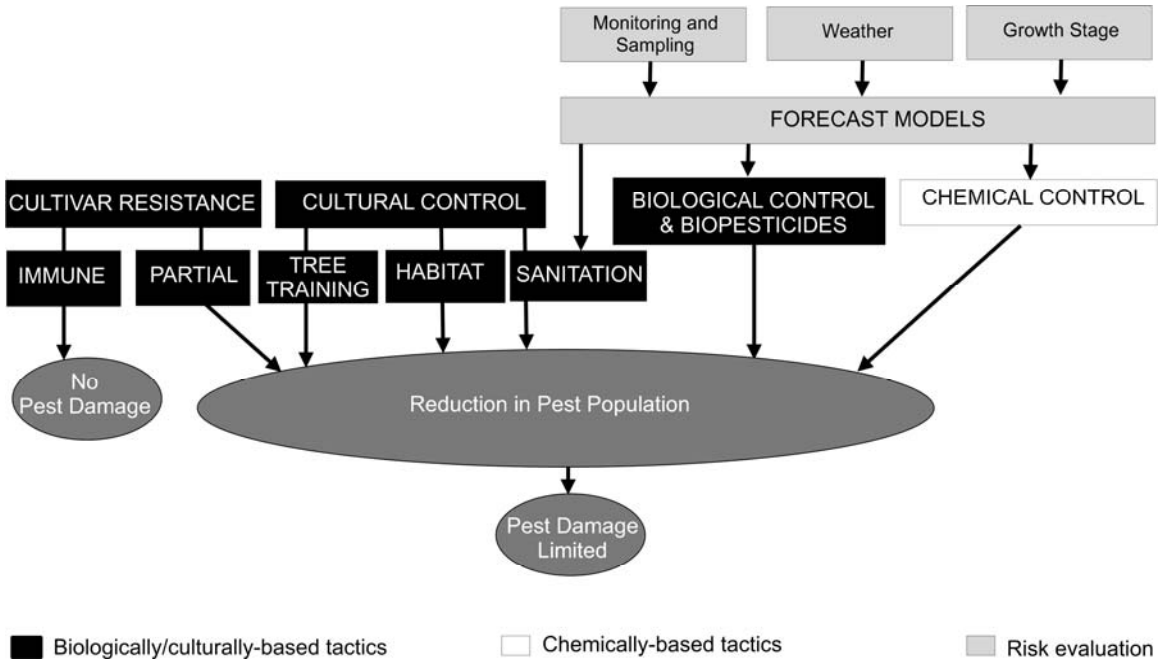

Figure 1.1.1. Diagram showing different management tactics for orchard pests (D. R. Cooley)

Instead of total eradication, the IPM approach stresses suppression of pest populations to levels that do not cause economic damage. Use of pesticide and other pest control options reaches a point of diminishing returns at which additional suppression is exceeded by the additional cost and negative impacts. In the case of insect pests, it may be important to have at least some pests present to ensure that natural enemies will remain in the orchard to suppress subsequent pest infestations.

Generally, IPM follows this process:

- Determine how much, if any, damage may be acceptable.
- Identify pest problems that are most significant from year to year, the key pests.
- Know when and how to monitor for these pests, and do it.
- Treat with an appropriate management tactic at an appropriate time.
- Monitor during the season and at harvest for results.
- Adjust tactics if needed to improve results.

1.3 Components of IPM

1.3.1 Monitoring (Scouting)

Scouting is making observations to identify and measure pest populations. Traps are available for some pests that can be used to indicate population density to compare against treatment thresholds and to identify optimum timing for control measures. For diseases, weeds and some insect pests, inspecting foliage, fruit, or groundcover is required. Monitoring individual orchard blocks throughout the season is the most effective way to assess the insect, disease, and weed situation and, therefore, the need and timing for chemical treatment. Scientifically-based and efficient monitoring methods are available for many tree-fruit pests. Brief descriptions of recommended monitoring methods are included in the "General Pest Management Consideration" notes for each crop in this publication.

1.3.2 Pest Models and Forecasting

Weather-based pest development models for some pests can be used to estimate the best timing for monitoring, prevention, or control. A record of daily maximum and minimum temperatures and rainfall can provide useful input for pest models and to estimate depletion of protective residue from a previous pesticide application. Alternatively, site-specific weather data are available from private companies (see IPM Resources).

An on-line tool called **Orchard Radar** processes weather data through IPM models, and is available through the **PRONewEngland.org** website. Information on the potential for pest outbreaks can also be obtained from Cooperative Extension newsletters and regional crop advisors.

Another on-line tool is the Network for Environment and Weather Awareness (**NEWA).** Some New England states send weather data to NEWA for use in pest forecasts. NEWA provides automated local weather information and the results of pest forecasts on a daily basis. Access NEWA online at newa.nysaes.cornell.edu.

1.3.3 Action Thresholds

A pest threshold is an estimate of the population density at which treatment is justified because the cost of economic damage is likely to outweigh the cost of prevention/control. Thresholds have been determined for some pests based on field studies of the relationship between pest population density and subsequent crop damage. For other pests, generally accepted "best guess" thresholds are used. By comparing pest monitoring observations with thresholds, tree fruit growers have been able to reduce pesticide use by as much as 50% without jeopardizing crop quality or yield. The risk of damage can be decreased by early detection and evaluation of pest threats. The term ***suggested action threshold*** in this publication denotes situations in which the decision to apply a pesticide can be made primarily on the basis of a properly timed visual inspection of the orchard. Applying general recommendations to individual orchard situations requires grower judgment. Knowledge and records of block history are very useful in making the best decisions for your orchard.

1.3.4 Management Tactics

Appropriate management tactics to prevent or control pests include cultural, biological, and physical methods, as well as chemical control (i.e.pesticide) when needed. Chemical control is deferred unless other tactics are not sufficient in order to minimize the social, environmental, economic, and safety concerns associated with pesticide use. Implementing some of the simple and relatively inexpensive non-chemical pest management methods described in this manual can yield significant savings in pesticide use and crop loss. Preventive measures taken before pest damage occurs can be much less expensive than the cost of rescue treatment later.

1.3.5 Recordkeeping

A yearly record of pest monitoring observations, treatment actions, and an end of season damage assessment provides a valuable reference for future decisions. Written records are likely to be more complete and accurate, and are more easily shared than memory. Complete pest management records can improve results and decrease costs, document and justify actions for compliance with regulatory and customer requirements. They also provide useful information for business planning. Post harvest evaluation of the season's pest management decisions helps you learn from mistakes and build on successes.

1.4 IPM Tactics

Actions taken at planting and before and during each growing season can affect the degree of pest risk and need for pesticide use. Here is an outline of methods that can be integrated into an overall management plan.

1.4.1 Resistant Varieties

There are commercially viable scion cultivars available that are resistant to apple scab and other major apple diseases. Among susceptible cultivars, the degree of susceptibility to different diseases and even some insect pests varies.

Rootstock selection must account for desired horticultural traits, soil conditions and low temperature hardiness, but can also include consideration of the degree of management needed to prevent fire blight and Phytophthora diseases.

1.4.2 Cultural Control

Consider pest pressure in selecting sites to plant trees. For example, low spots that hold fog and dew have increased risk of fungal diseases. Orient orchards to provide maximum air drainage and circulation. If possible, remove hedgerows of wild shrubs and trees immediately adjacent to the orchard. Dense vegetation close to the orchard blocks sunlight and wind, thus keeping foliage wet longer which encourages growth of some disease organisms. In some cases, wild plants provide a source of disease and insects.

Remove disease inoculum from the orchard when possible. Get rid of piles of culled fruit or prunings, and chop prunings and leaves in the spring to speed degradation. Remove materials that provide overwintering sites for pests: dead or dying wood, branch cankers, prunings, mummified fruit, root suckers, and alternate host trees near the orchard.

Use deer fencing and open mesh vole guards, especially for young orchards that are particularly vulnerable to vertebrate pest damage.

Support tree health and regulate vegetative vigor through careful management of fertilizer, water, and groundcover. Avoid stresses such as overwatering, drought, mechanical trunk damage, overcropping or other conditions that may predispose trees or fruit to damage by insects, diseases, physiological disorders or environmental stresses such as rapid temperature changes and low winter temperatures.

1.4.3 Biological Control

Conserve natural enemies of insect and mite pests by only using insecticides, miticides, fungicides, and herbicides when needed. Select pesticides that are effective against the targeted pest(s) with minimal negative impact on predators, parasites, pollinators and other beneficial organisms. Consider the impact of groundcover management decisions on beneficial organisms. Consider “seeding” releases of predator mites if practical.

1.4.4 Chemical Control

Only use pesticides if monitoring and economic thresholds, model forecasts, block history or other information indicates a need.

Many factors need to be considered when selecting a pesticide. Some choices are constrained by third-parties, such as processors or marketers using eco- or organic labels. Additional factors must also be taken into account.

- applicator and worker safety
- required protective equipment
- reentry and preharvest intervals
- pest efficacy
- resistance management
- impact on the environment and natural enemies
- tank mix compatibility
- suitability for the application equipment that will be used

Ensure complete and uniform spray coverage by using recommended pesticide dosage, accurately calibrated equipment, optimum spray pattern, travel speed, droplet size, and sufficient water per acre to insure good coverage for protective surface residue for contact materials, or absorption for locally systemic materials.
Try to time spray applications for maximum impact on pests and minimum off-target impacts, and for weather conditions that allow for optimum coverage and drying.

Do not apply pesticide when wind velocity is more than ten miles per hour to avoid drift to nontarget sites, or when air is completely calm because of the risk of inversion. Avoid making foliar sprays when high temperatures and high humidity can increase the risk of phytotoxicity. Test new tank mix combinations with a jar test or trial application to a few trees.

2 Organic Tree Fruit Production in New England

2.1 Introduction

There is more interest in organic tree fruit production than the actual number of certified orchards reflect and some growers are taking a new look at organic production, particularly organic apple production, given some recent research advances that address long-standing obstacles.

In the past, very few growers in the Northeast have attempted to produce apples and other tree fruits organically in part because of the practical difficulties involved in managing pests in this region with organically-approved pesticides. Wet weather in the spring and summer coupled with the disease-susceptible apple cultivars present significant challenges in disease management, particularly apple scab. In addition, a large number of both native and introduced arthropod pest species attack apples and other tree fruits grown in commercial orchards.

Management of pest complexes is particularly challenging in New England, because unlike more arid production regions in the country, fruit orchards in New England are commonly in close proximity to semi-wooded areas with an abundance of naturalized and wild host species that can harbor populations of certain tree fruit pests. However, during the last 10-15 years studies have been conducted to develop management tactics that address key pests that can be incorporated into an organic program. For example, recent studies have shown that the predaceous mite, *Typhlodromus pyri*, which is native to apple production regions in western New York and New England, can successfully manage populations of the key mite pest, European red mite, in commercial apple orchards so that no applications of miticides are required. Also, the trend of planting apple cultivars less susceptible to disease than 'McIntosh' may make organic production more feasible.

In addition, recent research in New York state and elsewhere has shown that pheromones can be deployed in orchards to disrupt mating of key lepidopteran species such as oriental fruit moth, and borer species, and substantially reduce damage from these pests. In addition, traditional management methods such as selective fruit thinning, pruning, sanitation (frequent removal of pest–infested, dropped fruit), removal of wild hosts near commercial plantings, and exclusion of pests, have been shown to reduce populations of some types of pests. Experience in Vermont has shown that non-managed *Malus* species can present significant inoculum for development of apple scab, fruit rot, and European apple sawfly outbreaks in adjacent organically managed apple blocks.

Ideally, organic fruit production is the synthesis of an entire suite of practices intended to take advantage of natural ecosystem interactions and minimize chemical intervention. In apples, such a system might start with the selection of disease-resistant cultivars to circumvent the need for the majority of normal disease sprays. This one tactic could eliminate or substantially reduce the need to manage apple scab, powdery mildew, cedar apple rust, and/or fire blight (Ellis et al., 1998). Many high-quality scab resistant apple cultivars, including 'Liberty', 'Crimson Crisp', 'Topaz', and others are commercially-available and worthy of trial in commercial New England orchards (Brown and Maloney, 2008). While resistant to apple scab, these cultivars are susceptible to other diseases which will require management during the growing season. Furthermore, genetic resistance to apple scab in commercially-available cultivars is largely dependent on a single gene, and in some production regions the apple scab fungus has eveolved to overcome this resictance. To reduce the likelihood of breakdown of apple scab resistance in your orchard, scab-resistant cultivars should not be interplanted with unmanaged, scab susceptible cultivars. Additionally, fungicide sprays may be warranted on scab-resistant cultivars during peak infection periods from pink to petal fall to reduce likelihood of germination of resistant spores. In lieu of resistance, a combined strategy of orchard sanitation and frequent applications of organic fungicides, such as elemental sulfur, throughout most of the season would be necessary.

Because spray materials acceptable under organic certification tend to have less target efficacy than many non-organic materials, organic IPM programs should include all available management options. Pest management can be improved by addressing biological and physical components of the orchard system, including orchard architecture that promotes good airflow and spray penetration within the trees, strict orchard sanitation, predator introduction and conservation, good tree nutrient and groundcover management, and regular scouting for orchard pests. Sprayer operation is more critical under organic management programs, requiring careful calibration to ensure effective material application. Sprays should penetrate fully into the top and interior of each tree without excessive drift occurring. One good way to quickly assess spray coverage is to observe the white surface residue if Surround (kaolin clay) is applied. The extent of the resulting residue will give some indication of the coverage of your sprayer. This is not a replacement for full annual sprayer calibration as discussed in Section 4 of this Guide.

2.2 What is Organic Agriculture?

In 1995, the USDA National Organic Standards Board (NOSB) defined organic agriculture as "an ecological production management system that promotes and enhances biodiversity, biological cycles, and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain, or enhance ecological harmony…. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people." Before a product can be labeled "organic," a

Government-approved certifier must inspect the farm where the food is grown to make sure the farmer is following all the rules necessary to meet the USDA organic standards. Detailed records are required and reviewed by the certifier. It takes three years of organic management before a farm product can be "certified" as organic. Please note that the labels "natural" and "eco-friendly" which have been used to describe agricultural products may imply that some organic methods were used in the production of the product, but this labeling does not guarantee complete adherence to organic practices as defined by law.

IMPORTANT: It is the grower's responsibility to ensure that any crop production practice or material used in the orchard is acceptable in their particular state's organic certification program. Some materials deemed organically acceptable on the National List may not be acceptable in some states. *Contact your certifier to know what is acceptable and to ensure compliance with regulations in your state.*

"A Grower's Guide to Organic Apples" published by Cornell Cooperative Extension (Peck and Merwin, 2010) provides a basic outline of management options for organic apple growers in the Northeast. The New England Tree Fruit Management Guide uses the symbol **"§"** to indicate materials that are considered organic options under at least *some* state certifying programs. Again, before using any product or production practice, consult with your certifying agency. Look for remarks or estimates of potential levels of efficacy in the footnoted comments associated with these materials, located in the "General Pest Management Considerations" sections preceding the Pesticide Spray Tables, and also in the respective tables giving the activity spectrums for the different pesticide classes (e.g., Tables 6.1.1, 7.1.1 and 7.1.2). Many newer materials, especially biopesticide materials with broad crop and pest uses have not been tested for efficacy on every crop-pest combination, so experimentation on small plots is suggested before adopting their use to the whole orchard.

Detailed recordkeeping is critical in organic production to receive certification and to maintain it. Contact your state certifier to find out what is required. Federally accredited certifying agencies for the New England states include the following:

Maine
MOFGA Certification Services, LLC
294 Crosby Brook Rd.
P.O. Box 170
Unity, ME 04988-0170
Contact: Mary Yurlina
207-568-4142
E-mail: certification@mofga.org
www.mofgacertification.org
Scope: crop, livestock, wild crop, handling

Connecticut and Massachusetts
Baystate Organic Certifiers
1220 Cedarwood Circle
North Dighton, MA 02764
Contact: Don Franczyk
(774)872-5544 Phone
(774)872-5545 Fax
E-mail: baystateorganic@earthlink.net
www.baystateorganic.org
Scope: crop, livestock, wild crop, handling

New Hampshire
NH Dept. Agriculture Markets, & Food
25 Capitol St.
P.O. Box 2042
Concord, NH 03302-2042
Contact: Jennifer Gornnert
603-271-3685
E-mail: jennifer.gornnert@agr.nh.gov
www.agriculture.nh.gov/divisions/markets/organic_certification.htm
Scope: crop, livestock, wild crop, handling

Rhode Island
Rhode Island Department of Environmental Management
Division of Agricultural and Resource Marketing
235 Promenade St.
Providence, RI 02908
Contact: Matt Green
401-222-2781 ext. 4516
E-mail: matt.green@dem.ri.gov
www.dem.ri.gov/programs/bnatres/agricult/orgcert.htm
Scope: crop and handling

Vermont
Vermont Organic Farmers, LLC
NOFA Vermont
P.O. Box 697
14 Pleasant St.
Richmond, VT 05477
Contact: Nicole Dehne
802-434-3821
E-mail: vof@nofavt.org
nofavt.org/programs/organic-certification
Scope: crop, livestock, wild crop, handling

2.3 Fungicide/Bactericide Options in Organic Apple Production

Ideally, organic fruit production involves a whole systems approach not just a substitution of materials. Research is currently underway in New England to examine the challenges and opportunities of organic apple production. Information from this and other research will be incorporated into future extension publications. The following information on organically acceptable fungicides is based on observations by researchers and Extension specialists in New York.

Sulfur (Microthiol Disperss) is effective for controlling some fruit diseases, but it must be applied prior to infection. Sulfur is easily removed by rain. Thus, coverage must be renewed much more frequently than is required with conventional fungicides with better rain resistance. Sulfur is not very effective for controlling rust diseases on apples. [Note: Rust diseases in organic apple orchards can be minimized if cedars within 500 ft can be removed or if new orchards are established in areas isolated from existing or potential cedar habitat.] In more southern areas of the region, sulfur is also relatively ineffective for controlling flyspeck, bitter rot, black rot and white rot on apples during July and August, but sulfur may provide adequate suppression of these diseases in more northern areas. Liquid lime sulfur applied at 2 qt/100 gal on a 21-day interval or at 1 qt/100 gal on a 10-day interval provided good control of flyspeck in a 2006 trial in New York's Hudson Valley. However, the liquid-lime sulfur sprays did not control summer fruit decays. [Note: Copper fungicides applied once or twice during late July or August should help to control both flyspeck and summer fruit decays, but this strategy needs further evaluation under New England conditions.]

Whereas wettable sulfur has no post-infection activity, liquid lime sulfur provides 60–70 hours of post-infection activity against apple scab (counting from the beginning of an infection period). Liquid lime sulfur is also useful to "burn out" scab infections when they appear on leaves, but it has no activity against scab during the incubation period between 70 hours post-infection and appearance of symptoms. Unfortunately, research has shown that both sulfur and lime sulfur can suppress photosynthesis which can reduce yield (Burell, 1945; Palmiter and Smock, 1954). Therefore, the number of sprays should be kept to a minimum.

Copper fungicides (Champ, Nu Cop) also control many tree fruit diseases, but copper causes phytotoxicity under certain conditions. Copper is extremely phytotoxic to foliage on sweet cherries. On apples, copper applied between half-inch green and bloom usually causes fruit russetting. Copper applied between bloom and roughly July 4 will cause blackening at the lenticels. Copper applied later in July will provide excellent control of sooty blotch and flyspeck on red apple cultivars, but July applications may still cause severe fruit discoloration of yellow cultivars.

Note: Very few copper fungicides have labels that allow application to apples after bloom.

Summer applications of copper fungicides have been used effectively to control bacterial leaf spot on peaches, but care is required to avoid a build-up of copper residues that can result in severe leaf injury on peaches. Repeated summer applications of copper on peaches should be avoided unless rainfall has removed the residue from the previous application. Copper has also been used to control cherry leaf spot on tart cherry.

Some newer formulations of copper fungicides (Cueva, Badge X_2) are available and labeled for use during the summer against multiple diseases including Brroks Spot, fruit rots, and Sooty Blotch. These materials contain different formulations of copper than many older materials, and the amount of available copper ions in applied rates may be substantially less than those materials. While this may reduce phytotoxicity and potential for fruit russetting, it may also reduce control of summer diseases affecting fruit and foliage.

Bacillus subtilis (Serenade**)** is a biofungicide labeled for control of fire blight, apple scab and powdery mildew. Serenade is a wettable powder formulation of the bacterium *Bacillus subtilis*, a common soil resident. The bacterium acts by releasing cell contents during growth in order to eliminate or reduce competitors in its immediate environment. Serenade is relatively ineffective for controlling fungal diseases under the climatic conditions that exist in the Northeast. When used alone, Serenade provides only partial control of fire blight. In alternation with streptomycin, it sometimes provides control approaching that of a full streptomycin program (see comments on streptomycin use in organic fruit production below). Serenade should be applied as a preventive and can be applied up to and including the day of harvest.

Potassium bicarbonate (Kaligreen, MilStop, Ecomate Armicarb) has variable activity as a fungicide. This material does not have post-infection activity and therefore needs to be applied prior to infection. In addition, it has a short residual period and repeated applications are necessary. Bicarbonate products may provide some control of diseases, but have been insufficient in trials when used alone. When combined or used in rotation with wettable sulfur, potassium bicarbonate products have been effective in managing apple scab in several European studies.

Hydrogen dioxide (Hydrogen peroxide) (StorOx and OxiDate) kills fungi and bacteria via surface contact with the organism. OxiDate is labeled for control of diseases in the field whereas StorOx is labeled for use as a surface disinfectant and as an antimicrobial for hydro coolers and water flumes. Hydrogen peroxide does not have residual activity, nor will it control fungi or bacteria that have already penetrated host tissue. Thus, it must be applied after pathogens have been deposited on plant surfaces but before they can initiate infections. Field applications to apples are not recommended because OxiDate can cause severe fruit russetting under certain conditions. Controlled inoculation trials indicate no significant effect of OxiDate on fire blight infection of apple.

Streptomycin (Agri-mycin) is a bactericide used for control of fire blight of apples and pears. It is formulated as streptomycin sulfate in a 17% wettable powder. Streptomycin is commonly used during bloom at the rate of 1/2 lb/100 gal for fire blight control. It can be applied to pears until 30 days before harvest and to apples until 50

days before harvest. However, summer sprays of streptomycin are NOT recommended, except following a hailstorm.

Resistance to streptomycin is widespread among populations of the fire blight bacterium in Pacific Coast and Midwest production districts, and has recently been detected in NY. Indiscriminate use of this material (e.g., summer sprays) will hasten the development of resistance. [Note: Growers must contact their certifying agency to determine acceptable streptomycin formulations since some are not allowed under organic rules.]

In a review of biocontrols labeled for use against fire blight, University of Massachusetts research showed that overall, biocontrols were not as effective as streptomycin against blossom blight. Biocontrols were effective in far fewer tests, and if effective, generally controlled blossom blight half as well as streptomycin.

Streptomycin products will no longer be allowed for use in organic orchards after October 21, 2014.

2.4 Insecticide Options in Organic Apple Production

Kaolin clay (Surround), when used properly, has proven an effective organic option to deter pear psylla on pears, and plum curculio and first generation codling moth damage on apples. Later season use can suppress apple maggot damage and second generation codling moth, but when used past early July when apple maggot becomes a threat, the increased chance of a bothersome amount of Surround residue remaining on apples at harvest becomes a limitation. Also, full season use of Surround has been associated with an increase in mite populations. To be effective, Surrouind must be applied in dilute (100 gallons water per acre minimum) applications, and a complete base layer must be present prior to target insect activity in the orchard.

Azadirachtin (Aza-Direct, Neemix) is derived from the seeds of the neem tree, *Azadirachta indica*, which is widely distributed throughout Asia and Africa. Azadirachtin has been shown to have repellent, antifeedent, or growth regulating insecticidal activity against a large number of insect species and some mites. It has also been reported to act as a repellent to nematodes. Neem extracts have also been used in medicines, soap, toothpaste and cosmetics. It shows some activity against leafminers, leafhoppers, mealybugs, aphids, caterpillars, tarnished plant bug and pear psylla, but repeated applications at short intervals are probably necessary for acceptable control of most pests. Azadirachtin is relatively short-lived and mammalian toxicity is low (rat oral LD50 >10,000). It can be used up to and including the day of harvest and reentry is permitted without protective clothing after the spray has dried. It is relatively nontoxic to beneficials, but toxic to fish, aquatic invertebrates, and bees exposed to direct treatment, although relatively non-toxic when dried. It is therefore categorized as having a moderate bee poisoning hazard.

Clarified Neem oil (Trilogy) is labeled for a wide range of pest control or suppression uses, including use as a fungicide, insecticide, and miticide. Specific uses have not been well-studied for every labeled pest; rates suggested on the label also vary widely. Neem oils have been found to suppress European apple sawfly and may deter feeding or egg laying of other insect pests. Research on its use as a scab fungicide has shown that it is ineffective as a stand-alone material. Because Trilogy is an oil-based material cautions against mixing with other pesticides incompatible with oil, such as sulfur, should be followed. Trilogy applications have been found to form a persistent film on fruit and foliage that may make removal of residues such as kaolin difficult at harvest or packout. This product is toxic to bees if exposed to direct treatment and is hazardous to fish and aquatic invertebrates.

Bacillus thuringiensis (Dipel, Deliver, Biobit, Javelin, Agree) is a microbial insecticide specific for the control of caterpillars. It contains spores and crystalline endotoxin that must be ingested by larvae with high gut pH to provide control. It is effective against many fruit pests, including leafrollers and fruitworms. Although this material will control codling moth and other internal lepidopterous apple pests, it is not as effective as most conventional insecticides. One exception is the obliquebanded leafroller, which has become so difficult to control with conventional toxicants that the Bt products work at least as well as any material available. Compared to conventional insecticides used against these pests, Bt insecticide coverage should begin earlier and requires shorter intervals between spray applications. This material is exempt from requirements for a tolerance on all raw agricultural commodities, thus it can be sprayed up until harvest. It is harmless to humans, animals, and beneficial insects, including the honey bee.

Spinosad (Entrust, GF-120**)** is the same active ingredient in the conventional insecticide SpinTor. Entrust is an organically accepted formulation that can provide good control of codling moth, leafollers, and fair control of apple maggot and spotted tentiform leafminer. Formulations with an attractant bait (GF-120) can be used at low rates to manage fruit flies.

Pyrethrin (Pyganic**)** is a material that has been used against European apple sawfly and for short term (relative to conventional insecticides) control of plum curculio, codling moth and apple maggot. Pyrethrins are rapidly broken down when exposed to UV-light and therefore applications before dawn or in late evening are recommended. For the duration of control it provides, Pyganic would be more expensive than conventional insecticides or other organic options as the foundation for an insect pest management program.

Insecticidal soaps (M-Pede) are concentrates made from biodegradable fatty acids and are contact insecticides that

can be effective against such soft-bodied arthropods as aphids, mealybugs, and psyllids. They can provide suppression of pear psylla when used in a seasonal spray program, but the residual period is short, and uniform drying conditions are required to prevent droplet residues on the fruit surface. They have a low bee-poisoning hazard.

Horticultural oil is an effective tool against mite pests, San Jose scale, and pear psylla, and can contribute to suppression of codling moth and spotted tentiform leafminer. Oils act as physical pesticides by creating a film over eggs, spores, or soft-bodied insects, thus suffocating them. A dormant (or prebloom) oil application can help manage mite populations; additional summer oil applications can also lower populations. However, some apple varieties have different sensitivities to summer oil sprays and use may result in fruit and foliar damage.

Codling Moth Granulosis Virus (Carpovirusine, Cyd-X). These products contain an insecticidal baculovirus, *Cydia pomonella* granulovirus, which is specific to the larval form of the codling moth, and is registered for use in apples, pears, and (Cyd-X only) plums. This biological insecticide must be ingested in order to be effective. The virus infects the moth larvae and causes it to stop feeding and eventually die. After death, the larva disintegrates, releasing the virus, which may infect other codling moth larvae upon ingestion. Applications are recommended at egg hatch, before the larvae penetrate the fruit. Best results are seen with repeated applications for each generation during the growing season. No adverse effect to fish, wildlife or beneficial organisms has been observed; it has a low bee-poisoning hazard.

Chromobacterium subtsugae (Grandevo) is a relatively new bioinsecticide registered for use against multiple insect pests on tree fruit. Its mode of action is complex, and is generally effective when consumed by target insects. Grandevo may be used against codling moth and other lepidopteran pests and may be useful in rotation with other materials including granulosis virus or Bt to improve efficacy and manage development of pest resistance to those materials.

Synthetic pheromones are available for disrupting the chemical communication of certain insect pests, thereby preventing them from mating and producing larvae that injure the crop. Pest-specific pheromones are released from dispensers or microcapsules placed in the orchard before the initiation of flight, and can reduce or in some cases eliminate the need for supplementary insecticidal sprays. This approach works best in large (5-10A or more), rectangular plantings, where the pheromone concentration in the air is more uniform and can be maintained at a high level. Border insecticide sprays may be needed in orchards adjacent to sources of adult immigration or in other high pressure situations. Growers should contact their certifying agencies to determine which specific pheromone materials are acceptable in their state.

While the organically accepted fungicides and insecticides individually do not offer the same degree of efficacy or longevity as their conventional counterparts, when used in concert with each other along with conservation of biological control agents, and cultural practices to reduce inocula, it is possible to produce a high percentage of fruit free of insect damage and disease symptoms within organic certification restriction on allowable materials.

2.5 Organic Apple Production Resources:

New England Resources:

- OrganicA Project: www.uvm.edu/organica/index.html
- Organic Apple IPM: www.uvm.edu/organica/OrganicOrchardInformation/OrganicIPM/organicIPM.html
- An Organic IPM Checklist for Vermont: www.uvm.edu/organica/OrganicOrchardInformation/OrganicIPM/checklist.html
- Practical Guide for Organic Apple Production: www.uvm.edu/organica/PracticalGuide/Home.html

Cornell University Resources:

- Peck, G. and I. Merwin. 2010. A Grower's Guide to Organic Apples. NYS IPM Pub. 223, Cornell University, Ithaca. 64pp. nysipm.cornell.edu/organic_guide/apples.pdf
- Brown, S. and K. Maloney. 2008. Scab-resistant Cultivars (Varieties). New York Fruit Quarterly 16:4. www.nyshs.org/pdf/fq/2008-Volume-16/Vol-16-No-4/Scab-resistant-Cultivars-%28Varieties%29.pdf

General Information on organic production can be found on the following websites:

- The National Organic Program: www.ams.usda.gov/AMSv1.0/nop
- The National List of Allowed and Prohibited Substances: www.ams.usda.gov/AMSv1.0/NOPPetitionedSubstancesDatabase
- The Organic Materials Review Institute (OMRI) Products List: www.omri.org/omri-lists
- Organic Food Production. Alternative Farming Systems Information Center: www.nal.usda.gov/afsic/pubs/ofp/ofp.shtml

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Ellis, M. A., D. C. Ferree, R. C. Funt, and L. V. Madden. 1998. Effects of an apple scab-resistant cultivar on use patterns of inorganic and organic fungicides and economics of disease control. Plant Dis. 82: 428–433.

Palmiter, D. H., and R. M. Smock. 1954. Effect of fungicides on McIntosh apple yield and quality: a five-year study under Hudson Valley conditions, 1949-1953. N.Y.S. Agric. Exp. Sta. Bull. 767. 40 p.

3 Pesticide Information

3.1 Pesticide Classification and Certification

Putting it simply, a pesticide is a substance used to control pests. Federal law, the Federal Insecticide, Fungicide and Rodenticide Act, or FIFRA, created two classifications of pesticides – general-use and restricted-use. General-use pesticides may be purchased and used by anyone, but only a certified applicator may purchase a restricted-use pesticide. Restricted-use pesticides must be used by a certified applicator or someone under their supervision.

The same federal law that classified pesticides divided applicators into two groups: private and commercial. Private Applicators use or supervise the use of pesticides to produce agricultural commodities or forest crops on land owned or operated by the private applicator or their employer. A farmer must be certified as a private applicator in order to purchase and use restricted-use pesticides on agricultural commodities. (No certification is needed if a farmer does not use restricted use pesticides.)

A Commercial Applicator uses or supervises the use of pesticides for any purpose or on any property not covered by the private applicator classification.

Certification training, exams, and recertification courses are continually given in each state in New England. Please consult your Cooperative Extension or the state pesticide regulating agency if you have questions concerning certification.

Please refer to the state pesticide regulating agency, in the state that you are spraying in, for specific rules and regulations in that state.

3.2 Use Pesticides Safely

Using a pesticide imparts a great responsibility on the user to be a good steward of your health and that of others. Keep in mind that there is more to "pesticide use" than the application. Pesticide use also includes mixing, loading, transporting, storing, or handling pesticides after the manufacturer's seal is broken; cleaning pesticide application equipment; and preparation of a container for disposal. All of these actions require thoughtful planning and preparation. They are also regulated by state and federal laws that are intended to protect the user, the community, and the environment from any adverse effects pesticides may cause.

3.2.1 Plan Ahead

Many safety precautions should be taken *before* you actually begin applying pesticides. Too many pesticide applicators are dangerously and unnecessarily exposed to pesticides while they are preparing to apply them. Most pesticide accidents can be prevented with informed and careful practices. Always read the label on the pesticide container before you begin to use it. Make sure that you understand everything you need to know about the pesticide ahead of time so that you are a responsible user. Carefully follow all the directions and precautionary advice on the label. Be sure that you are prepared to deal with an emergency exposure or spill before you begin using pesticides. Be sure to know the first aid procedures for the pesticides you use.

3.2.2 Move Pesticides Safely

Carelessness in transporting pesticides can result in broken containers, spills, and contamination of people and the environment. Once pesticides are in your possession, you are responsible for safely transporting them. Accidents can occur, even when transporting materials a short distance. If a pesticide accident occurs, you are responsible. Do all you can to prevent a problem when transporting pesticides. Be prepared in case an emergency should arise.

3.2.3 Personal Protective Equipment

The need for personal protective equipment depends mainly on the pesticide being handled. Personal protective equipment requirements are printed on pesticide labels. These requirements are based on the toxicity, route of exposure, and formulation of that pesticide. The requirements posted on the label are the minimum that must be worn during the pesticide use. A pesticide user always has the option of wearing more protection than the label requires.

The activity, the environment, and the handler also influence the choice of protective equipment. The activity-related factors are type of activity, duration of the activity, equipment, and deposition pattern of the pesticide onto the handler. Mixing/loading procedures often require extra precautions when the pesticide is in concentrated form. Studies show that you are at a greater risk of accidental poisoning when handling pesticide concentrates. Pouring pesticide concentrates from one container to another is the most hazardous activity. A closed mixing/loading system can reduce this risk. Closed mixing systems are part of an array of protective devices called "engineering controls." You may learn more about engineering controls at this web site: umes.edu/NC170/Default.aspx?id=7196. Access this web site for more information on personal protective equipment: umes.edu/NC170/Default.aspx?id=7184

3.2.4 Avoid Drift, Runoff, and Spills

Pesticides that fall anywhere but on the target area can injure people, crops, and the environment. Choose weather conditions, pesticides, application equipment, pressure,

droplet size, formulations, and adjuvants that minimize drift and runoff hazard.

3.2.5 Avoid Equipment Accidents

Properly maintained and carefully used equipment contribute to safe pesticide application:

- Be sure to turn off your machinery before making any adjustments.
- Do not allow children, pets, or unauthorized people near the pesticide equipment.
- Between jobs, depressurize tanks or systems.
- Always return equipment to appropriate areas for cleaning and storage when pesticide applications are completed.

3.2.6 Pesticide Storage

Most pesticide applicators use existing buildings or areas within existing buildings for pesticide storage. Whether you choose a site to build a new storage area or use existing buildings, you need to consider several points:

- The site should be in an area where flooding is unlikely.
- It should be downwind and downhill from sensitive areas such as houses, ponds, and play areas.
- There should be no chance that runoff or drainage from the site could contaminate surface or groundwater.

Storage facility check list:

- ❑ Is the facility separated from offices, workshops, and livestock areas?
- ❑ Is the facility separated from wells, streams, lakes, ponds, wildlife?
- ❑ Is the facility separated from food and feed?
- ❑ Is the facility made of fire resistant building materials?
- ❑ Does the facility have impermeable flooring?
- ❑ Does the facility have liquid spill containment (berms to hold 25% of liquid storage)?
- ❑ Can the doors be locked?
- ❑ Is the facility fenced in?
- ❑ Are warning signs posted?
- ❑ Is a spill kit readily available?
- ❑ Are fire extinguishers readily available?
- ❑ Is personal protective equipment readily available?

3.3 Protect Honey Bees from Insecticides

Honey bees, wild bees, and other insects are important for proper pollination of many vegetables. Vine crops, for example, must be pollinated because they have male and female flowers, and pollen must be transferred from the male to female flowers if fruit is to set. Poor pollination results in small or odd-shaped fruit as well as low yields. Each flower must be visited eight or more times for adequate pollination to occur.

To avoid harming bees with insecticide treatments, remember these points:

- Do not spray crops in bloom;
- Mow blooming weeds before treatment or spray when the blossoms are closed;
- Avoid application during the time of day when field bees are most numerous;
- Make application in the early morning or evening; and
- Always read the label before use.

If pesticides that are highly toxic to bees are used in strict accordance with label directions, little or no harm should be done to bees. Label statements on pesticides that are highly toxic to honey bees may carry a caution statement such as: "This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area."

3.4 Verifying Pesticide Registration and Restricted-Use Status

Any pesticide used must be currently registered with the state pesticide regulating agency and the USEPA. Applicators can easily verify whether pesticides are currently registered and classified as restricted-use by contacting the state pesticide regulating agency, in the state that you are spraying in, for specific rules and regulations in that state.

3.5 Pesticide Recordkeeping/Reporting

Each state in New England has pesticide recordkeeping requirements and reporting. Contact the state pesticide regulating agency if you have questions concerning pesticide recordkeeping requirements and reporting.

3.6 Reduced-Risk Pesticides, Minimum-Risk Pesticides, and Biopesticides

3.6.1 Reduced-Risk Pesticides

Since 1993 EPA has expedited the registration of conventional pesticides with characteristics such as very low toxicity to humans and nontarget organisms including fish and birds, low risk of groundwater contamination or runoff, low potential for pesticide resistance, demonstrated efficacy, and compatibility with IPM. Materials meeting these criteria are referred to by EPA as "reduced-risk." The "reduced-risk" designation applies only to certain uses of a particular pesticide, which may not be all label uses for that product.

3.6.2 Minimum-Risk Pesticides

Minimum-risk pesticides are products that are exempted from EPA registration (and therefore have no EPA registration number). They contain only active ingredients outlined in FRFRA 40 CFR 152.25(g) ("the 25b list") and inert ingredients currently identified on Federal Register Notice 59 FR 49400 ("the 4a list"). The lists can be accessed from the following link: www.epa.gov/pesticides/biopesticides/. All ingredients and percent concentrations must also be listed on the label. Policies may differ in each New England state, which sometimes require such products to carry a state registration number. Contact the state pesticide regulating agency for specific rules and regulations.

3.6.3 Biopesticides

Biopesticides, or biological pesticides as defined by EPA, are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. These include microbial pesticides, which contain bacteria, fungi, virus, etc., as the active ingredient; plant-pesticides, i.e., pesticidal substances that plants produce from added genetic material (such as corn genetically modified to produce *Bacillus thuringiensis* toxins); and biochemical pesticides comprised of naturally occurring substances that control pests by nontoxic mechanisms (such as pheromones or some insect growth regulators). Biopesticides must be registered with EPA. More information on biopesticides is available at www.epa.gov/pesticides/biopesticides/.

3.7 FIFRA 2(ee) Recommendations

Certain limited variations from the use directions specified on pesticide labels are authorized under FIFRA Section 2(ee).

These "2(ee) recommendations" allow:

1) Use at any dosage, concentration, or frequency less than specified on the labeling.
2) Use against any target pest not specified on the labeling.
3) Methods of application not prohibited on the labeling.
4) Mixtures with fertilizer unless prohibited on the labeling.

No fee is required for a 2(ee) recommendation request.

3.7.1 Requirements:

1) Anyone receiving approval of a 2(ee) recommendation is responsible for distributing the recommendation to all users of the product pursuant to the approved recommendation.
2) Any user must have the 2(ee) recommendation in his or her possession at the time of application.

3.7.2 Information Required for Submission of 2(ee) Recommendations:

1) Requests for approval of 2(ee) recommendations must be made in writing by recognized research institutions, certified crop advisers, manufacturers (registrants), or organizations representing individual users. Individual users may not request approval of 2(ee) recommendations.
2) Requests must be accompanied by data demonstrating that the use will be effective.

3.8 Prepare for Emergencies

Call a POISON CONTROL CENTER or physician in ALL cases of suspected poisoning. It is better to be too cautious than too late.

During an emergency call, tell the physician the chemicals listed on the label, the EPA registration number, antidotes given on the label and other information about the accident that could aid in treatment. Be prepared! READ and POST SAFETY RULES. Fill in the phone number of your local ambulance service, doctor and hospital as well. Inform your doctor of the *Notes to Physicians* on labels of the pesticides you plan to use, and get his/her advice on whether antidotes should be kept on site.

3.9 Organophosphate Poisoning

The effects of organophosphate and carbamate poisoning are rapid. Poisoning must be recognized early for effective treatment. Early symptoms are usually a headache, feeling of weakness, blurred vision, excessive perspiration, and nausea. Abdominal cramps, vomiting, and excessive salivation may set in with, or without, diarrhea. The throat and chest will feel constricted, making breathing difficult. In mild poisoning, some of these symptoms may be absent. Heat stress causes symptoms similar to pesticide poisoning.

If breathing stops, artificial respiration is the most important first-aid. While waiting for medical help, give first-aid as indicated on the label. Never try to give anything by mouth to an unconscious person. Get the victim to a doctor as soon as possible. If you know which pesticide is involved, take the container along so the doctor can read the label. If this is impractical, remove the label and take it with you. Re-label the container as soon as possible.

Cholinesterase is an enzyme necessary for the proper function of the nervous system in humans and several other animals. Organophosphate pesticides (dimethoate, diazinon, azinphosmethyl, phosmet, chlorpyrifos and methidathion) and carbamate pesticides (carbaryl, methomyl, oxamyl), and many other natural and synthetic chemicals, interfere with the action of cholinesterase. An applicator that uses these types of pesticides regularly would be wise to have a cholinesterase activity test. This is a simple blood test that can be taken at many hospitals. The test finds the base line

or "normal" level of cholinesterase in your blood. If pesticide poisoning is suspected, the cholinesterase level can be checked again at that time for confirmation. The best time to establish the base line is before the spray season. The important level is the total or true cholinesterase. Discuss this with your physician beforehand. Inform your doctor of the *Notes to Physicians* on labels of the pesticides you plan to use, and get their advice on whether antidotes should be kept on site.

3.10 Your Responsibility as a Pesticide User

This guide summarizes information from product labels and other sources, but it **does not include** all of the information for which users are responsible.

Contact Cooperative Extension for pesticide safety training materials, and your state Department of Agriculture for current pesticide regulations. A primary requirement is that no owner or lessee shall permit pesticide application in such a manner as to directly, or through drift, expose workers or other persons to spray or dust.

Pesticide product labels are the legal documents governing proper usage. Always read the label before using any pesticide. If you are unsure about any aspect of safe or proper use, contact the dealer, manufacturer or Cooperative Extension before use.

Wear the appropriate personal protective equipment (PPE) listed on the label when working with any pesticide. At a minimum you should wear long sleeve shirt, long pants, shoes plus socks and chemical resistant gloves. Do not allow pesticides to contact your skin. Read and follow all safety precautions on labels.

After handling pesticide, wash hands and face before eating, smoking, or using a restroom. Instruct your family, coworkers and farm laborers on pesticide safety procedures. Post safety rules and emergency information where workers will see them.

Tree fruit growers sometimes need to use pesticide in areas where residences, cropland, pasture, or bodies of water are nearby. Pesticide drift from orchards to off-target areas presents a hazard. Avoid application when conditions favor drift.

3.11 Field Use and Care of Respirators

Wear the label-recommended respirator with a filter for powders and an activated charcoal filter for organic vapors. Write the date of first use on the cartridge. Change the filters and cartridges after the number of hours specified, or more often if breathing becomes difficult or if pesticide odor is detected. Respirators do not provide adequate protection from inhalation of pesticide dust, mist or vapors when mixing pesticide in closed or poorly ventilated areas.

The respirator should be fitted properly on the face, not too high on the nose, with narrow portion over the bridge of the nose, and chin cup contacting under side of the chin. Headbands should be adjusted just tight enough to insure a good seal. Refer to the directions for respirator fit testing which should be included with the respirator packaging. Remove filters and cartridges and wash face piece with soap and warm water after use. Dry face piece with a clean cloth and/or place face piece in a well-ventilated area to dry. Store respirator, filters, and cartridges in a clean, dry place, preferably in a tightly closed plastic bag.

3.11.1 Other Safety Equipment

- Chemical resistant gloves.
- Personal protective clothing, such as rubber apron, coveralls and cap.
- Chemical resistant work shoes or boots.
- Chemical resistant goggles.

3.12 Acute Toxicity of Pesticide

A pesticide's hazard to warm-blooded animals, including humans, is usually determined in relation to the way it enters the body. Methods of entry include the respiratory system, digestive system and skin. The greatest hazard is from pesticide entry via the respiratory system (inhalation).

Pesticide toxicity by this route is not much different from that of intravenous injection because membranes of the lungs that separate air from blood are extremely thin, and absorption is therefore very rapid (this is also true for the eyes). Oral absorption (through the digestive tract) is the next most hazardous avenue for poisoning. Dermal (skin) absorption is less immediate than respiratory or oral. However, there is considerable variation in the rate of penetration through the skin by different materials and formulations, and by different areas of the body.

When spraying, many airborne spray particles are trapped in the secretions of the upper respiratory tract and swallowed, thereby providing exposure by inhalation and ingestion. Assuming that the person applying the pesticide takes adequate precaution (respirator, goggles, etc.) to prevent inhalation and oral exposure, dermal toxicity is probably a more realistic index of occupational hazard than oral toxicity.

3.12.1 Danger — Poison; Warning; Caution:

One of these "signal words" appears on the label of every pesticide. Acute (or immediate, single dose) toxicity is reported as an LD_{50} value. The LD_{50} for a chemical is the dose that has been found in controlled experiments to kill 50% of a large number of test animals. The LD_{50} dose is usually expressed as the number of milligrams (mg) of pure active ingredient per kilogram (kg) body weight of the test animals. The lower the LD_{50}, the more toxic the chemical is.

Because the LD_{50} is based on animal tests, uses pure active ingredient rather than formulated product, and does not account for individual sensitivity, it does not necessarily represent the toxic dose for an individual human. The LD_{50} of a chemical gives no information on the possible long-term chronic health effects from repeated exposure at low levels.

Toxicity Category & Signal Word on Label	LD_{50} Oral (mg active ingredient per kg body weight)	LD_{50} Dermal (mg active ingredient per kg body weight)
I DANGER – POISON	0 to 50	0 to 200
II WARNING	>50 to 500	>200 to 2,000
III CAUTION*	>500 to 5,000	>2,000 to 20,000
IV none*	>5,000	> 20,000
* Category IV materials may have Caution signal word due to skin irritation or other hazard.		

READ THE LABEL FOR PRESCRIBED SAFETY EQUIPMENT AND PRECAUTIONS!

In addition to oral or dermal acute toxicity, a pesticide may also carry the **DANGER - POISON**, **DANGER**, or **WARNING** signal words because of other potential hazards, such as inhalation toxicity or the ability to cause severe eye or skin damage.

3.13 Label Compliance

Under the present EPA regulations, pesticides may be applied:

- At a different rate per 100 gallons dilute than stated on label as long as the application stays within the dose per acre limit;
- At a lower rate per acre than on label; and
- Less frequently than on label.

IMPORTANT — it is **illegal** to:

- Increase amount applied per acre (overdosage);
- Use shorter intervals between sprays than minimum interval stated on label; and
- Shorten intervals to harvest (illegal residues on crop).

State regulations may be more restrictive than those of the EPA.

3.14 Protecting Water Quality

Tree fruit growers have a responsibility to prevent pesticide from contaminating surface bodies of water and groundwater supplies. Over 90% of the rural population in the U.S. depends on groundwater as their supply of drinking water. Groundwater is very difficult to clean if it does become polluted. Listed below are a few practices that can help prevent water contamination. Contact Extension for more information.

- Consider the potential for rinse water, spills, application or erosion to create pesticide laden runoff which can reach a surface body of water. If you do not have a self-contained mixing pad, use an area where the run-off risk is low. If you are working near a stream or pond, do not allow runoff to occur.
- Use an anti-backflow device when filling the spray tank.
- Periodically change the location of field mixing areas. Be aware of the location and condition of wells; stay at least 50 feet away from wells. Special caution is needed around wells with cracked casings.
- Be aware of the soil types, geology, and depth of water table in your local area. The potential for pesticide leaching into groundwater is generally greater on ledge, sandy soils, or other soils low in organic matter. The risk increases when the water table is close to the surface. Try to choose pesticides with a low leachability hazard if you are working under these conditions.
- Keep spray equipment accurately calibrated.
- Use proper procedures for pesticide storage and disposal. Keep pesticide storage and mixing areas away from streams, ponds, and springs.

3.15 Restricted Entry Interval

Manufacturers may write the label with a longer REI than required by the EPA, or the EPA may change its minimum REI requirement. To know the use restrictions for a pesticide you must READ THE LABEL!

3.16 Pesticide Residue Tolerances

Federal laws warn that food shipments bearing residues of pesticide chemicals in excess of established tolerances will be contraband and subject to seizures as "adulterated." This applies to both raw and processed foods.

The amount of pesticide residue in or on a food material at harvest must fall into established tolerances, expressed in "parts per million" (ppm). The actual amount of pesticide chemical found in a food at harvest depends in part on the amount applied to the crop and the length of time since the last application. Therefore, growers are responsible for strictly following label information as to:

- Maximum spray dosage, and
- The preharvest interval: which is the required length of time between the final pesticide application and harvest.

3.17 EPA Worker Protection Standard

This section is adapted from *Worker Protection Standard Brochure #1: Duties of Employers* by the Maine Board of Pesticides Control. **This is only a very brief summary of the WPS.** Check with the pesticide regulatory agency in your state for complete information.

3.17.1 Who Must Comply?

The U.S. Environmental Protection Agency (EPA) has issued rules governing the protection from occupational exposure to agricultural pesticides of workers on farms, in forests, nurseries, and greenhouses. Chemical growth regulators and thinning agents are included as "pesticides." These regulations apply if you are an employer with workers that fit in either of the two following categories:

- **Agricultural workers** – performing tasks related to the cultivation and harvesting of plants on farms, greenhouses, nurseries, or forests; or
- **Pesticide handlers** – assigned to mix, load or apply agricultural pesticides; clean or repair equipment, act as flaggers, or IPM scouts, etc.

Employers are responsible for making sure that workers and handlers receive the protection required by the pesticide labeling and the WPS. There are two types of employers:

- **Agricultural employers** – employ or contract for the services of workers or own/operate an establishment that employs workers, and;
- **Handler employers** – hire pesticide handlers or are self-employed as handlers. This definition includes commercial applicators and companies that supply crop advisory services.

3.17.2 What Must an Employer Do?

It is the responsibility of the employer to provide the following to all employees who meet the WPS definition of an agricultural worker or pesticide handler.

1) **Pesticide Safety Training:**
   Handlers and workers must be trained every 5 years unless they are certified applicators. Handlers must be trained before they do any handling activity. Workers must be provided with basic pesticide safety information before entering an area of your agricultural establishment that is or has been under a restricted entry interval (REI) within the last 30 days. Full WPS training must be done within 5 days of employment.

- **Information at a Central Location:**
  a. Facts about each pesticide application – product name(s), EPA registration number(s), and active ingredient(s); location and description of treated area(s); the time and date of the application and the restricted-entry interval (REI);
  b. The name, address and telephone number of the nearest emergency medical facility;
  c. An EPA WPS safety poster.
- **Decontamination Sites:**
  a. A decontamination site must be provided within 1/4 mile of the employee's work site.
  b. A decontamination site must contain enough water for routine and emergency whole-body washing (3 gallons for handlers and 1 gallon for workers) and for eye flushing; plenty of soap and single-use towels; and a clean overall, for use by handlers.
  c. Handler employers must also provide a decontamination site where handlers remove their personal protective equipment (PPE) at the end of a task and at each mixing site.
- **Emergency Assistance:**
  a. Employer must provide product name(s), EPA registration number(s) and active ingredient(s);
  b. All first aid and medical information from the label(s);
  c. Description of how the pesticide was used and;
  d. Information about the victim's exposure.
  e. Transportation to the hospital if necessary.
- **Restrictions During Applications:**
  An employer must keep all workers, other than trained and equipped handlers, out of areas being treated with pesticides.
- **Restricted-Entry Intervals (REI):**
  The restricted-entry interval is the period immediately after a pesticide application during which entry into the treated area is limited. The REI is located on the product label. **During an REI, do not allow workers to enter a treated area** or contact anything treated with the pesticide to which the REI applies. Pesticide handlers may reenter during the REI, but only if they wear the personal protection equipment required for early entry as stated on the label.

  REIs for many labels have changed in the past 2 years, so read the label!
- **Notice About Applications:**
  Employers must notify workers and handlers about pesticide applications on the establishment. In most cases, employers may choose between oral warnings or posted warning signs, but they must tell employees which warning method is in effect. For some pesticides, employers must provide both oral warnings and posted warning signs.

  Posted warning signs must be:
  a. At least 14" x 16" in size, with an EPA-mandated design;
  b. Posted 24 hours or less before application; posted during the REI; removed before workers enter and within 3 days after the end of the REI;
  c. Posted so they can be seen at all normal entrances to treated areas, including entrances from labor camps.

  Oral warnings must be delivered in a manner understood by workers and handlers, using an interpreter if necessary. Oral warnings must contain the following information:
  a. Location and description of treated area;
  b. The REI; and
  c. Specific directions not to enter during the REI.

3.17.3 Additional Duties for Handler Employers

Handler employers are also required to provide the following protection to their employees.

- **Application Restrictions:**
  Do not allow handlers to apply pesticide so that it contacts, directly or through drift, anyone other than trained and PPE-equipped handlers.
- **Monitoring:**
  Sight or voice contact must be made at least every two hours with anyone handling pesticides labeled with a skull and crossbones (signal word: DANGER-POISON).
- **Specific Instructions for Handlers:**
  Handler employers must make sure that before any handling task, the handlers are given: information from the pesticide labeling regarding its safe use; access to the label during the entire handling task; and instructions on the safe operation of the equipment they will be using.
- **Personal Protection Equipment (PPE):**
  a. When personal protective equipment is required by the product label, the handler employer must provide the PPE; clean and maintain it correctly; make sure each handler wears and uses the PPE correctly; provide a clean place to change and store PPE; take action to prevent heat stress resulting from wearing PPE; and not allow the PPE to be worn or taken home.
  b. The employer must make sure that PPE is cleaned according to manufacturer's instructions; inspected and repaired before each use; that non-reusable or uncleanable PPE, or PPE that is drenched with pesticide concentrates labeled DANGER or WARNING, are properly disposed of; that PPE is washed and dried appropriately and stored separately from personal clothing; and that respirator filters, cartridges, and canisters are replaced as often as required.
  c. The employer must make sure anyone cleaning PPE is informed of the potential hazards associated with the possible pesticide residues on the PPE.
- **Equipment Safety and Maintenance:**
  a. Handler employers must make sure that equipment used for mixing, loading, transferring, or applying pesticides is inspected and repaired or replaced as needed.
  b. Only appropriately trained and equipped handlers may repair, clean, or adjust pesticide handling
  c. Equipment that contains pesticides or pesticide residues.

3.18 OSHA Hazard Communications Standard

This law (often called the "worker's right-to know law") requires employers to inform employees of any chemical hazards they may be exposed to while performing their work. The Bureau of Labor Standards (or the comparable agency in your state) is responsible for administering and enforcing this law.

Farmers who employ 11 or more people during a year, or who have temporary labor camps, must comply with the law by the following means:

1) Develop a written policy on how you comply with the law.
2) Inventory all hazardous materials held.
3) Obtain the Material Safety Data Sheets (MSDS) for each hazardous material or product to be used. (Request pesticide suppliers to provide MSDS).
4) Provide warning labels for secondary containers used to hold hazardous materials. Never put pesticides in secondary containers.
5) Provide documented annual training for each employee, including:
   a. Explanation of the written hazard communication program, chemical inventory, MSDS, and secondary warning labels. Inform employees of the location and provide access to these documents.
   b. The physical and health hazards of the chemicals used.
   c. Description of areas or tasks where hazardous materials are present.
   d. Methods of detecting presence or release of hazardous chemicals in work areas.
   e. Protective measures, including the use and limitations of personal protective equipment.
   f. Emergency procedures.
6) Report on chemicals used, and other information as requested, to the proper state agency.

4 Sprayer Information

4.1 Solutions for Safer Spraying

Handling and applying pesticides is risky business. Devices known as engineering controls can be used to keep pesticide exposure to a minimum. This section describes how to prevent pesticide exposure at five key areas of potential contamination.

4.1.1 Loading the Sprayer

Closed Transfer Systems allow concentrated pesticide to be moved from the original shipping container to the sprayer mix tank with minimal or no applicator contact. Many systems provide a method to measure the concentrated pesticide. Some systems also include a container rinsing system that pipes rinse water into the spray tank.

Induction Bowls are metal, plastic or fiberglass hoppers attached to the side of the sprayer or nurse tank that allow pesticides to be added to the mix tank without the applicator climbing onto the spray rig. Pesticides are poured into the bowl and water is added to flush out the bowl and carry the pesticide to the spray tank. Often a rinse nozzle is mounted inside the bowl for rinsing out empty pesticide containers. Typically, induction bowls are raised out of the way during spraying and lowered to about 3 feet above ground when loading the sprayer.

Direct Pesticide Injection Systems allow pesticides to be mixed directly with water in the sprayer plumbing system rather than in the main spray tank. The pesticide is pumped from its container and mixed with the water either in a manifold or at the main water pump. Only clean water is held in the main tank of the sprayer. An electronic controller and pumps adjust the amount of concentrated pesticide that is injected into the water stream, allowing for variable application rates.

Container Rinse Systems consist of a rinse nozzle and a catch bowl that traps the container washings (rinsate). The empty container is placed over the rinse nozzle and a jet of water cleans the inside of the container. The rinsate caught in the bowl is pumped into the spray tank to be used along with the spray mixture. Rinse nozzles are often installed in chemical induction bowls.

4.1.2 Contamination at the Boom

Boom Folding/Extending - Manually folding booms can be a major source of operator contamination because the boom can be covered with pesticide from drift or dripping nozzles. Consider the use of hydraulic or mechanical folding methods.

Diaphragm Check Valves - Typically, when a sprayer is shut off and as the system pressure drops, any liquid remaining in the boom piping drips from the nozzles, possibly dripping onto the boom or even the operator. Diaphragm check valves installed at each nozzle prevent this by using a spring-loaded rubber diaphragm to close off the flow of liquid once the system pressure drops below about 10 pounds per square inch. When the sprayer is switched on and system pressure builds up, the valve opens and allows the liquid to flow through the nozzles.

Multiple Nozzle Bodies - Contamination can occur when operators change or unclog nozzles during an application. Multiple nozzle bodies (or turret nozzles) allow operators to switch between nozzles with a turn of the nozzle body rather than having to unscrew or undo a threaded or a bayonet fitting.

Hand Wash Water Supply - Providing adequate wash water is essential (and often required). A simple container with a hand-operated valve can be mounted on the side of the sprayer to provide clean water for hand washing and personal hygiene.

4.1.3 Sprayer Cab Contamination

Cab Filtration Using Carbon Filters - Carbon filtration systems are used to remove pesticide odor and pesticide-laden mist from fresh air used in a tractor or self-propelled sprayer cab. Carbon filtration systems are often a standard feature on self-propelled sprayers. Many factory installed tractor cabs offer optional filtration systems. Cabs certified under the ASAE standard meet the requirements for enclosed cabs contained in the Worker Protection Standard.

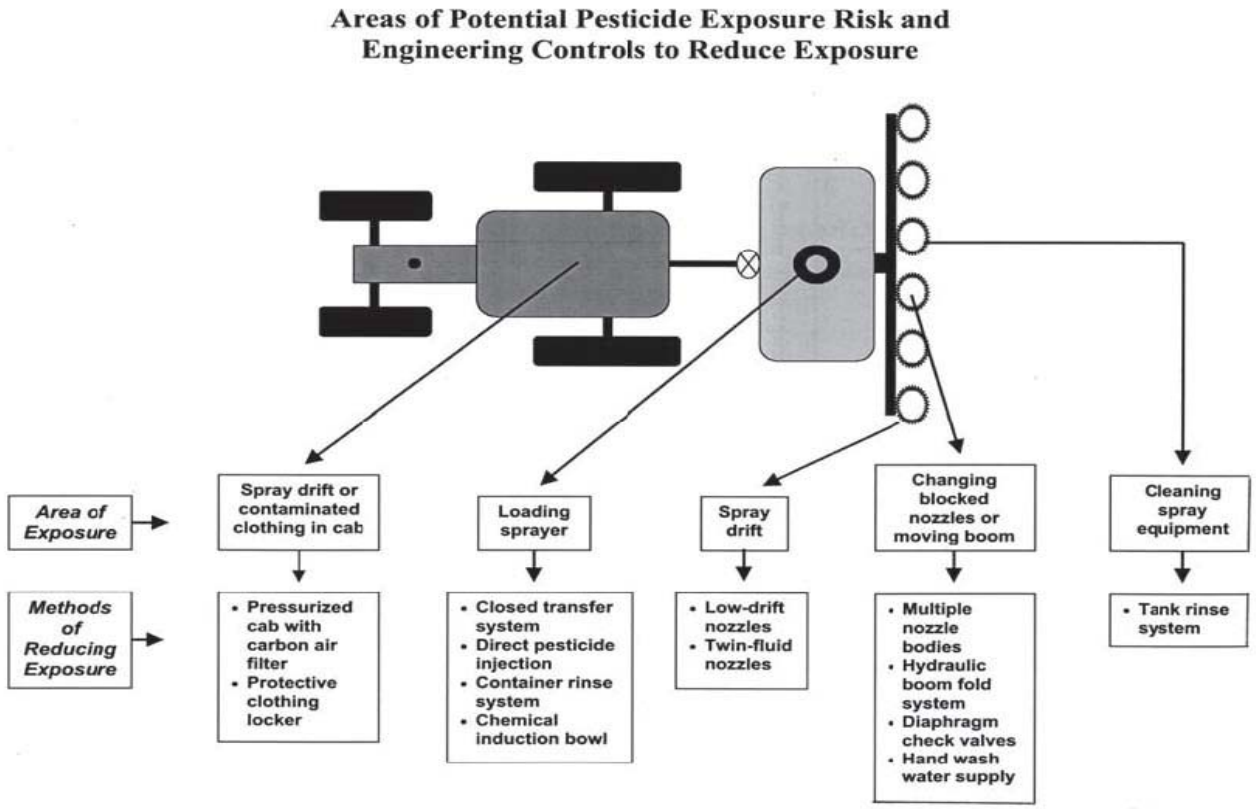
Protective Clothing Lockers - Some sprayer manufacturers offer a simple compartment (orlocker) mounted to the side or front of the sprayer where protective clothing can be stored to prevent contamination of the tractor or sprayer cab interior. Alternatively a locker can be fitted to the nurse tank.

4.1.4 Drift

Low-Drift Nozzles - Low-drift nozzles create larger-size droplets than conventional nozzles. The larger droplet sizes are less prone to drift, reducing environmental and operator contamination.

Air Induction (Twin Fluid) Nozzles - These nozzles allow air to mix with the spray liquid, creating large, air-filled droplets that have virtually no fine, drift-prone droplets. The droplets explode when they contact their target and offer similar coverage to droplets from conventional, finer-spray nozzles.

Use of alternate row spraying with drift controlling nozzles is likely to create poor coverage because the inherent property of these nozzles is to restrict spray deposition within a short distance of the sprayer.



4.1.5 Cleaning the Sprayer

Tank Rinse Systems - Tank rinse systems consist of a clean water supply tank mounted to the sprayer and one or more rotating discs or nozzles mounted inside the main sprayer tank. Water is pumped from the clean water tank to the rinse nozzles, which spray water around the inside of the spray tank. These systems are designed for in-field rinsing of the sprayer so that the tank washings can be applied to the field at label rates.

4.2 Minimizing Pesticide Drift

Spray drift of pesticides is an important and costly problem facing pesticide applicators. Drift results in damage to susceptible off-target crops, environmental contamination to waterways, and a lower than intended rate to the target crop thus reducing efficacy. Drift onto neighboring properties can lead to legal disputes. Applying the correct product to the correct target at the correct time with the correct equipment is the key to good spraying.

There are two types of drift. Vapor drift is usually invisible. The amount of vapor drift depends upon atmospheric conditions such as humidity, temperature and the product being applied, and can occur days after an application is made. The second type, airborne drift, is often very noticeable. The amount of airborne drift is influenced by many interrelated factors including droplet size, nozzle type and size, sprayer design, weather conditions and, last but not least, the operator.

4.2.1 Droplet Size

Switching to lower spray volumes may result in smaller droplet size. Within an effective range, smaller droplets can provide more uniform coverage. There is a lower limit to droplet size because of concerns about drift. Droplets under 150 microns diameter generally pose the greatest hazard. A 100-micron droplet takes 11 seconds approximately to fall ten feet in still air. With a 5 mph wind it will drift about 75-feet before hitting the ground. Droplets less than 50 microns have insufficient momentum for impaction and can remain suspended in the air indefinitely until they evaporate.

The higher the operating pressure, the smaller the droplet; conversely, low pressure produces large droplets that may bounce off the target. Traditional air blast sprayers give the greatest cause for concern as they produce many small droplets, which are often off-target. Certain spray surfactants can change the droplet spectrum, reducing the number of driftable droplets.

4.2.2 Nozzle Type and Size

Modern nozzle technology such as air inclusion nozzles produce larger droplets than conventional cone nozzles. Large droplets normally roll off the leaf, but air inclusion nozzles create air bubbles within the larger droplets, which then collapse on contact with the leaf, dissipating the energy and dispersing the liquid. Research has shown promising results using air inclusion nozzles with air blast sprayers, although further trials are necessary in apple orchards.

Rotary atomizers create smaller, more uniform droplets, which would normally drift. When used in conjunction with a tower and cross-flow fan design, the smaller droplets are directed into the canopy. This type of sprayer, sometimes called controlled droplet application, produces 95–98% of its droplets all of the same size. The size produced depends on the speed of the spinning cage. Advantages include less water, resulting in better timeliness and a more targeted spray. Research shows that controlled droplet application can effectively control orchard diseases and insects.

4.2.3 Sprayer Design

Tower sprayers and tunnel sprayers are better at targeting the spray into the canopy, reducing drift and increasing deposition. The conventional air blast sprayer sends droplets in an air blast from a central fan upwards into the canopy. The tower sprayer, using an air curtain and rotary atomizer has shown excellent results at disease and insect control. Horizontal penetration into the canopy is preferential to vertical penetration from an air blast sprayer. Tunnel sprayers, developed many years ago in Europe and the US, have tremendous advantages in managed orchards using trellis designs and dwarf trees. The use of a spray collection device at the base of the tunnel canopy results in the ability to recirculate spray with subsequent savings in pesticide and a reduction in drift. Many growers believe that tunnel sprayers are only suitable for level land, but an increasing number are to be found in orchards on undulating land.

Drift problems increase when a space occurs within the row. Air blast sprayers, with or without a tower, can be fitted with ultrasonic or laser canopy sensors. The sensors also detect the shape of a tree and adjust the spray pattern accordingly. The advantages include reduced drift and ground deposition, reduced pesticide use, and more efficient use of spray water allowing and more acres per tankload.

Correct calibration will ensure that all the nozzles are discharging the correct amount of liquid at the correct distance and angle to the target and at the correct forward speed. Operators must set the air deflectors correctly to confine airflow, spray pattern and disturbance to the tree canopy.

German Drift Reduction Methods – Adapted from: Registration of BBA – approved plant protection equipment for orchards in the list of loss reducing equipment.

Key: ID = Lechler Air Induction; AD = Lechler Drift Reducing; TD = Agrotop by GreenLeaf; DG = Drift Guard by TeeJet; AVI = Albuz Air Induction; Website: www.bba.de

Drift Reduction Class	Sprayer	Nozzle Types	Regulations of Use
50%	All air assisted sprayers	ID, TD, AVI, DG, AD Various Sizes	First 5 rows without air towards field edge.
	Foliage Detector	All Types	
	Air assisted sprayers with axial fan.	ID Various Sizes, TD 80-02 Keramik, AVI 80-03	Spray pressure max 58-73 PSI. First 5 rows with reduced air (max 30,000m3/h
	All air assisted sprayers	All Types	Hail nets above orchards.
75%	All air assisted sprayers	ID, TD, AVI, DG, AD Various Sizes	Hail nets above orchards.
	Sprayers with axial fan with max 30,000 m3/h, at least with first gear.	ID, TD, AVI, Various Sizes	Spray pressure max 58-73 PSI. First 5 rows with reduced air (max 20,000m3/h). AVI 80-015 max 44 PSI, ID 90-015 max 44 PSI
	Tower Sprayer	ID, TD, AVI, DG, AD Various Sizes	First 3 rows spraying without air towards field edge.
	Sprayers with cross flow fan	ID, TD, AVI, DG, AD Various Sizes	First 3 rows spraying without air towards field edge.
90%	Sprayers with cross flow fan.	ID, TD, AVI, DG, AD Various Sizes	First 5 rows spraying with reduced/sealing #4 towards filed edge; sealing #8 inwards.
	Tower sprayers with fan Lipco Tunnel sprayers	ID, TD, AVI, DG, AD Various sizes	First 5 rows spraying without air towards field edge. Partly with reduced spray pressure.
99%	Lipco Tunnel sprayers	ID, TD, AVI, DG, AD Various Sizes	

Herbicide drift from weed control practices is also important. Shielded herbicide sprayers prevent drift from contaminating fruit and damaging leaves and trunks. Shields can vary from the simple to the complex. Shielded sprayers allow growers to apply herbicides in variable weather conditions. Different nozzle types such as hydraulic flat fan nozzles and controlled droplet applicators using reduced herbicide rates.

4.2.4 Weather

Wind speed and direction, relative humidity, temperature and atmospheric stability all affect drift. Research in England and New Zealand has measured the effectiveness of shelterbelts (windbreaks). Shelter belt height and density affect drift, and may, in certain conditions, create additional air currents and eddies. There are so many variables such as topography and wind direction that it is difficult to conclude that research at one site is transferable to another.

4.2.5 Forward Planning

Forward planning is the key to good management. Choose the correct size sprayer with good back-up support to ensure that spraying can be done in a timely manner. Racing around in an attempt to apply pesticides after a problem disease or insect attack has occurred increases chance of errors. The use of orchard field cards to record sprayer settings, pesticide dosage and application rates, quantity required per tank fill, etc. will reduce the chance of errors and stress levels, and will improve efficiency and safety. Use of pest monitoring and forecasts provides warning of needed applications, allowing more preparation time versus discovering problems at the last minute or after they have already occurred.

Before Spraying

1. Train the operator to use the sprayer correctly on your farm under your conditions.
2. Plan the spraying operation; consider the use of orchard field cards as a good management tool.
3. Always read and follow pesticide label instructions.
4. Select the correct nozzle for the target. Adjust the size and position of the nozzles to achieve correct distribution within the canopy, particularly as the growing season progresses.
5. Consider the use of sprayers that direct the spray to the target, such as towers and tunnels. Check that air deflectors are set properly to confine disturbance to the target area.
6. Consider use of spray additives to reduce drift.
7. Improve spraying logistics to ensure adequate time to spray within “ideal” conditions.
8. Only spray when weather conditions are ideal; avoid spraying when conditions are favorable for atmospheric inversion or wind drift. Generally wind speed between 2 and 7 mph is best.
9. Calibrate the sprayer with water to ensure that everything is working correctly.
10. Start planting windbreaks!

During Spraying

1. Stay alert: ensure the spray is not allowed to drift on to non-target areas and watch for changes in wind speed and direction.
2. Use the appropriate pressure for your equipment and nozzles to generate droplet sizes in the 150 – 250 micron range. Regularly check the accuracy of the pressure gauge.
3. Maintain a constant speed and pressure. Small increases in speed can result in large changes in spray penetration, coverage, and amount per acre.
4. Avoid spraying near sensitive crops or waterways; use a 50–100-ft buffer zone. Spray inwards, with one side of the sprayer, for at least 50 feet from the boundary to create a “headland”.

Tools and Options

1. Monitoring equipment. Purchase and use good quality instruments for wind speed, temperature, and humidity.
2. Monitor spray pattern to see where the spray is actually going, One method is to use a patternator. Another method is to use a 16-foot high pole (two 8 foot 2x4 inch boards end to end) with a paper tape stapled along the leading edge. Place the pole between two trees within the row and spray a mixture of clean water and food coloring. Travel between the rows, spraying out the mixture. The spray will stain the paper where it hits. By looking at the colored spray droplets on the paper, you can alter the orientation of the nozzles or deflectors until the spray is only hitting the portion of the vertical pole/trees that is desirable.
3. Air Induction Nozzles (AI): These nozzles, when used properly, can reduce drift by at least 50 percent. These nozzles create a larger droplet that will not drift as far but still maintains good leaf and fruit coverage. Not all AI nozzles are the same.
4. End Plates and One-sided spraying: A shroud can be used to block any air on the opposite side of the sprayer. On the outer rows you can only spray inwards. This can reduce drift by 50 percent.
5. Foliage Sensors: These sensors tell whether or not the sprayer is next to a tree, automatically shutting the spray off if no tree is present. There are ultrasonic or infrared sensor types that if used properly reduce overspray and drift by 50 percent.
6. Hail Nets can reduce drift up to 75 percent.
7. Tower sprayers are better at targeting the spray into the canopy than a conventional air blast. The conventional air blast sprayer sends droplets in an air blast from a central fan upwards into the canopy, whereas the tower sprayer uses a horizontal air curtain.

8. Tunnel Sprayers: Tunnel sprayers are the best way to reduce drift. Very little spray gets out of the tunnel spraying system, allowing for a 90 percent reduction in drift. If AI nozzles are used with the tunnel sprayer, 99 percent of drift can be reduced.
9. Axial fan size and speed: Using an axial fan producing 30,000 cu. meters/hr in conjunction with AI nozzles will result in a 75 percent reduction of drift.
10. PTO speed: Regulating the PTO speed of the tractor is an inexpensive way to reduce drift. Lowering the PTO speed reduces fan speed, preventing excessive amounts of air from blowing pesticides through the target and allowing good deposition to occur. On an airshear type sprayer, reducing PTO speed by 25% reduced drift by 75%. The reduced speed also increased droplet size, further reducing the effects of drift (see NY Fruit Quarterly, Vol. 12 #3, Autumn 2004).
11. Hydraulic Drive: Using a hydraulic motor to drive the sprayer fan will allow you to regulate airspeed velocity separately from tractor speed.
12. Cornell Doughnuts: These attachments restrict air intake to reduce air flow through the sprayer. For early season, the 1/2 air intake doughnut can be used to only allow enough air to penetrate just the target row. A 2/3rd air intake hole can be used for early/mid-season to allow more air. Finally, in full canopy, no doughnut is required.
13. Drift-reducing additives usually work by increasing droplet size. Beware, not all of them can withstand the higher pressures associated with fruit sprayers and need independent verification.
14. Calibrate and check that the sprayer is functioning correctly.

Conclusion

Drift is impossible to eliminate but can be minimized. Implementing just one of these methods will greatly reduce the effects of drift and improve your efficiency of spray application, saving you time, money, and future problems.

4.3 Preparing an Air Blast Sprayer

4.3.1 Checking the Sprayer

Sprayers must be regularly checked over to ensure that proper maintenance has been carried out and that no outstanding repairs need to be done. Faulty sprayers contribute to increased drift levels and waste money through inefficiency and overuse of chemicals.

Before attempting any work on a machine make sure that it is fully supported on stands and that all necessary protective clothing is on hand.

Maintenance measures such as fitting a new set of nozzles at the beginning of each season also save money. Even when there is overdosing by as little as 5%, the cost of a new set of nozzles will be recovered in less than one of spraying.

Caution –

- ☐ Take great care when adjusting a sprayer while the tractor engine is running.
- ☐ Always ensure that the fan is stationary before approaching the rear of the sprayer.
- ☐ Engage the handbrake when leaving tractor seat.

4.3.2 Fitting the Sprayer to the Tractor

The selected tractor must always be powerful enough to operate the sprayer efficiently under the working conditions that will be encountered. All its external services – hydraulic, electrical and pneumatic – must be clean and in working order. Tractors fitted with cabs must have efficient air filtration systems. All protective guards must be in place. Trailed sprayers are often close-coupled to the tractor, so it is essential that the drawbar and the PTO shaft are correctly adjusted for turning. PTO shafts must be disengaged when making very tight turns.

4.3.3 Checking the Operation of the Sprayer

Part fill the tank with clean water and move the sprayer to uncropped waste ground. Remove the nozzles. Although not using any chemical at this point, get into the habit of wearing a coverall, gloves and a face visor when working with the sprayer. Engage the PTO and gently turn the shaft, increasing speed slowly to operating revs. Test the on/off and pressure relief valves, and check the agitation system. Flush through the spray lines, then switch off the tractor. Refit the nozzles and check the liquid system again for leaks.

4.3.4 Pre-Season Maintenance Checklists

Hoses

- ☐ for splits and cracks
- ☐ connections to ensure they are water-tight
- ☐ for hose chafe, particularly in routing clips

Filters

- ☐ for missing filter elements and seals
- ☐ for leakage
- ☐ for blocked or damaged filters

Tank

- ☐ for fractures and any other damage
- ☐ the tank sits firmly in its mount
- ☐ the securing straps are correctly adjusted
- ☐ the agitation is working
- ☐ the tank is clean

Controls

- ☐ the control circuitry (electrical, hydraulic or air) for correct operation
- ☐ valves for both internal and external leaks

Pump
- ☐ lubrication levels
- ☐ for leaks
- ☐ the air pressure in the pulsation chamber (if fitted) is at the recommended level
- ☐ the pump rotates freely without friction or noise. Do so by rotating manually or starting at low speed (corrosion may cause seizing up)

Pressure Gauge
The pressure gauge is vital for indicating whether the nozzles are delivering the correct amount of chemical per unit time while spraying. If you have any doubts about the pressure gauge, replace it or refer the problem to the manufacturer or supplier. **The cost of replacing a faulty pressure gauge which has been indicating at 15% below the actual pressure is recouped in around two hours operation**.

Nozzles
- ☐ the correct nozzles are at each location
- ☐ all nozzles are in good condition, with no leaks around the body
- ☐ all nozzles are clean and free from obstruction (note: clean with a soft brush or airline – don't damage nozzles by using wires or pins)
- ☐ all nozzles deliver to within + or - 5% of the manufacturer's chart value

Using water only, run the sprayer at the specified pressure and collect the output from each nozzle in turn for a period of 60 seconds. Record each output and replace those outside the 5% tolerance stated in the manufacturer's chart.

Controllers
Where your sprayer has automatic controllers to monitor the speed of the sprayer and the flow, pressure and area sprayed, check that:

- ☐ they are in good condition and properly maintained .
- ☐ they are frequently calibrated for accuracy, leaks, blockages, variations in pressure or any minor damage during spraying.

Routine Maintenance
The following checks should be carried out routinely:

- ☐ All hoses are tightly connected and free from sharp bends; cracked or damaged hoses must be replaced.
- ☐ All controls move freely and are fully adjustable.
- ☐ Pressure gauge reads zero.
- ☐ Pump can be turned over by hand.
- ☐ Fan turns freely and is not obstructed; bearings are sound and lubricated.
- ☐ Air pressure in pump accumulator (if fitted) is correctly adjusted.
- ☐ Drain plugs and clean filters are in position.
- ☐ Tires on trailed machines are sound and correctly inflated; wheel nuts are tight.

4.4 Sprayer Calibration
Accurate calibration of orchard spray equipment is essential for efficient and effective use of pesticides and other spray materials. Calibration starts with having a sprayer with adequate capacity to distribute the spray evenly throughout the trees. Sprayer performance is limited by pump output, maximum pressure, fan capacity, and travel speed. The best spray coverage and deposit are obtained within the manufacturer's recommended operating range.

4.4.1 Travel Speed
Travel speed is a critical factor in maintaining accurate application rates and will influence spray deposition within the canopy. The higher the travel speed, the greater the variability in spray deposit. Speed over 4 mph greatly increases risk of poor coverage.

Factors that will affect travel speed include:
- Weight of sprayer being pulled
- Slope of terrain
- Ground conditions and traction (wheel slippage!)

The best way to measure travel speed is to pull a sprayer with tank half filled with water on the same type of terrain that the sprayer will be operated on. Set up test course at least 100 feet long, measure the course with a tape measure. Do not pace the distance. The longer the course the smaller the margin of error. Run the course in both directions.

Use an accurate stop watch to check the time required to travel the course in each direction. Average the two runs and use the following formula to calculate the speed in MPH.

Formula: $$\text{MPH} = \frac{\text{feet traveled}}{\text{seconds}} \times \frac{60}{88}$$

Your numbers:
Tractor gear _____ Engine RPM_____

$$\text{MPH} = \frac{\text{feet traveled}}{\text{seconds}} \times \frac{60}{88}$$

NOTE: You can also use a hand-held GPS receiver to measure forward speed.

4.4.2 Dilute Gallons per Acre
For trees on standard rootstock and row spacing, a dilute application to the point where additional spray would just run-off the leaves requires about 400 gallons water per acre (GPA). Trees in modern orchards on semi-dwarf or dwarf rootstocks require much less water per acre for a dilute application.

The amount of dilute spray required to adequately cover trees also varies with grpwth stage and canopy density. Unless adjustments are made in the spray delivery, spray

pattern, and fan output required by differences in tree size and canopy density, difficulties such as inadequate pest control or excessive application of material will result.

Use the **Tree Row Volume (TRV)** formula to calculate the canopy volume and dilute gallons per acre for your blocks.

Canopy width is the average width of the trees looking along the row.

Row length per acre is 43,560 square feet per acre divided by the distance between rows.

Step 1: Canopy Volume per Acre

TRV = Canopy width x Tree height x Row length per acre

$$\text{Tree row volume (cu ft/acre)} = \text{Canopy width (feet)} \times \text{Tree height (feet)} \times \frac{43{,}560 \text{ sq. ft./acre}}{\text{Distance between rows (feet)}}$$

Example 1a:
Trees are 12 feet wide and 11 feet tall in rows 20 feet apart

$$= 12 \text{ ft.} \times 11 \text{ ft.} \times \frac{43{,}560 \text{ sq. ft./acre}}{20}$$

$$= \frac{132}{0} \times 2178 = 287{,}496 \text{ cu. ft./acre}$$

Step 2: Dilute Gallons per Acre

It takes about 0.5 gallon to cover 1,000 cubic feet of tree canopy volume early in the spring, about 0.7 gallon at Petal Fall, and about 1.0 gallon in late summer. If you want to use a single value for the whole season, assume 0.7 gallon per 1,000 cu. ft. of canopy volume for reasonably well pruned trees. For large poorly pruned trees, 1.0 gallon per 1,000 cu. ft. is a safer estimate to insure good coverage.

Example 1b: Dilute gallons per acre for pruned orchard.

$$\text{Dilute gallons per acre (DGA)} = \text{Tree row volume (cu. ft./acre)} \times \frac{0.7 \text{ gal}}{1{,}000 \text{ cu. ft.}}$$

$$\text{DGA} = 287{,}496 \text{ cu. ft.} \times \frac{0.7 \text{ gal.}}{1{,}000 \text{ cu. ft.}} = 201 \text{ gallons}$$

Example 1c: Dilute gallons per acre for thick canopies (either poorly pruned or near end of summer at maximum foliage density)

$$\text{Dilute gallons per acre (DGA)} = \text{Tree row volume (cu. ft./acre)} \times \frac{1.0 \text{ gal}}{1{,}000 \text{ cu. ft.}}$$

$$\text{DGA} = 287{,}496 \text{ cu. ft.} \times \frac{1.0 \text{ gal}}{1{,}000 \text{ cu. ft.}} = 287 \text{ gallons}$$

For very small trees, the TRV formula yields dilute gallons per acre estimates of less than 100 gallons per acre. Spray trials on the efficacy of adjusting spray volume and pesticide dosage according to TRV calculation are inconclusive, but suggest that below a certain minimum gallons per acre, the inefficiency of spray capture by very small trees prevents further reduction in spray volume.

The exact value for this basement level is unclear, but is somewhere between 100 and 200 gallons per acre. For example, assuming a 200 gallon per acre minimum means that even if the TRV calculation generates a lower value, you would estimate spray concentration and pesticide dosage on the assumption that the block need 200 gallons per acre for a dilute application.

To check the accuracy of your calcuations, a rough estimate of dilute gallons per acre can be made by using Table 4.4.1.

Table 4.4.1 Dilute gallons per acre for mature trees of different sizes and row spacings.

Distance Between Rows (feet)	Canopy Width (feet)	Tree Height (feet)	Dilute Gallons per Acre
40	28	20	427
40	28	16	342
30	20	15	305
25	16	14	273
22	14	13	252
20	12	12	220
18	10	12	203
16	8	10	152
14	6	10	131
12	5	10	127
11	4	10	111
10	3	9	82

4.4.3 Concentrate Sprays

Concentrate spraying is reducing the gallons of water sprayed per acre below the dilute rate. This can reduce or eliminate run-off, and increases the speed and efficiency of spraying by getting more acres covered per tankload and reduce the number of tank refills needed.
However, as the gallons of water per acre used to apply spray materials is reduced, errors become more critical and risk of poor coverage increases. The upper limit on acceptable spray concentration depends on several factors including: the pest being controlled, canopy density, weather conditions, and the types materials being applied. Sprays at 1X (dilute) to 3X concentration are generally more effective and are preferred for applying growth regulators, chemical thinners, drop inhibitors, nutrient sprays. Miticides, and insecticides for control of pests such as scales and woolly aphid are also generally more effective at higher spray volumes as are bactericide, and fungicides applied for postinfection activity against apple scab.

For most other insecticide and fungicide applications, concentrate sprays in the range of 6X to 8X usually provide satisfactory results. Above 8X, the additional savings in refill time, speed and cost of application are minimal, and frequency of poor spray performance increases.

$$\text{Concentration} = \frac{\text{Dilute gallons per acre}}{\text{Actual gallons per acre sprayed}}$$

Example 1: If the dilute gallons per acre is 200 and the sprayer is applying at 66 gallons/acre, then the concentration is:

$$\frac{\text{200 gals. water/acre}}{\text{66 gals. water/acre}} = 3\text{X}$$

Example 2: If the dilute gallons per acre is 200 and the sprayer is applying at 50 gallons/acre, then the concentration is:

$$\frac{\text{200 gals. water/acre}}{\text{50 gals. water/acre}} = 4\text{X}$$

Concentrate spray tank mixing:
If a spray material has a dilute label rate of 1 lb. per 100 gallons dilute, then for an application made at 3X, you need to add 3 lbs. of product for each 100 gallons of tank mix. For a 4X spray, you would add 4 lbs. to each 100 gallons of tankmix.

For pesticide labels that give only a rate per acre, the standard assumption is that "acre" refers to an orchard of standard trees that require 400 gallons per acre for a dilute application. In which case the amount per 100 gallons dilute would be 1/4th the label rate per acre. However, not all labels follow this convention. Also, some labels call for a minimum amount of product per acre regardless of how small the trees are.

4.4.4 Sprayer Output (Gallons per Minute)

In order to choose nozzles with the correct delivery rate, you first need to calculate the total gallons per minute needed from all of the nozzles on the sprayer. This depends on the gallons per acre of actual spray delivery, travel speed, and row width. There are several ways to adjust output and spray pattern when spraying multiple blocks with different gallons per acre and spray patterns. You can set up the sprayer for the largest trees and use flip nozzles to adjust for smaller trees or turn off nozzles not needed for smaller trees. Adjusting travel speed within the range of 2 – 4 mph is another way to adjust spray volume per acre.

Adjusting pressure is NOT a good way to adjust spray delivery. Pressure must change by the square of the desired change in delivery rate. For example, to increase the flow rate by 40%, the pressure must be doubled (1.4 x 1.4 = 2). Sprayers and nozzles are designed to operate within a relatively narrow pressure range, and so cannot operate properly with large changes in pressure.

$$\text{Gallons/minute (GPM)} = \frac{\text{GPA} \times \text{mph} \times \text{Row width}}{495}$$

GPM = total sprayer output in gallons/minute
mph = travel speed in miles per hour
Row width = width between rows of trees in feet
495 = a mathematical constant to correct units of measurement

Example: The orchard requires 200 gallons per acre for a dilute spray, and will be sprayed at 3X. So the sprayer must deliver 66 gallons per acre. The sprayer has 6 nozzles on each side. The comfortable forward speed for our ground conditions is 3mph. Rows are 20 feet apart.

$$\text{GPM} = \frac{\text{66 GPA} \times \text{3mph} \times \text{20 feet row width}}{495} = 8$$

8 GPM for two sides = 4 gallons per minute per side

4 gallons divided by 6 nozzles = 0.67 GPM per nozzle.

You could use a combination of different nozzles as long as the total output for all nozzles on a side = 4 gallons per minute at the chosen operating pressure.

To check accuracy of gallons per minute calculations, you can divide the desired gallons per acre by a rough estimate of the minutes travel time per acre from Table 4.4.2.

Table 4.4.2. Approximate time required to spray 1 acre of orchard (two-sided sprayer operation, spraying both sides of trees).

Distance between Rows (feet)	Linear feet of Row/ acre[1]	Travel speed (mph)				
		1	1.5	2	2.5	3
		minutes per acre[2]				
40	1089	12.4	8.2	6.2	5.0	4.1
30	1452	16.5	11.0	8.2	6.6	5.5
25	1742	19.8	12.4	9.9	7.9	6.6
22	1980	22.5	15.0	11.2	9.0	7.5
20	2178	24.8	16.5	12.4	9.9	8.3
18	2420	27.5	18.3	13.8	11.0	9.2
16	2723	30.9	20.6	15.5	12.4	10.3
14	3112	35.4	23.6	17.7	14.1	11.8

4.5 Nozzle Information

The following websites have information on nozzles and other orchard spraying equipment:

www.albuz.com.fr/
Agricultural and industrial nozzles.

www.delavanagspray.com/Index.htm
Nozzles, nozzle accessories, sprayer accessories, high pressure guns/nozzles, pumps and high pressure washers, calibration, and a nozzle selection guide.

www.hardi-us.com/html/home.html
Sprayers for all crops, nozzles, pumps and electronic controllers, sprayer servicing, and a nozzle selection guide.

www.hypropumps.com/Agriculture/default.cfm
Pumps, boom and sprayer components, nozzle bodies, pressure washer pumps, spray tips, and nozzle selection. They are the US distributor for Albuz nozzles.

www.lechlerusa.com/whois.asp
Nozzles and sprayer components, nozzle selection and sprayer conversion.

www.teejet.com/ms/teejet/
Nozzles, spray guns, valves, manifolds, boom components, electronic controls guidance systems. Site also has a spray calibration calculator and a nozzle selection guide you can download.

www.turbodrop.com/index.html
Nozzles for turf, vegetables and other crops. The featured products are the Turbodrop, Spraymax and Airmix nozzles. Has a nozzle guide plus information on droplet size and independent test data.

www.wilger.net/home.html
Various sprayer parts and nozzles. Some of their featured products include tips, caps, strainers, nozzle bodies and flow indicators. Nozzle selection and detailed information about each nozzle.

www.nysaes.cornell.edu/ent/faculty/landers/pestapp/
Cover multiple types of sprayers (air-blast, boom and knapsack). Hasw links to most of the manufacturers of orchard, vineyard, turf, and vegetable spraying equipment. includes sprayer calibration, nozzles, and publications on sprayer research projects conducted in the Northeast.

4.6 Selecting Airblast Sprayer Nozzles

Example: Using a hollow cone nozzle lookup table from a Spraying Systems catalogue shown on the next page to select a disc and whirlplate combination.

1. Read along the pressure row at the top of the table.
2. Read down the column for 80 psi until you find a value close to the target 0.67 gpm, finding 0.64 gpm. Then looking to the left you will see we need a D5 disc with a DC45 whirl plate or core.
3. Alternatively, you may read down the column for 100 psi until you find 0.70 gpm. Look across to the left and you will see we need a D6 disc with a DC25 whirl plate or core.

A better alternative to consider is a one-piece hollow cone nozzle tip. These are easier to fit into the cap and are much easier to remove for cleaning, changing tips etc.

Example:
To find a nozzle tip with a flow rate near 0.67 gpm for a sprayer operating at 200 psi, using the Conejet hollow cone nozzle table from Spraying Systems TeeJet catalogue:

1. Read along the pressure row at the top of the table.
2. Read down the column for 200 psi until you read 0.667 gpm, look across to the left, you will see we need a blue TXVK-18 one-piece nozzle.

4.7 Calibrating Airblast Sprayers

A simple vertical patternator can be constructed in the farm workshop using readily available materials; a build list and photographs can be found at: <www.nysaes.cornell.edu/ent/faculty/landers/pdf/Patternator.pdf>

Videos showing calibration and nozzle selection may be found at: www.youtube.com. Search for "Calibration of airblast sprayers for orchards part 1 selecting and changing nozzles" or "Calibration of airblast sprayers for orchards part 2 measuring liquid flow".

It is a valuable exercise to assess the spray deposits at various points in the canopy and on upper and lower leaf surfaces of the trees to be sprayed. This is particularly important if the foliage is dense or if the trees are grown in beds of three or more rows. Water-sensitive papers, food coloring, fluorescent tracers, or Surround kaolin clay are available for this purpose. An increase in spray volume or adjustment of the nozzles and their locations may be necessary in order to achieve the correct deposits.

Check Nozzle Pressure (Use clean water!)
Place a pressure gauge on the nozzle fitting farthest away from the pump and turn the sprayer on. If pressure is lower at the nozzle than specified, increase pressure at the regulator.

Pressure at nozzle _____psi

Pressure at sprayer gauge _____psi

Test Nozzle Output
Use a flow meter (obtainable from Gemplers, Spraying Systems, etc.) attached to individual nozzles, OR

Connect hoses to each of the nozzles and measure the flow from each nozzle into a calibrated jug for one minute.

			GPM												
			10 PSI	20 PSI	30 PSI	40 PSI	60 PSI	80 PSI	100 PSI	150 PSI	200 PSI	300 PSI	20 PSI	40 PSI	80 PSI
D1	DC13	.031″	—	—	.059	.066	.078	.088	.097	.115	.128	.152	—	51°	62°
D1.5	DC13	.036″	—	.057	.067	.075	.088	.098	.110	.127	.142	.167	38°	55°	66°
D2	DC13	.041″	—	.064	.075	.08	.10	.11	.12	.14	.16	.18	49°	67°	72°
D3	DC13	.047″	—	.071	.08	.09	.11	.12	.13	.16	.18	.20	53°	70°	75°
D4	DC13	.063″	.070	.09	.11	.12	.14	.16	.17	.20	.23	.27	69°	79°	83°
D1	DC23	.031″	—	—	.064	.072	.080	.096	.107	.124	.139	.164	—	47°	58°
D1.5	DC23	.036″	—	.064	.076	.086	.103	.117	.130	.155	.175	.210	34°	51°	62°
D2	DC23	.041″	—	.078	.092	.10	.13	.14	.16	.19	.21	.25	51°	63°	70°
D3	DC23	.047″	.065	.087	.10	.12	.14	.16	.18	.21	.24	.28	58°	69°	75°
D4	DC23	.063″	.082	.113	.14	.15	.19	.21	.23	.28	.32	.38	68°	82°	87°
D5	DC23	.078″	.095	.13	.16	.18	.22	.25	.28	.34	.38	.46	79°	89°	94°
D6	DC23	.094″	.112	.15	.19	.21	.26	.29	.32	.39	.45	.54	84°	93°	98°
D1	DC25	.031″	—	—	.088	.101	.122	.138	.156	.185	.210	.255	—	27°	43°
D1.5	DC25	.036″	—	—	.118	.135	.162	.185	.205	.245	.280	.33	—	38°	49°
D2	DC25	.041″	—	.12	.14	.16	.19	.22	.25	.29	.34	.41	39°	51°	58°
D3	DC25	.047″	.10	.14	.17	.19	.23	.26	.29	.35	.40	.48	52°	61°	67°
D4	DC25	.063″	.15	.21	.25	.29	.35	.40	.45	.54	.62	.75	67°	74°	80°
D5	DC25	.078″	.18	.25	.30	.35	.42	.48	.54	.65	.75	.90	73°	79°	84°
D6	DC25	.094″	.23	.32	.39	.44	.54		.70	.85	.97	1.19	79°	85°	89°
D7	DC25	.109″	.26	.37	.45	.52	.63	.73	.81	.98	1.18	1.37	85°	91°	93°
D8	DC25	.125″	.31	.43	.53	.61	.75	.89	.97	1.19	1.36	1.68	91°	96°	97°
D10	DC25	.156″	.38	.54	.65	.76	.93	1.07	1.21	1.48	1.71	2.1	97°	102°	103°
D12	DC25	.188″	.46	.61	.80	.93	1.15	1.32	1.47	1.81	2.09	2.55	103°	109°	112°
D14	DC25	.219″	.51	.72	.88	1.03	1.26	1.47	1.65	2.02	2.34	2.89	108°	113°	114°
D1	DC45	.031″	—	—	—	.125	.148	.170	.190	.225	.257	.310	—	22°	34°
D1.5	DC45	.036″	—	—	.14	.16	.20	.23	.25	.31	.35	.43	—	33°	44°
D2	DC45	.041″	—	.14	.18	.20	.25	.28	.32	.38	.44	.53	32°	46°	55°
D3	DC45	.047″	—	.17	.20	.23	.28	.33	.36	.44	.51	.62	40°	53°	60°
D4	DC45	.063″	.18	.25	.31	.36	.43	.50	.56	.68	.78	.95	62°	69°	72°
D5	DC45	.078″	.23	.32	.39	.45		.64	.71	.86	.99	1.22	67°	73°	76°
D6	DC45	.094″	.29	.41	.50	.58	.72	.83	.93	1.15	1.33	1.64	73°	79°	81°
D7	DC45	.109″	.33	.48	.59	.68	.84	.97	1.11	1.35	1.57	1.94	81°	86°	87°
D8	DC45	.125″	.41	.59	.72	.84	1.04	1.21	1.35	1.68	1.94	2.40	86°	90°	90°
D10	DC45	.156″	.54	.77	.94	1.10	1.35	1.57	1.77	2.18	2.50	3.10	90°	93°	93°
D12	DC45	.188″	.67	.95	1.17	1.36	1.68	1.95	2.20	2.69	3.11	3.80	97°	100°	102°
D14	DC45	.218″	.75	1.07	1.32	1.53	1.89	2.19	2.45	3.00	3.49	4.30	101°	104°	105°
D16	DC45	.250″	.86	1.25	1.54	1.79	2.20	2.57	2.89	3.54	4.11	5.20	108°	111°	112°
D1	DC46	.031″	—	—	—	.145	.178	.205	.23	.28	.32	.39	—	13°	15°
D1.5	DC46	.036″	—	—	—	.213	.260	.300	.33	.41	.46	.56	—	15°	17°
D2	DC46	.041″	—	—	.24	.27	.33	.37	.42	.50	.57	.68	—	18°	21°
D3	DC46	.047″	—	.23	.28	.32	.39	.45	.51	.61	.70	.86	14°	20°	24°
D4	DC46	.063″	.28	.39	.48	.56	.68	.78	.88	1.07	1.23	1.52	23°	29°	33°
D5	DC46	.078″	.38	.54	.66	.77	.94	1.10	1.25	1.50	1.73	2.13	33°	39°	42°
D6	DC46	.094″	.55	.78	.95	1.10	1.35	1.58	1.73	2.16	2.50	3.06	42°	48°	50°
D7	DC46	.109″	—	.98	1.22	1.39	1.72	1.97	2.22	2.73	3.15	3.85	48°	53°	56°
D8	DC46	.125″	—	—	1.59	1.84	2.25	2.62	2.93	3.60	4.17	5.05	—	60°	62°
D10	DC46	.156″	—	—	2.15	2.48	3.05	3.53	3.96	4.83	5.59	6.80	—	66°	68°

		GPM																	
		30 PSI	40 PSI	50 PSI	60 PSI	70 PSI	80 PSI	90 PSI	100 PSI	120 PSI	140 PSI	160 PSI	180 PSI	200 PSI	220 PSI	240 PSI	260 PSI	280 PSI	300 PSI
TXVK-1	100	0.015	0.017	0.018	0.020	0.021	0.022	0.023	0.024	0.026	0.028	0.030	0.031	0.032	0.034	0.035	0.036	0.037	0.038
TXVK-2	100	0.029	0.033	0.037	0.040	0.043	0.045	0.047	0.050	0.054	0.058	0.061	0.064	0.067	0.070	0.073	0.075	0.078	0.080
TXVK-3	100	0.044	0.050	0.055	0.060	0.064	0.068	0.071	0.075	0.081	0.086	0.092	0.096	0.101	0.105	0.109	0.113	0.117	0.120
TXVK-4	50	0.058	0.067	0.074	0.080	0.086	0.091	0.096	0.101	0.110	0.118	0.125	0.132	0.139	0.145	0.151	0.157	0.162	0.167
TXVK-6	50	0.088	0.100	0.111	0.120	0.129	0.137	0.145	0.152	0.165	0.177	0.188	0.199	0.208	0.218	0.226	0.235	0.243	0.251
TXVK-8	50	0.116	0.133	0.148	0.162	0.174	0.186	0.196	0.207	0.225	0.243	0.259	0.274	0.288	0.301	0.314	0.326	0.338	0.349
TXVK-10	50	0.145	0.167	0.185	0.202	0.218	0.232	0.246	0.258	0.282	0.303	0.323	0.342	0.360	0.376	0.392	0.408	0.422	0.437
TXVK-12	50	0.174	0.200	0.223	0.243	0.261	0.279	0.295	0.310	0.338	0.364	0.388	0.410	0.432	0.452	0.471	0.489	0.507	0.524
TXVK-18	50	0.260	0.300	0.335	0.367	0.396	0.423	0.449	0.473	0.517	0.558	0.5		0.667	0.699	0.730	0.759	0.788	0.815
TXVK-26	50	0.376	0.433	0.484	0.530	0.572	0.611	0.648	0.683	0.747	0.807	0.862	0.914	0.963	1.01	1.05	1.10	1.14	1.18
TX†800050VK	100	0.044	0.050	0.055	0.060	0.064	0.068	0.071	0.075	0.081	0.086	0.092	0.096	0.101	0.105	0.109	0.113	0.117	0.120
TX†800067VK	50	0.058	0.067	0.074	0.080	0.086	0.091	0.096	0.101	0.110	0.118	0.125	0.132	0.139	0.145	0.151	0.157	0.162	0.167
TX†8001VK	50	0.088	0.100	0.111	0.120	0.129	0.137	0.145	0.152	0.165	0.177	0.188	0.199	0.208	0.218	0.226	0.235	0.243	0.251
TX†80015VK	50	0.131	0.150	0.167	0.182	0.196	0.209	0.221	0.232	0.254	0.273	0.291	0.308	0.324	0.339	0.353	0.367	0.380	0.393
TX†8002VK	50	0.174	0.200	0.223	0.243	0.261	0.279	0.295	0.310	0.338	0.364	0.388	0.410	0.432	0.452	0.471	0.489	0.507	0.524
TX†8003VK	50	0.260	0.300	0.335	0.367	0.396	0.423	0.449	0.473	0.517	0.558	0.597	0.633	0.667	0.699	0.730	0.759	0.788	0.815
TX†8004VK	50	0.347	0.400	0.447	0.489	0.528	0.564	0.598	0.630	0.690	0.745	0.796	0.843	0.889	0.932	0.973	1.01	1.05	1.09

Remember 128 fl. oz. = one gallon.

Example: If the output of one nozzle has been measured at 83 fl. oz. in one minute, then output per minute is divided by 128 = 0.65 GPM.

Record the output of each nozzle and compare the actual to the desired output. Examne and replace if necessary all nozzle tips that are more than 5% inaccurate. In this example, with a desired nozzle output of 0.67 GPM, then a nozzle delivering less than 0.63 GPM, or more than 0.70 GPM, at the operating pressure should be examined and if necessary, replaced.

4.7.1 Calibrating a Kinkelder Tree Sprayer

Formula:

$$\frac{\text{Rate of spray gals/acre} \times \text{Forward speed mph} \times \text{Row spacing ft} \times 60}{500} = \text{gals/hr delivery}$$

Your numbers:

$$\frac{\text{gallons/acre} \times \text{mph} \times \text{ft} \times 60}{500} = \text{gals/hr delivery}$$

This figure should be set on both scales.

Both taps should be set on the distribution conduit in such a way that the index is set on the sign 162 on the index plate of the distribution conduit. The emission indication on the index plate has been fixed at a working pressure of 21 lbs (1.5 bar).

Check the output of the sprayer (Use clean water!):

1. Divide the gallons/hour figure obtained above by 60 to give output/minute e.g., 162 gpm divided by 60 = 2.7 gallons/minute total of left and right side then divide 2.7 gallons/minute by 2 = 1.35 gallons/minute/side
2. Remove the plastic pipes from the nozzles on the left or right side, tie together and place in a measuring jug
3. Run the sprayer for one minute at correct engine speed, collecting the output in a measuring jug.

   Remember 128 fl. Ozs = one gallon.

   Example: If the output of one side has been measured at 173fl. ozs, then output is divided by 128 = 1.35 gallons per minute.

4. Then check the output of the opposite side.

4.7.2 Calibrating an Agtec Tree Sprayer

1. **Formula:**

$$\frac{\text{Speed} \times \text{gallons/acre} \times \text{Row width}}{1000} = \text{Gallons per minute/side}$$

Your numbers:

$$\frac{\text{mph} \times \text{gallons/acre} \times \text{ft}}{1000} = \text{Gallons per minute/side}$$

2. Check AgTec tables for correct meter setting, select the gal/min as calculated above, and then find the meter setting, e.g., meter #12 @30 psi gives 1.34 gallons/min.
3. Remove the hoses from the nozzles on the left or right side, tie together and place in a measuring jug
4. Run the sprayer for one minute at correct engine speed, collecting the output in a measuring jug.
   Remember 128 fl. ozs = one gallon.

Example: Output of one side at 173 fl. ozs. divided by 128 = 1.35 gallons per minute.

5. Then check the output of the other side.

4.8 Orchard Weed Control Equipment

Herbicides, although relatively inexpensive, require good application techniques to improve deposition and drift reduction. Off-target drift wastes money, reduces deposition on the target plant, damages trees, pollutes water courses, and may cause health effects in humans.

4.8.1 Boom Applicators

A boom may be fitted either to the front of the tractor or be mid-mounted for spraying one side of the adjacent row. Typcial spray volume is 20–30 gallons per acre.

The use of hoods and break-back devices are important. A hood will protect the branches from drift created by the small droplets being emitted from the conventional flat fan nozzle. A break-back device will protect the sprayer boom and nozzle from damage caused by inadvertently striking a trunk or trellis post etc. Break-back devices normally comprise a spring-loaded arm.

Boom manufacturers/distributors include: Phil Brown Welding Corp., The Green Hoe Co. Inc., OESCO, Inc.

Correct Nozzle Selection

Correct nozzle selection is one of the most important yet inexpensive aspects of pesticide application. A nozzle's droplet size spectrum determines deposition and drift and is referred to as spray quality. Modern nozzle catalogues provide information on spray quality for each nozzle, when applying herbicides, we need to select a MEDIUM quality spray. Conventional flat fan nozzles produce droplets in the range of 10–450 microns. There are 25,000 microns in one inch. Drift is a major problem with droplets less than 150 microns.

Increasing the Volume Median Diameter (VMD) will certainly reduce drift, but too large a droplet (>300 microns) will bounce off the leaves to the ground, thus causing pollution, wasting money and resulting in less product on the target.

Conventional Flat Fan Nozzles
Nozzles with 80 degree angle produce coarser droplets than 110 degree angles at the same flow rate, but 80 degree nozzles require the boom to be set at 17–19 inches, whereas 110 degree nozzles can be set lower at 15–18 inches above the target. (The lower the boom, the less chance of drift). Spray quality is fine – medium at 15–60 psi.

Pre-orifice Flat Fan Nozzles
The internal design of this nozzle reduces the internal operating pressure compared with a conventional flat fan, resulting in coarser droplets (high pressure creates fine droplets, low pressure creates coarser droplets). Available as 800 or 1100 nozzles. Spray quality is medium–coarse at 30–60 psi. Drift-guard is a well-known trade name.

Turbo-Teejet
A turbulence chamber produces a wide-angle flat spray pattern of 1500. Spray quality is medium–coarse at 15–90 psi. Nozzles can be set at 15–18 inches above the target.

Air Induction Nozzles
Air induction, air inclusion or venturi nozzles are flat fan nozzles where an internal venturi creates negative pressure inside the nozzle body. Air is drawn into the nozzle through two holes in the nozzle side, mixing with the spray liquid. The emitted spray contains large droplets filled with air bubbles (similar to a candy malt ball) and virtually no fine, drift-prone droplets. The droplets explode on impact with leaves and produce similar coverage to conventional, finer sprays.

Air induction nozzles reduce drift even when operating at higher pressures of 80–90 psi. They are available at 110º fan angles, so boom height may need to be adjusted to 15–18 inches. The use of adjuvants will certainly help create bubbles. Air induction nozzles work very well for herbicide application; trials with paraquat in the Finger Lakes have shown good deposition with no drift.

Nozzle manufacturers include*:*Albuz, Greenleaf, Hardi, Lechler, Tee Jet.

4.8.2 Sensor-Controlled Applicators

Sensor-controlled pesticide applicators use optical sensors to determine where weeds are located. These sensors, coupled with a computer controller, regulate the spray nozzles and apply herbicides only when needed, thus considerably reducing herbicide use. A computer-controlled sensor detects chlorophyll in plants and then sends a signal to the appropriate spray nozzle, applying the herbicide directly to the weed. The operator calibrates the system to bare soil or pavement, allowing the computer to determine when there is a weed present. Sensor-controlled applicators are often mounted on ATVs, John Deere Gators, etc.; they can also be attached to tractors or trucks. Typically, this type of applicator can be used at speeds up to 10 mph. A complete sensor-controlled system consists of a chemical tank, pump, battery power, computer controller, optical sensors and spray nozzles.

Benefits of Sensor-Controlled Applicators:
- Reduced amount of herbicide applied
- Reduced potential for groundwater contamination
- Ability to apply herbicides in dark or light conditions
- If equipped with wind-deflecting shields, can reduce herbicide drift

Sensor manufacturers/distributors include: Patchen/Ntech, OESCO, Zahm and Matson.

4.8.3 Controlled Droplet Applicators (CDA)

Traditional flat fan nozzles produce a range of droplets, 10–450 microns; some drift, some roll off the leaves, others will adhere to the target leaves. A CDA herbicide applicator comprises an electrically-driven spinning disc under a large plastic hood or dome. The circumference of the disc has small teeth, which break up the liquid herbicide into droplets, of which 95% are the same size. The speed of the spinning disc dictates droplet size. As there are no large or small droplets in the CDA spectrum, all the droplets stick to the plant and so reduced rates can be applied, e.g. 1–8 GPA.

Various widths of hood or dome can be selected, and are fitted with break-back devices. Where the ground is rough, e.g., stones, then a bristle skirt maybe used. In young trees an optional plastic cover can be fitted over the bristle skirt.

CDA sprayers reduce the amount of water required, thus considerably improving spraying logistics. They are lightweight, relatively inexpensive and very maneuverable.

Controlled droplet applicators distributors include**:**
Bdi Machinery Sales, North-Eastern Equipment, Lakeview Harvesters, Rammelt & Co.

4.8.4 Flame Applicators

Flame applicators simply use a flame to destroy weeds. Most flame applicators burn liquid propane gas to create a flame having a temperature near 2000∞F. The flame is applied directly to the weeds using a hand-held wand or with boom-mounted torches attached to a tractor or ATV. The flame is applied to the weed for only a short period of time, usually about 1/10 of a second. The length of time the flame is applied depends on the age, size and tenderness of the weed. It is recommended that the flame be applied to weeds when they are 1 to 3 inches tall, and typically in the spring and early summer. When the weeds are exposed to the flame, the water inside the plant cells boil, causing them to burst. (The weeds are not burned up.) By destroying the plant cells, the plant is unable to transport water and continue photosynthesis, causing the weed to wilt and die. Flame applicators should only be used when there is little or no potential for setting fire to dry plant material. Beware of setting fire to trellis posts and poison ivy.

Benefits of Flame Applicators:

- Non-chemical weed control method
- No harmful drift
- No groundwater contamination
- No chemical exposure to workers

Flame applicator manufacturer: Red Dragon

4.8.5 Boom Sprayer and Nozzle Manufacturers and Dealers

Albuz nozzles:
651-766-6300
www.hypropumps.com

BDi Machinery Sales, Macungie, PA
1-800-808-0454
Bdi@fast.net

Green Hoe Company Inc.
716-792-9433
www.greenhoecompany.com

GreenLeaf nozzles
www.turbodrop.com
1-800-881-4832

Hardi nozzles
563-386-1730
www.hardi-us.com

Lakeview Harvesters, Ontario, Canada
1-866-677-4717
www.gregoireharvesters.com

Lechler nozzles
630-377-6611
www.lechler.com/seiten/en/lechler.html

Patchen Weedseeker:
1-888-728-2436
www.ntechindustries.com/

Phil Brown Welding Corp.
616-784-3046

NorthEastern Equipment
1-631-765-3865

OESCO Inc., Conway, MA
1-800-634-5557
www.oescoinc.com

Rammelt & Sons
1-800-388-3802

Red Dragon Flame
1-800-255-2469
www.flameeng.com/

Rittenhouse, Ontario, Canada
1-800-461-1041
www.rittenhouse.ca

Tee Jet nozzles
717-432-7222
www.teejet.com/ms/teejet/

4.9 Selecting Nozzles for Boom Sprayers

Step 1. Calculate the required nozzle output.

Formula: $GPM = \frac{GPA \times mph \times \text{nozzle spacing}}{5940 \text{ (constant)}}$

Example: $GPM = \frac{20 \times 4 \times 20}{5940} = \frac{1600}{5940} = 0.27$ GPM

Consider forward speed. If too high boom bounce and boom yaw may become a problem.

Consider pressure. Too high may lead to drift, too low may lead to droplet bounce

Step 2. Choose a nozzle
Example 1: Using a lookup table from a Spraying Systems catalogue shown on next page.

Look at the columns headed GPA at 20" nozzle spacing Select the 4 mph column; look down the column until you see a figure close to 20 gpa, then look to the left to find the operating pressure

a) select nozzle XR8003VS or XR11003VS at 30psi to give 19.3 gpa
b) select nozzle XR8004VS or XR11004VS at 20psi to give 21 gpa

Example 2: Using the same lookup table from a Spraying Systems catalogue shown on next page. Look at the column headed: "Capacity of 1 nozzle in GPM"

Read down column
c) select nozzle XR8003VS or XR11003VS at 30psi to give 0.26 GPM or
d) select nozzle XR8004VS or XR11004VS at 20psi to give 0.28 GPM

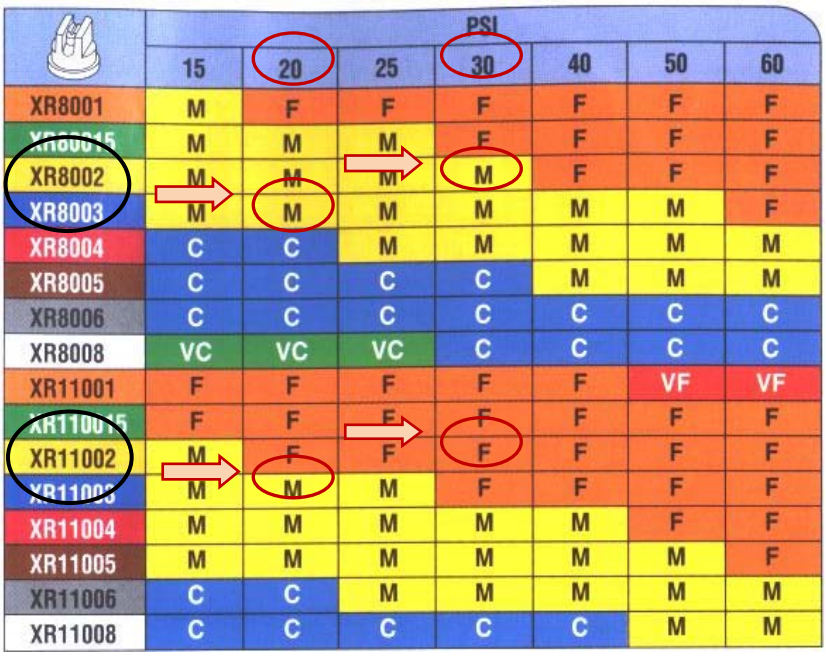
	PSI	Capacity 1 Nozzle in GPM	Capacity 1 Nozzle in oz/min.	GPA 20" 4 mph	5 mph	6 mph	7 mph	8 mph	9 mph	10 mph	12 mph
XR8001VS XR11001VS (100)	15	0.06	8	4.5	3.6	3.0	2.5	2.2	2.0	1.8	1.5
	20	0.07	9	5.2	4.2	3.5	3.0	2.6	2.3	2.1	1.7
	30	0.09	12	6.7	5.3	4.5	3.8	3.3	3.0	2.7	2.2
	40	0.10	13	7.4	5.9	5.0	4.2	3.7	3.3	3.0	2.5
	50	0.11	14	8.2	6.5	5.4	4.7	4.1	3.6	3.3	2.7
	60	0.12	15	8.9	7.1	5.9	5.1	4.5	4.0	3.6	3.0
XR80015VS XR110015VS (100)	15	0.09	12	6.7	5.3	4.5	3.8	3.3	3.0	2.7	2.2
	20	0.11	14	8.2	6.5	5.4	4.7	4.1	3.6	3.3	2.7
	30	0.13	17	9.7	7.7	6.4	5.5	4.8	4.3	3.9	3.2
	40	0.15	19	11.1	8.9	7.4	6.4	5.6	5.0	4.5	3.7
	50	0.17	22	12.6	10.1	8.4	7.2	6.3	5.6	5.0	4.2
	60	0.18	23	13.4	10.7	8.9	7.6	6.7	5.9	5.3	4.5
XR8002VS XR11002VS (50)	15	0.12	15	8.9	7.1	5.9	5.1	4.5	4.0	3.6	3.0
	20	0.14	18	10.4	8.3	6.9	5.9	5.2	4.6	4.2	3.5
	30	0.17	22	12.6	10.1	8.4	7.2	6.3	5.6	5.0	4.2
	40	0.20	26	14.9	11.9	9.9	8.5	7.4	6.6	5.9	5.0
	50	0.22	28	16.3	13.1	10.9	9.3	8.2	7.3	6.5	5.4
	60	0.24	31	17.8	14.3	11.9	10.2	8.9	7.9	7.1	5.9
XR8003VS XR11003VS (50)	15	0.18	23	13.4	10.7	8.9	7.6	6.7	5.9	5.3	4.5
	20	0.21	27	15.6	12.5	10.4	8.9	7.8	6.9	6.2	5.2
	30	0.26		19.3	15.4	12.9	11.0	9.7	8.6	7.7	6.4
	40	0.30	38	22	17.8	14.9	12.7	11.1	9.9	8.9	7.4
	50	0.34	44	25	20	16.8	14.4	12.6	11.2	10.1	8.4
	60	0.37	47	27	22	18.3	15.7	13.7	12.2	11.0	9.2
XR8004VS XR11004VS (50)	15	0.24	31	18	14.3	11.9	10.2	8.9	7.9	7.1	5.9
	20	0.28		21	16.6	13.9	11.9	10.4	9.2	8.3	6.9
	30	0.35	45	26	21	17.3	14.9	13.0	11.6	10.4	8.7
	40	0.40	51	30	24	19.8	17.0	14.9	13.2	11.9	9.9
	50	0.45	58	33	27	22	19.1	16.7	14.9	13.4	11.1
	60	0.49	63	36	29	24	21	18.2	16.2	14.6	12.1
XR8005VS XR11005VS (50)	15	0.31	40	23	18.4	15.3	13.2	11.5	10.2	9.2	7.7
	20	0.35	45	26	21	17.3	14.9	13.0	11.6	10.4	8.7
	30	0.43	55	32	26	21	18.2	16.0	14.2	12.8	10.6
	40	0.50	64	37	30	25	21	18.6	16.5	14.9	12.4
	50	0.56	72	42	33	28	24	21	18.5	16.6	13.9
	60	0.61	78	45	36	30	26	23	20	18.1	15.1

WHAT ABOUT SPRAY QUALITY?

Selecting a Nozzle for Desired Spray Quality
Example using Spraying Systems catalogue.

In the previous examples we selected:
e) nozzle XR8003VS or XR11003VS at 30psi to give 0.26 GPM, or
f) nozzle XR8004VS or XR11004VS at 20psi to give 0.28GPM

Using the spray quality table, you can see:
a) an XR8003VS at 30psi gives a medium spray quality
b) an XR8004VS at 20psi gives a coarse spray qualityand that
c) an XR11003VS at 30psi gives a fine spray quality
d) an XR11004VS at 20psi gives a medium spray quality



	PSI						
	15	20	25	30	40	50	60
XR8001	M	F	F	F	F	F	F
[illegible]	M	M	M	F	F	F	F
XR8002	M	M	M	M	F	F	F
XR8003	M	M	M	M	M	M	F
XR8004	C	C	M	M	M	M	M
XR8005	C	C	C	C	M	M	M
XR8006	C	C	C	C	C	C	C
XR8008	VC	VC	VC	C	C	C	C
XR11001	F	F	F	F	F	VF	VF
[illegible]	F	F	F	F	F	F	F
XR11002	M	F	F	F	F	F	F
[illegible]	M	M	M	F	F	F	F
XR11004	M	M	M	M	M	F	F
XR11005	M	M	M	M	M	M	F
XR11006	C	C	M	M	M	M	M
XR11008	C	C	C	C	C	M	M

Spray classification and target

1. **Fine sprays** can produce enhanced retention on the target and may be used for foliar acting weed control and cotyledon-stage weed control. Give careful attention to weather conditions. Do not use a fine spray for pesticides with the 'Danger' signal word on the label, or when drift may cause problems near sensitive areas.
2. **Medium sprays** are typically recommended for foliar applications.
3. **Coarse sprays** have a low risk of drift, but should be used only where recommended as a much of the pesticide may be wasted by larger droplets bouncing off leaves or other target surface.

4.10 Boom Sprayer Calibration

(Use clean water during calibration!)

Step 1. Check your tractor/sprayer speed

$$\text{Formula: MPH} = \frac{\text{ft traveled}}{\text{sec traveled}} \times \frac{60}{88}$$

Your tractor sprayer speed:

$$\text{MPH} \quad \frac{\text{ft traveled}}{\text{sec traveled}} \times \frac{60}{88} = \_\_\_\_\_$$

Step 2. Record the settings

	Your value	**Example**
Nozzle type on your sprayer (all nozzles must be identical)	_____	110 04 flat fan
Recommend application volume (from product lable	_____	20 GPA
Measured sprayer speed	_____	4 mph
Nozzle spacing	_____	20 inches

Step 3. Calculate the required nozzle output.

$$\text{Formula: GPM} = \frac{\text{GPA} \times \text{mph} \times \text{Nozzle spacing}}{5940 \text{ (constant)}}$$

Example:

$$\text{GPM} = \frac{20 \times 4 \times 20}{5940} = \frac{1600}{5940} = 0.27\text{GPM}$$

Your figures:

$$\text{GPM} = \frac{\_\_\_ \times \_\_\_}{5940} = \frac{\_\_\_}{5940} = \text{GPM}$$

Step 4. Operate the sprayer

Set the correct pressure at the gauge using the pressure regulating valve.

Collect and measure the output of each nozzle for one minute.

The output of each nozzle should be the approximately the same as calculated in Step 3 above. Remember 128 fl. oz. in one gallon. If output has been calculated at 0.27 GPM then output is 128 multiplied by 0.27 = 34.5 fl. oz. in one minute.

Replace all nozzle tips that are more than 10% inaccurate.

4.11 MIXING PROCEDURES

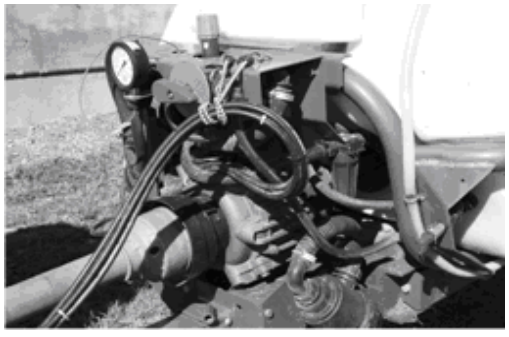
Safety and the Law

- Always remain alert, pesticides are potentially dangerous to the operator and the environment.
- Tractors and sprayers are dangerous machines and care should be taken when operating them.
- Always follow Federal and State laws concerning licensing of operators and handling, application and disposal of pesticides.

- Always read the label for detailed application information and keep a record.
- The seven P's of management:

Proper
Prior
Planning
Prevents
Poor
Performance

- Fill the tank on level ground per label instructions. If none are given, fill the tank half full with clean water.

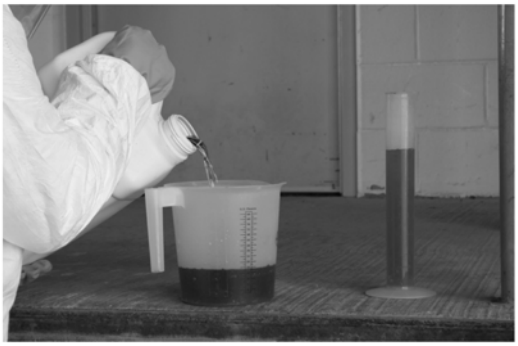


- Prime the pump with water, if needed.

ALWAYS

- Make sure there is no direct connection between the water source and sprayer tank. Direct connections can contaminate the supply by allowing chemicals to siphon back.
- Use a strainer when using water from a stream or pond.

- When opening a package:
  - Avoid using an "implement"; if used, decontaminate after use.
  - Avoid splashing and "glugging" of liquid formulations.
- Always add concentrated pesticides to a partially filled tank.
- If adding more than one product, do so separately and in the recommended order. NEVER mix them together in their concentrated forms
- If available, add product through a low-level induction bowl or through a suction probe.
  - If not available, add pesticides through the tank filter basket, except for soluble packs and some water dispersible granule formulations. Some wettable powders may need to be premixed.

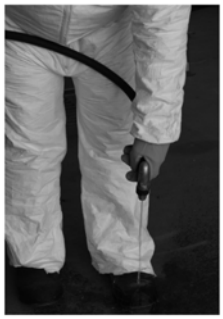


- Accurately measure the calculated amount of product.
  - Weigh solid formulations, and measure out liquid formulations, unless they come in pre-weighed packages appropriate for the spraying area.
  - Handle water soluble packages according to directions. Keep packs dry and do not force open the packs.

- If foaming is likely:
  - Fill the tank three-quarters full of water and use gentle agitation.
  - Add the pesticide.
  - Add the surfactant.
  - Continue to use gentle agitation until filling is finished.
  - Do not add water from a height.

- Triple rinse pesticide containers with clean water and put washings into the tank.
- Rinse off any pesticides spilled on the sprayer or container, and avoid contaminating the surroundings or yourself.

- Fill tank to the correct level and agitate while filling. Continue agitating while driving to the field and whilst spraying unless instructions advise otherwise. If spraying is delayed, agitate thoroughly just before use.



- Rinse impermeable protective clothing (rubber boots, gloves, etc.) with clean water after use.

- Remove other protective clothing and store before getting into tractor cab.

- Seal unused chemicals and store in a safe location.

4.12 Cleaning Sprayers

Sprayers must be thoroughly cleaned inside and out after use. Ideally, a sprayer should be cleaned at the end of each day and especially before switching to a different pesticide. Pesticide residues left on the outside of the sprayer can cause operator contamination. Residues on the inside of the tank or left over pesticides trapped inside the sprayer plumbing system can contaminate the operator, cause residue violoations or crop damage. This is especially important if one sprayer is used on different crops. Even a small amount of a pesticide remaining in the sprayer can can cause significant problems. Crop contamination can occur several months after a sprayer has not been properly cleaned.

Sprayers can also retain a large amount of pesticide solution. Depending on the size and design of the sprayer, there can be nearly 6 gallons of solution left in an airblast sprayer's plumbing. As illustrated in the following table, research conducted on boom sprayers has shown that, depending on the spray tank size, the total chemical solution retained in the sprayer ranged from just under 3 gallons to over 12 gallons. The parts that retain the most chemical solution are the chemical induction bowl, the booms, the tank, and the pump and its related piping.

Tests have shown that triple rinsing the spray tank is better than using just one single rinse. For example, using 100 gallons of clean water in one single rinse to clean a 100-gallon sprayer tank reduced the concentration of the original spray solution from 100% to 5% both in the tank and at the nozzle. If triple rinsing was performed using 33 gallons of clean water per rinse, a concentration of 0.2% to 0.5% was gained. The aim is for maximum dilution with minimal use of water. The following table illustrates how triple rinsing reduces the pesticide concentration at the nozzle and the tank drain.

Before rinsing a sprayer, read the sprayer manufacturer's instructions for specific guidance on the best methods for cleaning your equipment. Also consult the pesticide label for any special cleaning instructions. When cleaning spray equipment, you should use the protective clothing listed on the pesticide label. Sprayer cleaning should be done so that rinse water does not enter any waterway, field drainage system, or well.

Ideally, sprayer rinsate should be applied to a labeled crop rather than dumped at the cleaning location. If rinsing needs to be done at the mixing/loading site, it must be done on an impervious surface. All contaminated rinse water must be trapped and either used to mix another load of the same pesticide at the label recommended rates or disposed of at an approved pesticide waste handling facility.

Concentration of Pesticide in Rinse Water

Rinse Number	Sample Location	Percent Concentration
1	Nozzle	5.5
	Tank Drain	4.8
2	Nozzle	1
	Tank Drain	1
3	Nozzle	0.2
	Tank Drain	0.2

Source: Nilsson, E., Hagenwall H. og Jorgensen L.

Table 4.13 Quantity and Location of Chemical Remnants in Crop Sprayers (*in gallons*)

	Sprayer Size		
Location	*159 Gallons- 39 foot boom*	*212 Gallons - 39 foot boom*	*396 Gallons - 59 foot boom*
Tank	.50	1.32	4.57
Pump and associated piping	.40	.85	2.22
Pressure agitation	.02	.16	.27
Manifold	.04	.16	.27
Filter relief valve	NA	.15	.23
Chemical induction bowl	1.16	1.69	NA
Total without boom	**2.12**	**4.33**	**7.56**
Booms	.50	2.32	4.76
Total with booms	**2.62**	**6.65**	**12.32**

Adapted from "Quantity and Location of Chemical Remnants within a Range of Field Crop Sprayers by S.E. Cooper. Available at www.hardiinternational.com/Agronomy/Education_Material/pdf/08a.pdf

4.12.1 Reducing Cleaning Problems

The need for cleaning can be reduced by good planning and equipment maintenance. The following are suggestions to help reduce cleaning needs:

- Carefully plan how much pesticide to mix so that all mixed pesticides are used up when you are finished with the field.
- Be sure that the sprayer is clean before you use it.
- Make sure all parts of the sprayer are in good condition. Corroded, cavitated or pitted surfaces are prime areas for pesticide residue to hide. Replace any worn parts.
- Mix the chemicals in the correct order. Some chemicals, when mixed in the wrong order, can actually become more difficult to remove from the equipment. Consult the pesticide label for the proper mixing order.
- Follow any label instructions for cleaning spray equipment.
- Be sure that cleaning solutions contact ALL equipment surfaces.
- Remove and clean filters, strainers and nozzle screens separately from the rest of the sprayer.

4.12.2 Sprayer Cleansers

Several sprayer cleansers are commercially available. These cleansers should be selected based on the pesticide formulation used. Specific recommendations can be found on the pesticide label, by contacting the pesticide manufacturer or through the label or manufacturer of the cleaning agent you wish to use. Some available cleansers are listed in the table below. Household detergents such as laundry soaps and household ammonia, can also be used, but they may not adequately deactivate and solubalize the pesticides for effective cleaning. Chlorine bleach solutions should NOT be used. Cleaning agents can be used to wash both the inside and outside of the sprayer. When using commercial cleansers, follow the product's instructions for the best results. Keep the volume of tank wash water produced to a minimum to make disposal easier.

4.12.3 Tank Rinse Systems (Low-Volume Tank Rinsing)

Tank rinse systems consist of a clean water supply tank mounted to the sprayer and one or more rotating discs or nozzles mounted inside the main sprayer tank. Water is pumped from the clean water tank to the rinse nozzles where the water is sprayed around the inside of the spray tank. These systems are designed for in-field rinsing of the sprayer so that the tank washings can be applied to the field and reduce the amount of time spent traveling to and from the farmyard.

A tank rinse system can be purchased as an option on some sprayers or as an add-on kit. Rinse systems can also be made from readily available parts and installed on the sprayer. A sample rinse system layout is shown below. A typical rinse system uses 360-degree tank wash nozzles mounted in the top of the tank. These nozzles are available in flow rates of 10 gallons of water per minute at 20 psi up to 20 GPM at 50 psi. If a spray tank has baffles, at least one rinse nozzle per compartment should be provided. In any case, a sufficient number of rinse nozzles should be installed to provide enough rinse water to contact the entire tank interior.

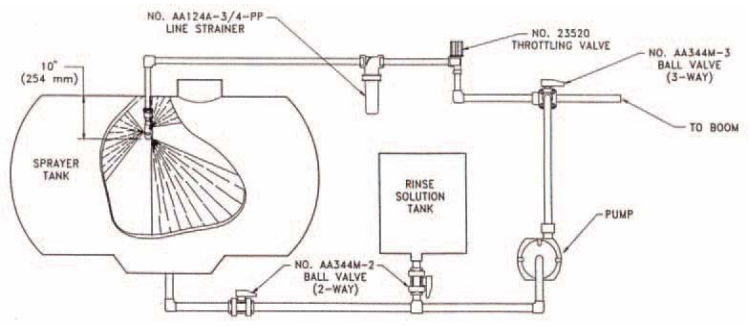
A 50 to 100 gallon tank is plumbed into the sprayer plumbing system to provide the clean water. This tank should be permanently marked "Clean Water Only" so that only clean water is placed in the tank, reducing the chance for contamination of the rinse system. The tank should be mounted above the pump in order to aid in priming the pump. Ideally, the tank should be mounted on the sprayer.

When using tank rinse systems, you may want to check the pesticide label or with the chemical manufacturer to be sure that low-volume rinsing is suitable for the products you're using. Also, during the rinse process, be sure to open and close the pressure valve and other control valves on the sprayer to ensure that any chemical that may be trapped in

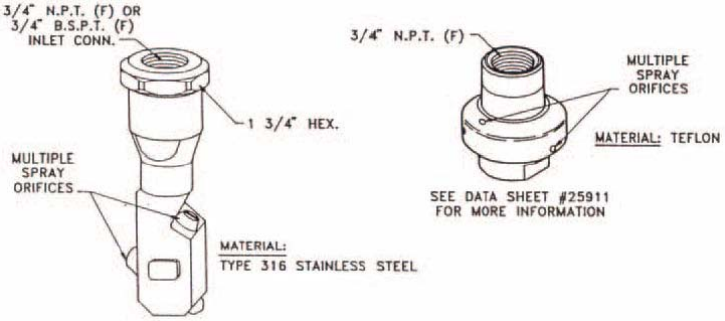
Commercially Available Sprayer Cleansers

Product	Supplier
Protank Cleaner	Agriliance P.O. Box 64089 St. Paul, MN 55164-0089 Phone: (651) 451-5151 Web: www.agriliance.com
All Clear Tank Decontaminator	UAP Loveland Industries, Inc. PO Box 1289 Greeley, CO 80632 Phone: 970-356-8920 Fax: 970-356-8926 Email: webmaster@lovelandindustries.com

Product	Supplier
Wipe-Out	Helena Chemical Company 225 Schilling Blvd. Collierville, TN 38017 Web: www.helenachemical.com
Ag Chem Tank Cleaner	Ag Chem Equipment Co. Ag-Chem Division 202 Industrial Park Jackson, MN 56143 Phone: 800-760-8800 Web: www.sprayparts.com



Sample layout of a sprayer rinse system



Two types of 360-degree tank rinse nozzles

the valve is rinsed out, further reducing the chance for contamination of future pesticide mixes. To obtain the best results, practice using the rinse system by placing spray marker dye or food coloring in the spray tank. Using the rinse system, run three rinse cycles, making sure the water discharged from the nozzles is completely clear by the end of the third rinse.

Tank Rinse Nozzle Suppliers include:
Spraying Systems (TeeJet) (www.teejet.com/techcent/catalog_english/%20spec_fert.pdf)
and
Delavan (www.delavan.co.uk/zCIP.pdf)

4.12.4 Levels of Sprayer Cleaning

There are two levels of sprayer cleaning:
- where the same or similar products are to be used on consecutive occasions, and
- where the type of product is changed between sprays, or at the end of the season.

Cleaning when Similar Products will be Used

Reminder: *Before cleaning application equipment, remember to wear the protective clothing listed on the pesticide label.*

1. Be sure that all mixed pesticides have been used up from the sprayer or removed and disposed of properly.
2. Flush sprayer with clean water, making sure to wash all inside surfaces of the tank, including the underside of the lid. Use of a tank rinse system is preferred so that rinsing can be done in the field where the rinse water can be applied to the crop. If a tank rinse system is not available, fill the spray tank about half full with clean water and flush the system for at least 5 minutes using both agitation and spraying. Be sure to open and close any control valves during the rinse process.
3. The rinsate should be applied to the crop at labeled rates. Repeat this procedure two more times.
4. Hose down the outside of the sprayer making sure to reach all parts, scrubbing if necessary.
5. Remove suction, main and in-line filter elements and wash them thoroughly in clean water using a soft bristle brush. Put the filters back on the sprayer when clean.
6. Remove the nozzles, nozzle screens and nozzle bar end caps (if used) and wash them thoroughly in clean water with the appropriate cleanser and rinse. Use a soft bristle brush, such as an old toothbrush, when cleaning nozzle parts.
7. Partly fill the sprayer with clean water and run the sprayer to flush out all parts.
8. Reinstall nozzles and nozzle screens.
9. Hose down the outside of the sprayer once again.

Cleaning Where Product Type is Changed

This procedure should be followed at the end of a season or before sprayer maintenance. **Wear the protective clothing listed on the pesticide label when cleaning sprayers!** Follow steps 1–6 above, then continue with steps below:

7. Refill the tank with clean water, adding any detergent recommended by the pesticide manufacturer. Remember, use commercial cleansers according to their directions. Agitate the solution and pump it through the sprayer plumbing system.
8. Discharge the cleaning solution from the sprayer through the plumbing system, making sure to drain the system as thoroughly as possible.
9. Rinse the sprayer and flush the plumbing system with clean water.

10. Inspect the sprayer for deposits that may remain in the tank or plumbing system. If any remain, use some of the cleaning solution and scrub the problem spots. Rinse the sprayer out completely.
11. Repeat steps 7 to 9.
12. Hose down the outside of the tractor and sprayer, scrubbing if necessary.
13. If changing from one type of pesticide to another, refit nozzles, filters and other parts that may have been removed in the cleaning process.
14. When cleaning and preparing the sprayer at the end of the season, safely store nozzles and filters to keep them clean and damage-free. Leave valves open and the tank lid loosely closed.

4.12.5 Disposal of Pesticide Waste

The safe disposal of pesticide waste is a serious responsibility. It is important, therefore, that everything should be done to minimize the amount of waste generated. Pesticide waste is of four types:

- Concentrated products.
- Diluted pesticides, including washings.
- Empty containers.
- Contaminated clothing and other materials.

4.12.6 References

DuPont Agricultural Products. 1995. A Guide to Application Equipment Cleanout for DuPont Sulfonylurea Herbicides. DuPont Agricultural Products.

Hardi International web site: www.hardi-international.com

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4.13 Mechanical Maintenance

Caution - All mounted sprayers tend to be unstable when removed from their tractors. Make sure they are safely chocked before leaving them.

Lubrication must be carried out at the time intervals specified by the sprayer manufacturer. The following components must be checked daily when a sprayer is in use:

☐ Pump crankshaft oil level.
☐ Fan drive gearbox oil level.
☐ Fan drive shaft bearings.
☐ Agitator shaft bearings.
☐ PTO shaft safety cover.
☐ Wheels, wheel bearings and tire inflation.
☐ Rotary atomizers for damage and lubrication.

At regular intervals check the spray liquid system for leaks and signs of damage or wear. Needed repairs should be carried out at once.

4.14 Sprayer Storage

Sprayers should be stored carefully after use. Manufacturer specific instructions should be followed but in their absence the following general guide should be of use:

1. Thoroughly wash the sprayer inside and out with water, followed by a solution of detergent and water, followed by water. Drain thoroughly. Allow the access of air to all parts of the sprayer system. A more thorough decontamination routine is outlined above.
2. Inspect filters, nozzles, hoses and all other components and order all necessary spares.
3. Pay particular attention to the pump. Inspect rollers or diaphragms (if fitted) and valves and order necessary spares.
4. Check the soundness of all mechanical components, particularly booms and boom hinges, and the wheels.
5. Store sprayer under cover, taking care to prevent dirt and moisture affecting tank or working parts.

4.15 Homeland Security

Examples of activity relating to spraying equipment that may be of possible concern to law enforcement:

- The unexplained loss or theft or attempted theft of equipment or separate machine components used in agricultural spraying.
- Inquiries from unknown persons as to the purchase or operation of spraying equipment. Unusual inquiries about modifying spraying equipment.
- Requests for information or for purchase of pesticides that may be harmful to humans.
- Individual making observations of your spraying operations, who when approached, deliberately leave to avoid questioning.
- A request to purchase spraying machinery by someone who does not appear to have previous experience in such work or a connection to the agricultural industry (i.e., unable to answer basic questions about intended application and range, water volume rates, desired nozzle output, spray pattern, acreage, crops, soil composition, etc.)
- A request to ship spraying equipment to an area or region not normally associated with spraying operations.
- A customer's reluctance to provide information on the locations of the plant or place where the equipment will be stored.

5 Characteristics of Crop Protectants Used On Tree Fruits

5.1 Cross Reference of Chemical vs. Trade Names of Pesticides

Key to pesticide type: (**A**), Acaricide; (**B**), Bactericide; (**F**), Fungicide; (**H**), Herbicide; (**I**), Insecticide.

NOTE: **See Chapter 8 for a discussion of herbicides used in tree fruit.**

5.1.1 By Common Name

2,4-D – (2,4-D Amine 4) WinField Solutions; (Amine 4) Loveland Products; (Weedar 64, Formula 40) Nufarm; (Unison) Helena **(H)**

abamectin/avermectin – (*Agri-Flex, *Agri-Mek) Syngenta; (*Temprano) Chemtura; (*Abba) Makhteshim; (*Gladiator) FMC (**A, I**)
acequinocyl – (Kanemite) Arysta LifeScience **(A)**
acetamiprid – (Assail) United Phosphorus (**I**)
azadirachtin – (Aza-Direct) Gowan; (Neemix 4.5, Azatin XL) Certis **(I)**
azoxystrobin – (Abound) Syngenta **(F)**

Bacillus subtilis – (Serenade) AgraQuest **(B, F)**
bifenazate – (Acramite) Chemtura **(A)**
bifenthrin – (*Bifenture) United Phosphorus; (*Brigade) FMC; (*Fanfare) Makhteshim Agan (**I, A**)
boscalid + pyraclostrobin – (Pristine) BASF (**F**)
Bacillus thuringiensis (B.t.) – (Agree) Certis; (Biobit) Valent BioSciences; (Dipel) Valent BioSciences; (Deliver) Certis; (Javelin) Certis **(I)**
bromacil – (Hyvar, Hyvar X-L) DuPont **(H)**
buprofezin – (Centaur, Tourismo) Nichino America **(I)**

captan – (Captan) Micro Flo, Drexel, Makhteshim Agan; (Captec) Micro Flo **(F)**
carbaryl – (Carbaryl) Drexel; (Sevin) TKI (**I**)
carfentrazone-ethyl – (Aim, Rage) FMC **(H)**
chlorantraniliprole – (Altacor) DuPont ;(Voliam Flexi, Voliam Xpress) Syngenta **(I)**
chlorpyrifos – (Lorsban) Dow AgroSciences, Gowan **(I)**
chlorothalonil – (Bravo) Syngenta; (Echo) Sipcam Agro; (Concorde) Griffin; (Equus) Makhteshim Agan **(F)**
clofentezine – (Apollo) Makhteshim Agan **(A)**
clopyralid – (Stinger) Dow AgroSciences **(H)**
clothianidin – (Clutch, Belay) Valent BioSciences **(I)**
codling moth granulosis virus – (Cyd-X) Certis; (Carpovirusine) Arysta LifeScience**(I)**
copper hydroxide – (Kocide, Champ) Griffin, Nufarm Americas **(B, F)**
copper oxychloride/copper sulfate – (C-O-C-S) Loveland **(B, F)**
copper sulfate – (Cuprofix Ultra Disperss) United Phosphorus; (Basicop) Griffin **(B, F)**
cyfluthrin – (*Baythroid, *Leverage) Bayer **(I)**
cyprodinil – (Vangard) Syngenta **(F)**
diazinon – (*Diazinon) Makhteshim **(I)**
dichlobenil – (Casoron) Chemtura **(H)**
dicloran – (Botran) Gowan **(F)**
difenoconazole + cyprodinil – (Inspire Super) Syngenta **(F)**
dimethoate – (Dimethoate) Loveland (Dimate) WinField Solutions; (Dimethoate) Drexel **(I)**
dinotefuran – (Scorpion) Gowan **(I)**
diuron – (Direx, Karmex) Griffin; (Diuron) Drexel, Loveland, WinField Solutions, Makhteshim Agan **(H)**
dodine – (Syllit FL) Agriphar **(F)**

emamectin benzoate – (*Proclaim) Syngenta **(I)**
endosulfan – (Endosulfan) Drexel; (Phaser) Bayer; (*Thionex) Makhteshim Agan **(I)**
esfenvalerate – (*Asana) DuPont **(I)**
etoxazole – (Zeal) Valent **(A)**

fenarimol – (Vintage) Gowan **(F)**
fenbuconazole – (Indar) Dow AgroSciences **(F)**
fenbutatin-oxide – (*Vendex) Griffin **(A)**
fenhexamid – (Elevate) Arysta **(F)**
fenpropathrin – (*Danitol) Valent BioSciences **(I)**
fenpyroximate – (Portal) Nichino America **(A, I)**
flonicamid – (Beleaf) FMC **(I)**
flubendiamide – (Belt) Bayer, Tourismo (Nichino) **(I)**
ferbam – (Ferbam Granuflo) Taminco **(F)**
fluazifop-p-butyl – (Fusilade) Syngenta **(H)**
fludioxonil – (Scholar) Syngenta **(F)**
flumioxazin – (Chateau) Valent (H)
fluopyram + trifloxystrobin – (Luna Sensation) Bayer (F)
fluopyram + pyrimethanil – (Luna Tranquility) Bayer (F)
flutriafol – (Topguard) Cheminova (F)
fluxapyroxad + pyraclostrobin – (Merivon) BASF (F)
fosetyl-Al – (Aliette) Bayer **(F)**

gamma cyhalothrin – (*Proaxis) Loveland **(I)**
glufosinate-ammonium – (Rely) Bayer **(H)**
glyphosate – (Roundup Original, Roundup Original II, Roundup Original Max, Roundup Ultra, Roundup Ultradry, Roundup Weathermax) Monsanto; (Atila, Credit) Nufarm; (Cornerstone) WinField Solutions; (Glystar Original) Albaugh; (Touchdown HiTech, Touchdown IQ, Touchdown Total IQ) Syngneta; (Rage) FMC **(H)**

halosulfuron – (Sandea) Gowan **(H)**
hexakis – (*Vendex) United Phosphorus **(I)**
hexythiazox – (Savey, Onager) Gowan **(A)**
hydrogen dioxide – (OxiDate, StorOx) Biosafe Systems **(B, F)**

imidacloprid – (Admire Pro, *Leverage) Bayer **(I)**
indaziflam – (Alion) Bayer **(H)**
indoxacarb – (Avaunt) DuPont **(I)**
iprodione – (Rovral) Bayer; (Iprodione) MicroFlo, (Meteor) United Phosphorus **(F)**

kaolin – (Surround) TKI (**A,F,I**)
kresoxim-methyl – (Sovran) BASF **(F)**

lambda-cyhalothrin – (*Lambda-Cy) United Phosphorus; (*Taiga Z) WinField Solutions; (*Endigo, *Voliam Xpress, *Warrior) Syngenta **(I)**
liquid lime-sulfur – (Suregard Lime Sulfur) Value Garden Supply; (Sulforix Lime Sulfur, Lime Sulfur Solution) Miller Chemical (**A, F, I**)

malathion – (Clean Crop Malathion) Loveland; (Malathion) Drexel; (Prentox Malathion) Prentiss **(I)**
mancozeb – (Dithane) Dow AgroSciences; (Manzate) United Phosphorus; (Penncozeb) United Phosphorus **(F)**
mefanoxam – (Ridomil Gold) Syngenta **(F)**
maneb – (Manex) Griffin **(F)**
metconazole – (Quash) Valent **(F)**
methidathion – (*Supracide) Gowan **(I)**
methomyl – (*Lannate) DuPont **(I)**
methoxyfenozide – (Intrepid) Dow AgroSciences **(I)**
metiram – (Polyram) BASF **(F)**
myclobutanil – (Rally) Dow AgroSciences **(F)**

napropamide – (Devrinol) United Phosphorus **(H)**
norflurazon – (Solicam) Syngenta **(H)**
novaluron – (Rimon) Chemtura **(I)**

oryzalin – (Surflan) United Phosphorus; (Oryza Ag) AgValue; (Oryzalin) FarmSaver.com; **(H)**
oxamyl – (*Vydate) DuPont **(I)**
oxyfluorfen – (Goal) Dow AgroSciences; (Galigan) Makhteshim Agan; Collide (United Phosphorus **(H)**
oxytetracycline – (Mycoshield) Nufarm; (Fireline) Agrosource; (Tree Tech OTC) Florida Silvics **(B)**

Pantoea agglomerans strain E325 – (Bloomtime Biological) Northwest Agricultural Products **(B)**
paraquat – (*Gramoxone) Syngenta-**(H)**
pendimethalin – (Prowl) BASF **(H)**
penthiopyrad – (Fontelis) DuPont **(F)**
permethrin – (*Ambush) AMVAC; (*Perm-Up) United Phosphorus; (*Pounce) FMC **(I)**
pheromones – (Checkmate) Suterra; (Isomate) CBC; (SPLAT) ISCA Tech **(I)**
phosmet – (Imidan) Gowan **(I)**
phosphite – (Phostrol) NuFarm (**F, B**)
phosphite – (ProPhyt) Luxembourg-Pamol (**F**)
phosphorous acid – (Fosphite) JH Biotech; (Topaz Fungicide) WinField Solutions (**F**)
phosphorous acid – (Agri-Fos) Agrichem Manufacturing Industries; (Fungi-Phite) Biagro Western Sales; (**F, B**)
pronamide – (*Kerb) Dow AgroSciences **(H)**
propiconazole – (Tilt) Syngenta; (Bumper) Makhteshim Agan **(F)**
pyraclostrobin (Cabrio EG) BASF **(F)**
pyraclostrobin+boscalid – (Pristine) BASF **(F)**
pyraflufen ethyl – (Venue) Nichino **(H)**
pyrethrins/rotenone – (PyGanic, Pyrenone) McLaughlin Gormley King, Bayer **(I)**
pyridaben – (Nexter) Gowan (**A,I**)
pyrimethanil – (Scala) Bayer; (Penbotec) Janssen **(F)**
pyriproxyfen – (Esteem) Valent BioSciences **(I)**

quinoxyfen – (Quintec) Dow AgroSciences **(F)**

rimsulfuron – (Matrix) DuPont (H)
rynaxypyr – (Altacor) DuPont **(I)**

sethoxydim – (Poast) BASF **(H)**
simazine – (Princep) Syngenta; (Simazine) WinField Solutions, Drexel, Loveland Products; (Sim-Trol) Sipcam Agro **(H)**
soap, insecticidal – (M-Pede) Dow AgroSciences **(I)**
spinetoram – (Delegate) Dow AgroSciences **(I)**
spinosad – (Entrust) Dow AgroSciences **(I)**
spirodiclofen – (Envidor) Bayer **(A)**
spirotetramat – (Movento) Bayer CropScience **(I)**
streptomycin – (Agri-mycin, Streptrol) Nufarm; (Agricultural Streptomycin) Farm Saver; (Firewall) AgroSource **(B)**
sulfur – (Microthiol Disperss) United Phosphorus (**F**)

tebuconazole – (Elite) Bayer; (Tebuzol) United Phosphorus**(F)**
tebufenozide – (Confirm) Dow AgroSciences **(I)**
terbacil – (Sinbar) DuPont **(H)**
thiabendazole – (Mertect) Syngenta; (Shield-Brite TBZ) Pace International **(F)**
thiacloprid – (Calypso) Bayer **(I)**
thiamethoxam – (Actara, *Agri-Flex, Endigo, Voliam Flexi) Syngenta **(I)**
thiophanate-methyl – (Topsin M) United Phosphorus; (Thiophanate-methyl) FarmSaver, Makhteshim Agan; (T-Methyl) Nufarm **(F)**
thiram – (Thiram Granuflo) Taminco **(F)**
triadimefon – (Triadimefon) Taminco; (Bayleton) Amvac **(F)**
trifloxystrobin – (Flint, Adament), Gem) Bayer **(F)**
triflumizole – (Procure) Chemtura **(F)**

zeta-cypermethrin – (*Gladiator) FMC **(A,I)**
ziram – (Ziram) United Phosphorus; (Ziram Granuflo) Taminco **(F)**

5.1.2 By Trade Name

2,4-D Amine 4 – (2,4-D) WinField Solutions **(H)**

*Abba – (abamectin) Makhteshim **(A, I)**
Abound – (azoxystrobin) Syngenta **(F)**
Acramite – (bifenazate) Chemtura **(A)**
Actara – (thiamethoxam) Syngenta **(I)**
Adament – (tebuconazole & trifloxystrobin) Bayer **(F)**
Admire Pro – (imidacloprid) Bayer **(I)**
Agree – (Bacillus thuringiensis) Certis **(I)**
*Agri-Flex – (abamectin + thiamethoxam) Syngenta **(I)**
Agri-Fos – Agrichem Manufacturing Industries (**F, B**)
*Agri-Mek – (abamectin) Syngenta (**A,I**)
Agrimycin – (streptomycin) Nufarm **(B)**
Aim – (carfentrazone-ethyl) FMC **(H)**

Aliette – (fosetyl-Al) Bayer **(F)**
Alion – (indaziflam) Bayer **(H)**
Allpro Lime Sulfur – (liquid lime-sulfur) Value Garden Supply (**A, F, I**)
Altacor – (chlorantraniliprole/rynaxypyr) DuPont **(I)**
Amine 4 – (2,4-D) Loveland Products **(H)**
*Ambush – (permethrin) AMVAC **(I)**
Applause – (chlorothalonil) Loveland (**F**)
Apollo – (clofentezine) Makhteshim **(A)**
*Asana – (esfenvalerate) DuPont **(I)**
Assail – (acetamiprid) United Phosphorus **(I)**
Atila Plus – (glyphosate) Nufarm **(H)**
Avaunt – (indoxacarb) DuPont **(I)**
Aza-Direct – (azadirachtin) Gowan **(I)**
Azatin XL – (azadirachtin) Certis **(I)**

Basicop – (copper sulfate) Griffin **(B, F)**
Bayleton – (triadimefon) Amvac **(F)**
*Baythroid – (cyfluthrin) Bayer **(I)**
Belay – (clothianidin) Valent BioSciences **(I)**
Beleaf – (flonicamid) FMC **(I)**
Belt – (flubendiamide) Bayer **(I)**
*Bifenture – (bifenthrin) United Phosphorus **(I, A)**
Biobit – (Bacillus thuringiensis) Valent BioSciences **(I)**
Botran – (dicloran) Gowan **(F)**
Bravo – (chlorothalonil) Syngenta **(F)**
*Brigade – (bifenthrin) FMC (**I, A**)
Bumper – (propiconazole) Makhteshim Agan **(B)**

C-O-C-S – (copper oxychloride/copper sulfate) Loveland **(B, F)**
Cabrio EG – (pyraclostrobin) BASF **(F)**
Calypso – (thiacloprid) Bayer **(I)**
Captan – (captan) Micro Flo, Drexel, Makhteshim Agan **(F)**
Captec – (captan) Micro Flo **(F)**
Carbaryl – (carbaryl) Drexel **(I)**
Carpovirusine – (codling moth granulosis virus) Arysta LifeScience **(I)**
Casoron – (dichlobenil) Chemtura **(H)**
Centaur – (buprofezin) Nichino America **(I)**
Champ – (copper hydroxide) Nufarm Americas **(B, F)**
Chateau – (flumioxazin) Valent **(H)**
Checkmate – (pheromones) Suterra **(I)**
Clean Crop Dimethoate – (dimethoate) Loveland **(I)**
Clean Crop Malathion – (malathion) Loveland **(I)**
Clutch – (clothianidin) Valent BioSciences **(I)**
Collide – (oxyfluorfen) United Phosphorus (**H**)
Concorde – (chlorothalonil) Griffin (**F**)
Cornerstone – (glyphosate) WinField Solutions **(H)**
Credit – (glyphosate) Nufarm **(H)**
Cuprofix Ultra Disperss – (copper sulfate) United Phosphorus **(B, F)**
Cyd-X – (codling moth granulosis virus) Certis **(I)**

*Danitol – (fenpropathrin) Valent BioSciences **(I)**
Delegate – (spinetoram) Dow AgroSciences **(I)**
Deliver – (Bacillus thuringiensis) Certis **(I)**
Devrinol – (napropamide) United Phosphorus **(H)**
Diazinon – (*Diazinon) Makhteshim **(I)**
Dimate – (dimethoate) WinField Solutions **(I)**
Dimethoate – (dimethoate) Drexel, Helena, Micro Flo **(I)**
Dipel – (Bacillus thuringiensis) Valent BioSciences **(F)**
Direx – (diuron) Griffin **(H)**
Dithane – (mancozeb) Dow AgroSciences **(F)**
Diuron – (diuron) WinField Solutions, Drexel, Loveland Products, Makhteshim Agan

Echo – (chlorothalonil) Sipcam Agro **(F)**
Elevate – (fenhexamid) Arvesta **(F)**
Elite – (tebuconazole) Bayer **(F)**
*Endigo – (lambda-cyhalothrin/thiamethoxam) Syngenta **(I)**
Endosulfan – (endosulfan) Drexel **(I)**
§Entrust – (spinosad) Dow AgroSciences **(I)**
Envidor – (spirodiclofen) Bayer **(A)**
Equus – (chlorothalonil) Makhteshim Agan (**F**)
Esteem – (pyriproxyfen) Valent BioSciences **(I)**

*Fanfare – (bifenthrin) Makhteshim Again **(A, I)**
Ferbam Granuflo – (ferbam) Taminco **(F)**
Fireline – (oxytetracycline) AgroSource **(B)**
Firewall – (streptomycin) AgroSource **(B)**
Flint – (trifloxystrobin) Bayer **(F)**
Fontelis – (penthiopyrad) DuPont **(F)**
Formula 40 – (2,4-D) Nufarm **(H)**
Fosphite – (phosphorous acid) JH Biotech (**F)**
Fungi-Phite – (phosphorous acid) Biagro Western Sales; (**F, B**)
Fusilade – (fluazifop-p-butyl) Syngenta **(H)**

Galigan – (oxyfluorfen) Makhteshim Agan **(H)**
Gem – (trifloxystrobin) Bayer **(F)**
*Gladiator – (avermectin B1/zeta-cypermethrin) FMC **(A,I)**
GlyStar Original – (glyphosate) Albaugh **(H)**
Goal – (oxyfluorfen) Dow AgroSciences **(H)**
Gramoxone (paraquat) Syngenta **(H)**

Hyvar – (bromacil) DuPont **(H)**

Imidan – (phosmet) Gowan **(I)**
Indar – (fenbuconazole) Dow AgroSciences **(F)**
Inspire Super – (difenoconazole & cyprodinil) Syngenta **(F)**
Intrepid – (methoxyfenozide) Dow AgroSciences **(I)**
Iprodione – (iprodione) MicroFlo **(F)**
Isomate – (pheromones) CBC **(I)**

Javelin – (Bacillus thuringiensis) Certis **(I)**

Kanemite – (acequinocyl) Arysta LifeScience **(A)**
Karmex – (diuron) Griffin **(H)**
*Kerb – (pronamide) Dow AgroSciences **(H)**
Kocide – (copper hydroxide) Griffin **(B, F)**

*Lambda-Cy – (lambda-cyhalothrin) United Phosphorus **(I)**
*Lannate – (methomyl) DuPont **(I)**
*Leverage – (cyfluthrin/imidacloprid) Bayer **(I)**
Lime Sulfur Solution – (liquid lime sulfur) Miller Chemical (**A, F, I**)
Lorsban – (chlorpyrifos) Dow AgroSciences, Gowan **(I)**

Luna Sensation – (fluopyram/trifloxystrobin) Bayer **(F)**
Luna Tranquility **(**fluopyram/pyrimethanil) Bayer **(F)**

Malathion – (malathion) Drexel **(I)**
Manex – (Maneb) DuPont **(F)**
Manzate – (mancozeb) Griffin **(F)**
Matrix – (rimsulfuron) DuPont (H)
Merivon – (fluxapyroxad + pyraclostrobin) BASF (F)
Mertect – (thiabendazole) Syngenta **(F)**
Messenger – (harpin) Eden Bioscience **(B)**
Meteor – (iprodione) United Phosphorus (F)
Movento – (spirotetramat) Bayer CropScience **(I)**
M-Pede – (insecticidal soap; potassium salts of fatty acids) Gowan **(I)**
Mycoshield – (oxytetracycline) Nufarm **(B)**
Microthiol Disperss – (sulfur) Unifos (**F**)

Neemix 4.5 – (azadirachtin) Certis **(I)**
Nexter – (pyridaben) Gowan (A, I)
Nova – (myclobutanil) Dow AgroSciences **(F)**

Onager – (hexythiazox) Gowan **(A)**
Orbit – (propiconazole) DuPont **(F)**
Oryza Ag – (oryzalin) AgValue **(H)**
Oryzalin – (oryzalin) FarmSaver.com **(H)**
OxiDate – (hydrogen dioxide) Biosafe Systems **(B, F)**

Penbotec– (pyrimethanil) Janssen **(F)**
Penncozeb – (mancozeb) United Phosphorus **(F)**
*Perm-Up – (permethrin) United Phosphorus **(I)**
Phaser – (endosulfan) Bayer **(I)**
Phostrol – (sodium, potassium, and ammonium phosphates) NuFarm (**F, B**)
Poast – (sethoxydim) BASF **(H)**
Polyram – (metiram) BASF **(F)**
Portal – (fenpyroximate) Nichino America **(A,I)**
*Pounce – (permethrin) FMC **(I)**
*Prentox Diazinon – (*diazinon) Prentiss **(I)**
Prentox Malathion – (malathion) Prentiss **(I)**
Princep – (simazine) Syngenta **(H)**
Pristine – (pyraclostrobin + boscalid) BASF **(F)**
*Proaxis – (gamma-cyhalothrin) Loveland **(I)**
*Proclaim – (emamectin benzoate) Syngenta **(I)**
ProPhyt – (potassium phosphite) Luxembourg-Pamol (**F)**
Procure – (triflumizole) Chemtura **(F)**
Prowl – (pendimethalin) BASF **(H)**
PyGanic, Pyrenone – (pyrethrins) McLaughlin Gormley King, Bayer **(I)**

Quash – (metconazole) Valent (**F**)
Quintec – (quinoxyfen) Dow AgroSciences **(F)**

Rage – (carfentrazone/glyphosate) FMC **(H)**
Rely – (glufosinate-ammonium) Bayer **(H)**
Ridomil Gold – (mefanoxam) Syngenta **(F)**
Rimon – (novaluron) Chemtura **(I)**
Roundup Original – (glyphosate) Monsanto **(H)**
Roundup Original II – (glyphosate) Monsanto **(H)**
Roundup Original Max – (glyphosate) Monsanto **(H)**
Roundup Ultra – (glyphosate) Monsanto **(H)**
Roundup Ultradry – (glyphosate) Monsanto **(H)**
Roundup Weathermax – (glyphosate) Monsanto **(H)**
Rovral – (iprodione) Bayer **(F)**

Sandea – (halosulfuron) Gowan **(H)**
Savey – (hexythiazox) Gowan **(A)**
Scala – (pyrimethanil) Bayer **(F)**
Scholar – (fludioxonil) Syngenta **(F)**
Scorpion – (dinotefuran) Gowan **(I)**
Serenade – (*Bacillus subtilis*) AgraQuest **(B, F)**
Sevin – (carbaryl) Bayer **(I)**
Shield-Brite TBZ – (thiabendazole) Pace International **(F)**
Simazine – (simazine) WinField Solutions, Drexel, Loveland Products **(H)**
Sim-Trol – (simazine) Sipcam Agro **(H)**
Sinbar – (terbacil) DuPont **(H)**
Solicam – (norflurazon) Syngenta **(H)**
Sovran – (kresoxim-methyl) BASF **(F)**
SPLAT – (pheromones) ISCA Tech **(I)**
Stinger – (clopyralid) Dow AgroSciences **(H)**
StorOx – (hydrogen dioxide) Biosafe Systems **(B, F)**
Streptrol – (streptomycin) Nufarm **(B)**
*Supracide – (methidathion) Gowan **(I)**
Suregard Lime Sulfur – (liquid lime-sulfur) Value Garden Supply (**A, F, I**)
Surflan – (oryzalin) United Phosphorus **(H)**
Sulforix Lime Sulfur – (liquid lime-sulfur) Miller Chemical (**A, F, I)**
Surround – (kaolin) TKI **(A,F,I)**
Syllit – (dodine) Loveland, Agriphar **(F)**

T-Methyl – (thiophanate-methyl) Micro Flo **(F)**
*Taiga Z – (lambda-cyhalothrin) WinField Solutions **(I)**
*Temprano – (abamectin) Chemtura **(A, I)**
*Thionex – (endosulfan) Makhteshim **(I)**
Thiophanate-methyl – (thiophanate-methyl) FarmSaver, Makhteshim Agan **(F)**
Thiram Granuflo – (thiram) Tamico **(F)**
Tilt – (propiconazole) Syngenta **(F)**
Topaz Fungicide – (phosphorous acid) WinField Solutions (**F)**
Topguard – (flutriafol) Cheminova **(F)**
Topsin M – (thiophanate-methyl) United Phosphorus **(F)**
Tourismo – (flubendiamide & buprofezin) Nichino **(I)**
Touchdown HiTech – (glyphosate) Syngenta **(H)**
Touchdown IQ – (glyphosate) Syngenta **(H)**
Touchdown Total IQ – (glyphosate) Syngenta **(H)**
Tree Tech OTC – (oxytetracycline) Florida Silvics **(B)**
Triadimefon – (triadimefon) Taminco **(F)**

Unison – (2,4-D) Helena **(H)**

Vangard – (cyprodinil) Syngenta **(F)**
*Vendex – (hexakis, fenbutatin-oxide) United Phosphorus **(A)**
Venue – (pyraflufen ethyl) Nichino **(H)**
Vintage – (fenarimol) Gowan **(F)**
Voliam Flexi – (thiamethoxam/chlorantraniliprole) Syngenta **(I)**

Voliam Xpress – (lambda-cyhalothrin) Syngenta **(I)**
*Vydate – (oxamyl) DuPont **(I)**

*Warrior – (lambda-cyhalothrin) Syngenta **(I)**
Weedar 64 – (2,4-D) Nufarm **(H)**

Zeal – (etoxazole) Valent **(A)**
Ziram – (ziram) United Phosphorus **(F)**
Ziram Granuflo – (ziram) Taminco **(F)**

5.2 Restricted Highly Toxic Pesticides

2,4-D, some formulations (Unison, Agrisolutions 2,4-D Amine, Weedar 64)

abamectin (*Agri-Flex, *Agri-Mek, *Abba, *Temprano)
azinphos-methyl (*Guthion)

bifenthrin (*Bifenture, *Brigade, *Fanfare)

carbaryl (*Sevin 80WS) - "G" restriction
chloropicrin (*Telone C-17)
clopyralid (Stinger)
cyfluthrin (*Baythroid, *Leverage)

emamectin benzoate (*Proclaim)
endosulfan (*Thionex)
esfenvalerate (*Asana)

fenpropathrin (*Danitol)

hexakis, fenbutatin-oxide (*Vendex)

imidacloprid (, *Leverage)

lambda - cyhalothrin (*Endigo, *Lambda-Cy, *Taiga Z, *Warrior, *Voliam Xpress)

methidathion (*Supracide)
methomyl (*Lannate)
methyl bromide

oxamyl (*Vydate)

paraquat (Gramoxone Inteon)
permethrin (*Ambush, *Perm-Up *Pounce)
pronamide (*Kerb)

zinc phosphide

5.3 Fungicides

(For meaning of symbols preceding product names, see abbreviation list at the end of this publication)

Azoxystrobin (Abound) is a locally systemic, strobilurin fungicide labeled on stone fruit for control of brown rot, powdery mildew (rusty spot), and peach scab. It is labeled on apricots, sweet and tart cherry, nectarines, peaches, plums and prunes. Abound is a protectant fungicide and should therefore be applied before infection occurs. Abound, like other strobilurin fungicides, is prone to resistance development. Follow label restrictions for resistance management. Abound can be applied up to the day of harvest.

Caution: Abound is extremely phytotoxic to certain apple varieties. Therefore, **DO NOT** spray Abound where spray drift may reach apple trees; do not spray when conditions favor drift beyond the intended area of application; do not use equipment to spray apple trees that previously has been used to spray Abound.

(§)Bordeaux Mixture is a mixture in water of copper sulfate (bluestone) and hydrated spray lime and is used as a spray on pears and apples for fire blight, on peaches for leaf curl, and on cherries in postharvest sprays for leaf spot. The recommended amount of each ingredient varies from one crop to another and is designated by 3 figures (e.g., Bordeaux 2-6-100). The 1st figure of the Bordeaux formula is the copper sulfate in lb, the 2d is the spray lime in lb, and the 3d is the water in gal. The mixture is prepared by dissolving copper sulfate snow (not fixed copper) in about 1/2 tank of water. Once the copper sulfate is completely dissolved, the spray lime is added slowly with constant agitation, and the tank is filled with water. Bordeaux mixture must be agitated vigorously to prevent settling.

Bordeaux mixture is generally unsafe to use on fruit crops after the 1/4-inch green stage. However, pears tolerate copper, and it can be used during bloom for fire blight control provided that the disease pressure is only moderate to light. Bordeaux mixture has long residual action and gives good control of leaf spot when applied to sour cherries in a postharvest spray.

Due to the large volume of spray lime, Bordeaux mixture has many compatibility problems. When used in combination with other pesticides, the labels of the pesticides involved should be read thoroughly.

Captan is formulated and sold as a 50% or 80% dry wettable powder, as an 80% wettable dry granular, as a liquid (4 lb AI/gal), and as dust formulations. Recent formulations may have a 24-hr re-entry: check labels.

On apples, captan controls apple scab, black rot, white rot, Brooks fruit spot, Botryosphaeria rot, bitter rot, and blossom-end rot. In the control of apple scab, captan used at the rate of 1 lb AI/100 gal of spray gives adequate protection when applied on a 6- to 10-day schedule. Shorter intervals should be used if excessive washing of the spray residue or rapid growth of tissue occurs during a critical period for spore discharge. Captan has limited postinfection activity. Captan is not effective for control of rust diseases and powdery mildew. In wet years or orchards where sooty blotch and fly speck are consistent problems, captan should be tank mixed with Topsin M to improve control of these diseases. Captan used alone is relatively weak against fly speck.

Captan may cause spotting, yellowing, and dropping of leaves when used at full strength early in the season on Delicious, Baldwin, and Stayman, especially when used in combination with sulfur. Captan can be combined with sulfur to control mildew on most other varieties. Combining captan with dodine or malathion may increase the injury. Captan should not be used with lime, or be applied to alkaline residues. Captan should not be applied within 7-10 days of an oil application. Tank-mixing captan with foliar nutrients or spray adjuvants that enhance penetration may result in phytotoxicity. Tank-mixing captan with foliar nutrients or spray adjuvants that enhance penetration such as Regulaid may severely damage fruit finish and cause spotting and necrosis of the foliage. The potential for fruit finish and foliar phytoxicity increases when applications made under slow drying conditions (e.g. high relative humidity, light rain, etc.) Given the potential for fruit finish and foliar damage, the use of adjunvants in tank mixes, and the susceptibility of young developing tissues, captan should not be applied from petal fall to 2nd cover.

Captan also controls brown rot on stone fruits and cherry leaf spot. Leaf injury occurs on certain sweet cherry varieties such as Emperor Francis, Schmidt, and Giant. Leaf and fruit injury is likely to occur on soft-fleshed plums if captan is used in several continuous sprays before July. On Stanley prune, a "shot-hole" type of injury to the leaves and roughening of the fruit surface may occur with the use of captan in sprays around bloom and shuck split stages. It has caused leaf injury on some varieties of peaches when sprayed on young developing leaves if the spray is preceded by extended periods of cloudy wet weather.

Captan is also registered for use as a postharvest dip or drench of apples, pears, cherries, and peaches for the control of postharvest rots. If fruit is likely to be exported, review the acceptability and tolerance limits of captan for countries of export destination before postharvest treatments. Check maximum residues allowed at <mrldatabase.com>

Chlorothalonil (Bravo, Echo, Applause, Concorde, Equus) is available in a number of different formulations. Chlorothalonil shows good activity against cherry leaf spot, peach leaf curl, brown rot blossom blight, and black knot. However, some of the generic products are not labeled for all of these diseases. Users should pay strict attention to the timing of applications because improper use of this material (after shuck split on some crops) may result in phytotoxicity and unacceptable residue levels. Chlorothalonil is a broad-spectrum fungicide that not at risk for development of fungicide-resistance in pathogens that it controls.

Cyprodinil (Vangard) is an anilinopyrimidine or AP fungicide registered for the control of apple scab and blossom blight on stone fruits (except for sweet cherries). Because it works best at lower temperatures and does not control fruit scab, Vangard is not recommended for use beyond tight cluster. Vangard can provide 48 to 72 hr of postinfection activity against apple scab on leaves. In efficacy trials conducted in Cornell orchards, Vangard was rarely more effective against scab than mancozeb fungicides except in situations where post-infection activity played a role. However, activity may be reduced in orchards with apple scab that is resistant to the SI fungicide group.

Dicloran (Botran) is formulated as a 75% WP or WSB for use on stone fruit. It is labeled for control of brown rot blossom blight on peaches, nectarines, sweet (but not tart) cherry, plums and prunes. It is labeled for control of brown rot fruit rot and Rhizopus rot on apricots, peaches, nectarines, and sweet cherry. Two applications at 18 and 10 days prior to harvest are permitted for control of fruit rot; Botran has a 10-day preharvest interval (PHI). Botran is not compatible with EC formulations.

Difenoconazole + Cyprodinil (Inspire Super) is labeled for use on for diseases of apples, pear, plums, peaches, and apricots and has provided outstanding control of apples scab, powdery mildew, and flyspeck and sooty blotch in research trials. Given the efficacy considerations mentioned above for Cyprodinil, it is important to note that a considerable portion of this fungicide premix's efficacy likely results from the difenoconazole component. No more than 60 fl oz./A of Inspire Super can be applied in a single season and no more than two consecutive applications of Inspire Super can be made before rotating to a non-frac group 3 or 9 chemistry. The product comes as a premix. In apples there is a 14 day PHI.

Note: Inspire Super is able to control SI resistant apple scab in varieties that have reduced susceptibility apple to apple scab (e.g. develop less scab than 'McIntosh') in seasons with low disease pressure. However, this material should not be used specifically to manage SI resistant apple scab.

Dodine (Syllit) is formulated and sold as a 65% wettable powder and as a flowable containing 3.4 lb dodine per gallon. Due to resistance concerns, we no longer recommend the use of dodine alone for apple scab control both because of uncertainty about the levels of resistance in most orchards and as a resistance management strategy for dodine where the scab population is still dodine-sensitive. Dodine should be applied at no more than 1.5 pt/A and should be combined with either captan (1.5-2 lbs a.i./acre) or a mancozeb fungicide (2.25 lbs a.i./acre). Syllit can provide excellent pre-symptom and antisporulant activity against dodine-sensitive strains of apple scab. However, regular use of dodine for post-infection suppression of scab will generate selection pressure for dodine-resistant scab populations and therefore is not

recommended. Dodine provides excellent control of cherry leaf spot on both sweet and sour cherry, although dodine-resistant cherry leaf spot has been reported in Michigan. Dodine is not effective against brown rot on cherries or against mildew and rust diseases on apples.

Warning: Incoompatibility problems have been reported for tank mixes consisting of Syllit and copper and Syllit with the insecticide Chlorpyrifos.

Fenarimol (Vintage, Rubigan, though no longer sold), a sterol-inhibitor or SI fungicide, is formulated as a 1-lb/gal emulsifiable concentrate. It is especially useful in an apple scab control program because of its long (72-96 hr) kickback activity and prolonged presymptom activity. However, it is important to remember that kickback and presymptom activities are strongly dependent on rate; thus, the longer one waits to spray after the start of an infection period, the higher the necessary rate. It has also been shown that a single post-infection spray of Vintage and Rubigan are more effective if followed by a back-to-back application 7-10 days later. Because the material has limited protectant capabilities against apple scab, especially on fruit, it should always be used in combination with a contact fungicide (e.g., captan, mancozeb). Fenarimol is also very active against cedar apple rust and powdery mildew.

On pears, Vintage and Rubigan are labeled for control of scab, powdery mildew, and rusts. It is more effective against leaf scab infections than it is against fruit scab, so tank-mixing with a protectant fungicide is recommended. Vintage cannot be used on pears until petal fall (potential for effects on fruit shape if used earlier).

Vintage and Rubigan are also registered for control of powdery mildew and leaf spot on cherries, against which it is very effective. However, it has little activity against brown rot.

Warning: Fenarimol is no longer effective against apple scab in many New England orchards because the pathogen has developed resistance to the SI fungicide group. It may also fail to control leaf spot on cherries where that pathogen has become resistant to SI fungicides.

Fenbuconazole (Indar) is a sterol inhibitor fungicide labeled for use on stone fruits and apples. Indar has provided outstanding control of brown rot in university trials and commercial orchards, with good residual activity following the last application. Follow label directions for including a spray adjuvant when using Indar to control brown rot on smooth-skinned stone fruits. Indar is also labeled for control of cherry leaf spot and peach scab, and provides moderate control of powdery mildew on sour cherries. For stone fruit, there is a 0-day PHI with respect to residue tolerance, and a 12-hour restricted-entry interval for worker protection. Indar has most recently been approved for use on apples. It has demonstrated outstanding control on apple scab, and is also labeled for control of powdery mildew, rusts, and flyspeck and sooty blotch.

Warning: Indar may fail to control disease where the pathogen populations have become resistant to SI fungicides.

Fenhexamid (Elevate) is labeled for control of brown rot blossom blight and fruit rot on all stone fruits. University trials in other states have shown that Elevate provides good control of blossom blight but is less effective than SI fungicides for controlling the fruit rot phase of brown rot.

Ferbam (Ferbam Granuflo) is a contact carbamate fungicide in the same chemical family as thiram and ziram, but it is not an EBDC fungicide. It is very effective against rust diseases of apple and moderately effective as a protectant against apple scab. It also is effective against Brooks fruit spot, frog-eye (black rot) leaf spot, sooty blotch, fly speck, pear scab, and pear leaf and fruit spots. It is recommended for use in combination with sulfur for control of brown rot and leaf spot on sour cherries under light to moderate disease pressure conditions. Ferbam also is very effective as a dormant spray on peaches for control of peach leaf curl.

Although ferbam is safe on apple foliage, it may cause enlargement of fruit lenticels in certain seasons and causes severe russeting on Golden Delicious. It is undesirable in late-season sprays because of its unsightly residues.

Ferbam is compatible with most commonly used pesticides. It should not be used with lime.

(§)Fixed Copper is a term that refers to several relatively insoluble forms of copper that are safer for fruit crops than basic copper sulfate and more convenient to use than Bordeaux mixture. The fixed copper compounds are sold under many trade names but fall into 4 basic types: copper oxychloride and copper sulfate (e.g., C-O-C-S WDG); copper hydroxide (e.g., Kocide 3000, Kocide 2000, Champ Formula 2); complexed forms of basic copper sulfate (e.g., Cuprofix Ultra Disperss). Dust preparations (e.g., C-O-C-S Copodust) are also available. All copper fungicides work by releasing free copper ions, so activity (and potential phytotoxicity) is usually related to the amount of actual metallic copper that is applied to the crop. Copper compounds acceptable for organic production have changed regularly in recent years, be sure to check with your certifying agency before applying copper materials in organic orchards.

Fludioxonil (Scholar) is a non-systemic fungicide registered for postharvest uses on stone fruits and pome fruits. Scholar is the only fruit fungicide in the new phenylypyrrole class of chemistry and it therefore is effective against fungi that have developed resistance to benzimidazole and other fungicide groups. Scholar

applied after harvest is effective against brown rot (Monilinia species), Botrytis cinerea, Rhizopus stolonifer, and Gilbertella persicaria, and Penicillium species. Scholar can be applied as a dip or drench, as line spray, or mixed in fruit waxes. For fruit destined for export, check with importers to be certain that the importing country has an established tolerance (MRL) for fludioxonil before treating fruit (see mrldatabase.com).

Fluopyram + Trifloxystrobin (Luna Sensation) is labeled for apples and cherries to control several diseases including apple scab, powdery mildew, cherry leaf spot, brown rot blossom blight and fruit rot and various post-harvest rots. It is premixed and contains a succinate dehydrogenase inhibitor (SDHI) (Group 7) plus a strobilurin (Group 11) fungicide. It has both preventative, systemic, and curative properties. Even though Luna Sensation is a premix of two fungicide modes of action, both are at risk of fungicide resistance development. To limit resistance development, make no more than two seqential applications of Fontelis, tank mix with an EBDC or captan, and rotate with other non-SDHI and other non-strobilurin fungicides. Do not apply where spray drift may reach Concord grapes as spray injury may occur.

Fluopyram + Pyrimethanil (Luna Tranquility) is a fungicide labeled for apples to control scab and powdery mildew. It is premixed and contains a succinate dehydrogenase inhibitor (SDHI) (Group 7) and an anilinopyrimidines (Group 9). It can be used where strobilurin resistant scab is suspected. However, the Even though Luna Tranquility is a premix of two fungicide modes of action, both are at risk of fungicide resistance development. To limit resistance development, make no more than two seqential applications of Fontelis, tank mix with an EBDC or captan, and rotate with other non-SDHI and other non-strobilurin fungicides. Also it has a 72 day pre-harvest interval.

Flutriafol (Topguard) is a member of the triazole group of sterol inhibitor fungicides. It is exceptionally effective against powdery mildew, cedar apple rust, and scab on apples. Fruit scab control is usually improved by tank-mixing with a contact fungicide (captan, mancozeb).

Warning: In the western United States, there have been some reports of foliar phytotoxicity when Topguard has been applied with that enhance penetration such as Regulaid. Moreover, Topguard may not effective against apple scab in many New England orchards where the pathogen has developed resistance to the SI fungicide group. The inclusion of a contact fungicide (captan, mancozeb) will help this fungicide over come an apple scab population with practical resistance to SI fungicides. Against a powerdery midew susceptible cultivar (e.g. 'Jonagold'), this fungicide would perform well. Topguard also may fail to control other diseases where the pathogen populations have become resistant to SI fungicides.

Fluxapyroxad + Pyraclostrobin (Merivon) is premixed combination of two fungicides, a succinate dehydrogenase inhibitor (SDHI; Group 7) and a strobilurin (QoI; Group 11) . Merivon is registered on apple, pear, sweet and tart cherry, peach, nectarine, apricot, plum, and prune. Merivon has activity against apple scab and powdery mildew on apple and cherry leaf spot, American brown rot, and powdery mildew of sweet and tart cherry. Even though Merivon is a premix of two fungicide modes of action, both are at risk of fungicide resistance development. To limit resistance development, make no more than two seqential applications of Fontelis, tank mix with an EBDC or captan, and rotate with other non-SDHI and other non-strobilurin fungicides.

Fosetyl-Al (Aliette) is registered for control of Phytophthora collar rot on bearing and non-bearing apples and for control of the bacterial disease, blister spot, on bearing apples. It is also labeled for control of fire blight but this use is not recommended. Aliette should not be tank mixed with copper compounds. If applied prior to or after the application of copper, the pH of Aliette should be raised to 6.0 or above with an alkaline buffer such as Potassium Carbonate (3 lbs of Potassium Carbonate to 5 lbs of Aliette WDG) or DiAmmonium Phosphate (1:1 ratio). Mixing of Aliette WDG with surfactants, foliar fertilizers or adjuvants that enhance pesticide penetration may cause phytotoxicity.

Iprodione (Rovral, Iprodione, Meteor) is highly effective for control of brown rot blossom blight on stone fruits (Group 2 fungicide). It is especially effective at inhibiting spore production by the brown rot fungus, and therefore is particularly recommended in wet years conducive to rapid disease buildup. This material has 24- to 48-hr post-infection activity against blossom blight infections. Iprodione cannot be applied after petal fall.

Kresoxim-Methyl (Sovran) is a strobilurin fungicide. Like the other strobilurin fungicides (e.g., Abound, Flint), Sovran is an excellent protectant, and will be most reliable when used in this manner. Sovran has some kickback activity against apple scab, but it is not as effective in this mode as the sterol inhibitors once were. However, Sovran reduces spore production from the lesions that are present when the fungicide is applied. Sovran provides good control of powdery mildew, but it is only moderately effective against cedar apple rust and weak against quince rust. Sovran provides excellent control of sooty blotch and flyspeck. Sovran provides good to very good control of black rot and fair control of bitter rot.

Caution: Sovran causes moderate to severe phytotoxicity (leaf burning) on several sweet cherry

varieties. The most sensitive varieties are: Somerset, Sweetheart, Valera, Van, and Vandalay; these varieties might also be injured by spray drift containing Sovran. Minor to moderate injury occurs on Cavalier, Coral Champagne, Emperor Francis, Royalton, Schmidt, Summit, and Viva; there is less danger of injury due to spray drift on these varieties. Many other sweet and sour cherry varieties (including Bing, Brooks, Cashmere, Gold, Hardy Giant, Hart-land, Hedelfingen, Hudson, Kristin, Lapins, Lambert, Montmorency, Napoleon, Nelson Black Sweet, Rainier, Royal Ann, Sam, Stark Crimson, Stella, Sue, Tehranivee, Tulare, Ulster, Vega, Vic, Viscount, and Windsor) showed no injury when sprayed directly with high labeled rates. The Sovran manufacturer recommends: (i) Do not apply Sovran near or allow drift onto cherries in the highly sensitive group (Somerset, etc.); and (ii) thoroughly rinse spray equipment (tanks, hoses, nozzles) after spraying Sovran and before using this equipment on sensitive cherry varieties.

Warning: Sovran may fail to control disease where the pathogen populations have become resistant to QoI fungicides.

Mancozeb (Dithane, Manzate Max, Penncozeb) is formulated for use on apples and pears as a 4 lb/gal liquid, a 75% active dry flowable and as an 80% active wettable powder. It is a broad spectrum protectant fungicide with good residual properties, providing excellent control of apple and pear scab, rust diseases, summer diseases (sooty blotch, fly speck, and bitter rot), and Fabraea leaf spot. Label changes effective in 1992 allow low-rate uses up to 77 days before harvest, whereas high rate applications are not allowed after bloom.

Mefanoxam (Ridomil Gold) is a systemic fungicide highly specific in its activity against a particular group of fungi. Important tree fruit crop diseases caused by these fungi are limited to root and crown rots caused by species of *Pythium* and *Phytophthora*.

The 4EC formulation of Ridomil Gold is labeled for use on bearing apple and stone fruit trees for the control of Phytophthora root and crown rots (collar rot). Although Ridomil is highly effective for preventing crown rot infections, it is usually ineffective for curing trees that are declining from this disease.

Metconazole (Quash) is a sterol inhibitor fungicide labeled for control of brown rot on apricots, cherries, nectarines, peaches, and plums. It is also labeled for cherry leaf spot, powdery mildew, and peach scab. Orbit has a 14-day PHI and a 12-hour restricted-entry interval for worker protection.

Warning: Quash may fail to control disease where the pathogen populations have become resistant to SI fungicides

Metiram (Polyram) is formulated as an 80% active dry flowable labeled for use on apples but not pears. It is an ethylenebisdithiocarbamate (EBDC) fungicide similar to mancozeb in chemistry and activity. Label changes effective in 1992 impose use limits similar to those for mancozeb.

Myclobutanil (Rally) is a member of the triazole group of sterol inhibitor fungicides. It is very active against powdery mildew, cedar apple rust, and scab on apples. Like the other sterol inhibitors, Rally is particularly active against apple scab in the kickback and presymptom modes. Fruit scab control is usually improved by tank-mixing with a contact fungicide (captan, mancozeb). It is also registered and very effective for control of brown rot blossom blight and powdery mildew on some stone fruits (cherries, peaches, and nectarines), and for control of cherry leaf spot. It is neither registered nor effective for control of fruit brown rot.

Warning: Rally is no longer effective against apple scab in some New England orchards where the pathogen has developed resistance to the SI fungicide group. The inclusion of a contact fungicide (captan, mancozeb) will help this fungicide over come an apple scab population with practical resistance to SI fungicides. Against a powerdery midew susceptible cultivar (e.g. 'Jonagold'), this fungicide would perform well. Rally may fail to control other diseases where the pathogen populations have become resistant to SI fungicides.

Penthiopyrad (Fontelis) is a succinate dehydrogenase inhibitor (SDHI) fungicide (Group 7) labeled for pome and stone fruit to control scab, Botrytis, powdery mildew and brown rot. Fontelis is rainfast within 1 hour of application. To limit the potential for resistance develop- ment, make no more than 2 sequential applications of Fontelis, tank mix with a broad-spectrum protectant such as an EBDC or Captan, and rotate with other non-SDHI fungicides. Fontelis has a 12-hr REI; a 28-day PHI for apple and pear, and a 0-day PHI for stone fruits. There have been reports of phytotoxicity with tank mixes of Fontellis and captan applied from petal fall to 2nd cover. Hence, tank mixes of Fontellis and captan should not be applied during this timeframe (see captan section).

Propiconazole (Tilt, Bumper) is a sterol inhibitor fungicide labeled for control of brown rot on apricots, cherries, nectarines, peaches, and plums. (Do not use on Stanley plums.) It is also labeled for cherry leaf spot. Tilt and Bumper have a 0-day PHI and a 12-hour restricted-entry interval for worker protection.

Warning: Propiconazole may fail to control disease where the pathogen populations have become resistant to SI fungicides.

Pyraclostrobin (Cabrio) is a fungicide that is registered for use on apples. Pyraclostrobin is in the strobilurin fungicide group with activity similar to that of Flint and Sovran. Cabrio controls apple scab and powdery

mildew. It may be applied up to 4 times per season on apples, but may not be applied more than two times in a row without rotating to non-group 11 fungicide.

Warning: Cabrio may fail to control disease where the pathogen populations have become resistant to QoI fungicides.

Pyraclostrobin + Boscalid (Pristine) is a fungicide that is registered for use on both pome fruits and stone fruits. Pyraclostrobin is in the strobilurin fungicide group with activity similar to that of Flint and Sovran whereas boscalid is a carboximide fungicide with good activity against Botrytis diseases and brown rot. Pristine controls a broad range of diseases including brown rot, peach scab, powdery mildew, cherry leaf spot, black rot, white rot, bitter rot, fly speck, sooty blotch, and fruit decays caused by Botrytis and Penicillium. It may be applied up to 5 times per season on stone fruits and 4 times per season on pome fruits. It has a 0-day PHI. Pristine may prove useful for managing SI fungicide resistance in brown rot and cherry leaf spot if used in alternations with SI fungicides. Pristine provides excellent control of summer diseases on apples. Note that the label prohibits rates of less than 14.5 oz/A on pome fruits.

Pyrimethanil (Penbotec, Scala) is a anilinopyrimidine fungicide (same class as Vangard) that is registered as Penbotec for postharvest use on pome fruits and as Scala for control of scab on pome fruits and brown rot blossom blight, scab, and shot hole on all stone fruits except cherries. Penbotec is very effective for controlling postharvest decays caused by *Penicillium expansum* and *Botrytis cinerea*. It can be applied as a dip or drench, as line spray, or mixed in fruit waxes. Scala has activity similar to that of Vangard (cyprodinil): it is most effective under cool conditions and has up to 48 to 72 hr of postinfection activity against apple scab. In trials in the Hudson Valley, it provided scab control similar to mancozeb when used in a protectant timing, but it was superior to mancozeb in a trial where short-term postinfection activity (<72 hr) was crucial. However, activity may be reduced in orchards with apple scab that is resistant to the SI fungicide group.

Quinoxyfen (Quintec) is a fungicide that inhbits signal transduction mechanisms in powdery mildew fungi. It is labeled for grapes, strawberries, hops, and cherries for control of powdery mildew. It provides protectant activity, but no post-infection activity. It does have vapor redistribution and re-adsorption into adjacent plant tissues. Quintec has a 7-day PHI and a 12-hour restricted-entry interval for worker protection.

(§)Sulfur. The most commonly used and acceptable form of sulfur is the wettable form. Wettable sulfurs are finely divided elemental sulfur particles with a wetting agent added so that the sulfur can be mixed with water and remain in suspension while being applied. The wettable sulfurs are most readily available as dry, wettable powder containing 90% sulfur, and as fused bentonite sulfur containing 30% or 81% sulfur, depending on the brand used. Against apple scab, the sulfur products are effective in a protective schedule only.

Dry wettable sulfur is used at a rate of 5 lb AI/100 gal in early-season sprays in a protective program. It can be used through bloom without substantially reducing set. Fruit russeting and reduction in yield may result if it is used under high-temperature conditions such as those that occur during postbloom sprays.

Sulfur is effective against powdery mildew of apple when used at 2 to 3 lb AI/100 gal. It is also somewhat effective against cherry mildew. Sulfur is used on stone fruits to control brown rot, but is not as effective as captan or the newer brown rot fungicides. It is moderately effective against cherry leaf spot, but not effective against Rhizopus rot.

Flowable sulfur products are also available. They have the advantage over wettable sulfur in that they are effective at lower rates and have better retention capabilities.

Check with your local organic certifier to confirm the acceptability of specific materials before using them in organbic orchards.

Tebuconazole (Elite, Adament) is a sterol-inhibitor fungicide that is registered for and provides excellent control of brown rot on cherry, peach, and nectarine, especially when used at the higher label rates. It also provides control of leaf spot and powdery mildew of cherry. It has a 0-day preharvest interval on these crops and a 12-hour reentry interval.

Warning: Elite may fail to control disease where the pathogen populations have become resistant to SI fungicides.

Thiabendazole (Mertect 340-F, Shield-Brite TBZ) is registered as a flowable formulation for control of storage rots of apples and pears. Thiabendazole (TBZ) is active against *Penicillium* and *Botrytis* (blue mold and gray mold), but will not control rots caused by Alternaria and Rhizopus. Dip, drench, or spray the harvested fruit with a suspension of 16 fl oz of the flowable formulation in 100 gal of water. TBZ is compatible with DPA, but not with ethoxyquin. Strains of fungi resistant to TBZ are present in most apple storages and may compromise the performance of this fungicide. Combinations with captan can improve activity against TBZ-resistant strains of *Penicillium*.

Thiophanate-Methyl (Topsin M, Thiophanate-Methyl, T-methyl) is formulated as a 70% or 85% wettable and a 4.5-lb/gal flowable and is registered for control of diseases of stone fruits, apples, and pears. Topsin M is a benzimidazole fungicide in the same chemical group as benomyl and thiabendazole. Many fruit pathogens have developed resistance to benzimidazole fungicides, but

Topsin M is still effective for controlling flyspeck, sooty blotch, black rot, and white rot on apples in New England orchards. Do not tank mix thiophanate-methyl with copper-containing materials or with highly alkaline pesticides such as Bordeaux mixture or lime sulfur. The maximum annual use-rates listed on the labels limit the number of applications can be used to control summer diseases on apples.

Thiram (Thiram Granuflo) is a contact carbamate fungicide in the same chemical family as ferbam and ziram, but it is not an EBDC fungicide. It is a moderately effective fungicide for brown rot, peach leaf curl, and peach scab, but is weaker than captan. Thiram Granuflo is no longer labeled for use on apples. Thiram is sometimes used for its activity as a deer and rabbit repellent.

Triadimefon (Bayleton, Triadimefon) is formulated as a 50% dry flowable. This material is effective against apple (but not cherry) powdery mildew and apple rust diseases. It has little activity against scab or other apple diseases.

Trifloxystrobin (Flint, Gem) is a strobilurin fungicide. Like Sovran, Flint is an excellent protectant and should be used in this manner. Flint provides good control of apple scab and powdery mildew but is only moderately effective against cedar apple rust and is weak against quince rust. Flint also provides excellent control of sooty blotch and flyspeck and good control of black rot bitter rot. Gem is the formulation registered for control of stone fruit diseases such as cherry leaf spot, scab, and mildew on stone fruits. **Warning:** Flint may fail to control disease where the pathogen populations have become resistant to QoI fungicides.

Trifloxystrobin + Tebuconazole (Adament) is a new fungicide that is registered for use on both pome fruits and stone fruits. Trifloxystrobin is in the strobilurin fungicide group and is the same active ingredient in Flint, whereas tebuconazole is a sterol-inhibitor fungicide with good control against brown rot. Adament can control against apple scab, and is also labeled for control of powdery mildew, cedar apple rust, flyspeck and sooty blotch, and white and bitter rot. Adament can also control of brown rot blossom blight and fruit rot in stone fruit and is also labeled for controlling jacket rot, mildew, anthracnose, cherry leaf spot, along with several other diseases on stone fruit. To limit resistance development, Adament or another fungicide from FRAC groups 11 or 3 should not be applied for more than two consecutive applications.

Triflumizole (Procure) is a sterol inhibitor fungicide with activities, strengths, and weaknesses similar to those of Vintage and Rally. Procure provides very good to excellent control of apple scab, powdery mildew and cedar apple rust. It is labeled for control of scab and mildew on pears and for brown rot, mildew, and leaf spot control on sweet and tart cherries.

Warning: Procure is no longer effective against apple scab in many New England orchards because the pathogen has developed resistance to the SI fungicide group. Procure may fail to control other disease where the pathogen populations have become resistant to SI fungicides.

Ziram (Ziram) is a contact carbamate fungicide in the same chemical family as ferbam and thiram, but it is not an EBDC fungicide. It is used most effectively as a summer cover spray for apples, where it provides good control of sooty blotch and fly speck, but only marginal control of rots (black, white, and bitter). It is not as effective against scab as either captan or the EBDC fungicides, but will provide acceptable control of secondary scab under low to moderate pressure. It is compatible with oil. Ziram is also labeled for control of scab and Fabraea leaf spot on pears. It has a 14-day PHI on both crops, and a 48-hour restricted-entry interval.

5.4 Bactericides

(§)Streptomycin (Agrimycin, Firewall, Streptrol, Streptomycin) is a bactericide used for control of blister spot on 'Crispin' apples and fire blight of apples and pears. It is formulated as streptomycin sulfate in a 17% wettable powder form. Streptomycin is commonly used in bloom at the rate of 1/2 lb/100 gal for fire blight control, but can be used at 1/4 lb/100 gal in combination with 1 pt of Regulaid/100 gal dilute spray. It can be applied to pears until 30 days before harvest and to apples until 50 days before harvest. However, summer sprays of streptomycin are NOT recommended, except following a hailstorm.

Tests of streptomycin applied during bloom at a constant amount in different volumes of water indicated that control of fire blight was reduced at concentrations in excess of 6X. Thus, concentration of streptomycin sprays greater than 6X is specifically not recommended.

Resistance to streptomycin is widespread among populations of the blister spot bacterium. Resistance is also widespread among populations of the fire blight bacterium in Pacific Coast and Midwest production districts, and has recently been detected in several NY counties. Indiscriminate use of this material during summer covers or for shoot blight control will hasten the further development of resistance.

Streptomycin use in organic orchards is currently allowed for fire blight management only. This use is scheduled to end in 2014, after which streptomycin will be restricted from use in organic production.

(§)Oxytetracycline (Mycoshield, Fireline, & Tree Tech OTC), another antibiotic, is registered for foliar use on peaches and nectarines to control bacterial spot. It is also resigsterd on peach for microinjection to manage peach

X-disease. It is also registered for control of fire blight on pear, but is not as effective as streptomycin.

Oxytetracycline use in organic orchards is only allowed for management of fire blight in apples and pears. This use is scheduled to end in 2014, after which oxytetracycline will be restricted from use in organic production.

5.5 Other Materials

Apogee (Prohexadione calcium) is a plant growth regulator that reduces shoot growth. It acts by inhibiting the biosynthesis of gibberellin, the plant hormone that regulates cell elongation. Apogee will reduce the severity of fire blight shoot infection if applied 10–14 days in advance of infections. It is not active against blossom blight and does not provide protection against rootstock infection. Apogee does not have direct antibiotic activity against the fire blight bacteria, rather it decreases host susceptibility. For maximum reduction in fire blight susceptibility, Apogee should be applied early in the growing season (when shoots are 1 to 3 inches long) and reapplied 14–21 days later to prevent vigorous shoot growth. Do not tank mix Apogee with calcium sprays because calcium will reduce the effectiveness of Apogee. One pound of ammonium sulfate may be added for each pound of Apogee if the water source for spray applications contains high levels of calcium carbonate (hard water). Use a standard adjuvant/non-ionic surfactant.

§Bloomtime Biological (*Pantoea agglomerans* strain *E325*) is a biopesticide labeled for control of the blossom blight phase of fire blight. Bloomtime Biological is a wettable powder formulation of the bacterium *Pantoea agglomerans* strain *E325*. The bacterium acts by colonizing susceptible blossom tissues and using up available nutrients in an effort to prevent colonization of fire blight bacteria (*Erwinia amylovora*). This competitive inhibition will, in theory, prevent the buildup of *Erwinia amylovora* numbers, and in turn, prevent blossom infections. Bloomtime Biological provides only partial control of fire blight in commercial orchards in New York. When used appropriately, studies conducted in NY indicate that Bloomtime Biological can provide up 50% compared to streptomycin under commercial conditions. Bloomtime Biological should be applied as a preventive and should not be applied after fruit set.

§Hydrogen Dioxide (StorOx, OxiDate) works like hydrogen peroxide and kills fungi and bacteria via surface contact with the organism. OxiDate is labeled for control of diseases in the field whereas StorOx is labeled for use as a surface disinfectant and as an antimicrobial for hydro coolers and water flumes. Hydrogen dioxide does not have residual activity, nor will it control fungi or bacteria that have already penetrated host tissue. Thus, it must be applied after pathogens have been deposited on plant surfaces but before they can initiate infections. Field applications to apples are not recommended because OxiDate can cause severe fruit russetting under certain conditions. Controlled inoculation trials indicate no significant effect of OxiDate on fire blight infection of apple.

Phosphorous Acid (Fosphite, Topaz Fungicide, Agri-Fos, Fungi-Phite) and Phosphites (Phostrol, ProPhyt) can be viewed as generic forms of Aliette and are labeled on tree fruits primarily for control of root and crown rot diseases caused by Phytophthora species. However, some products are also labeled for suppression of fire blight and/or blister spot. Experience in NY suggests they do not provide reliable suppression of fire blight when applied during bloom, but they can be very useful as part of a program for controlling blister spot. Although these products are being tested for controlling other diseases of tree fruits, there is not yet sufficient data to support labels for other diseases. As with Aliette, using these products with or soon after copper fungicides can cause copper phytotoxicity.

§Serenade (*Bacillus subtilis*) is a biofungicide labeled for control of fire blight, apple scab and powdery mildew. Serenade is a wettable powder formulation of the bacterium *Bacillus subtilis*, a common soil resident. The bacterium acts by releasing cell contents during growth in order to eliminate or reduce competitors in its immediate environment. Serenade is relatively ineffective for controlling fungal diseases under the climatic conditions that exist in New England. When used alone, Serenade provides only partial control of fire blight. In alternation with streptomycin, it sometimes provides control approaching that of a full streptomycin program. Serenade should be applied as a preventive and can be applied up to and including the day of harvest.

5.6 Insecticides

The insecticides and acaricides used to control fruit pests can be divided into several categories according to their chemical composition, mode of action, persistence, and other properties. To plan and carry out an effective spray program, it is important to understand these characteristics. A simplified classification of most of the insecticides and acaricides recommended in this bulletin is given, along with some of their general properties and uses.

Notes on Materials

The hazard of a material poisoning honey bees is given as follows: High = hazardous to bees at any time; 1 day to 2 wk residual toxicity. Moderate = not hazardous if applied in either evening or early morning when bees are not foraging, except during periods of high temperature; 3 hr to 1 day residual toxicity. Low = not hazardous to bees at any time; 1 hr to 1 day residual toxicity.

5.6.1 Organophosphates

Most organophosphate insecticides are highly toxic to warm-blooded animals when inhaled, swallowed, or absorbed through the skin. Persons handling or applying these materials should take every precaution for their own safety and for that of others. Although the organophosphates in general are less persistent than the chlorinated hydrocarbons, their toxicity often prohibits their use close to harvest (see following materials). Organophosphates are contact insecticides as well as stomach poisons. Therefore, they are useful for a quick kill of all insect forms present at the time of application, as well as for reasonable residual protection. When used alone or in combination with other materials, some organophosphates cause phytotoxicity on fruit varieties. Check this bulletin under the pest, the crop, and the product for more details about this situation.

Chlorpyrifos Lorsban 4E and Lorsban Advanced formulations are registered for control of San Jose scale during the dormant/delayed dormant period on apples, pears, peaches, cherries and plums. Application during this period will also control rosy apple aphid. This material can be used alone or in combination with oil. It is also registered for use on peaches, nectarines and cherries to control peachtree borers and in apples as a postbloom trunk spray to control a variety of borers. A 75 WG (water dispersible granule) formulation is available for all tree fruits except apricots, and exhibits better efficacy, rainfastness, and fewer phytotoxicity problems than the 4E formulation. This label also lists trunk sprays for many borer species in apple. All three formulations can also be used in tart cherries to control borers, as well as other pests including leafrollers, plant bugs, and scales. The material has a high bee-poisoning hazard. On apples, only one application of any chlorpyrifos containing product can be made per year.

Diazinon has caused russeting or related finish problems on R.I. Greening, Golden Delicious, and Baldwin. No injury has been reported on McIntosh or closely related varieties. Observations on other varieties are limited. The material should not be used in combination with copper. It is principally used prebloom for control of San Jose scale. On apples, post-bloom applications are for San Jose scale and woolly apple aphid. It is generally less persistent than other standard phosphates and has a high bee-poisoning hazard.

Dimethoate is a broad-spectrum systemic material registered on pears that is still effective against certain organophosphate-resistant aphids and leafhoppers. It will also suppress tarnished plant bug when used prebloom and will control apple maggot. It has a high bee-poisoning hazard.

Malathion is a mild phosphate that is used where a high degree of safety to people or animals is desired. It is no longer labeled for apples. It is registered for use on cherry, peach, nectarine and apricot for a variety of pests including aphids, scales, codling moth, oriental fruit moth, plum curculio and Japanese beetle. It has a very short PHI, is compatible with most other insecticides and fungicides and has a high bee-poisoning hazard.

Methidathion (*Supracide) is registered for dormant or delayed dormant use on apples, peaches, plums, apricots, and cherries for the control of San Jose scale and rosy apple aphid. It may be mixed with oil in these sprays. It has a high bee-poisoning hazard.

Phosmet (Imidan) is a broad-spectrum material with a lower toxicity to mammals than many other commonly used organophosphates. It is compatible with most commonly used insecticides and fungicides, but is incompatible with alkaline materials such as Bordeaux mixture and lime. It may cause severe leaf injury to sweet cherries, particularly those of Emperor Francis parentage. It can be used in summer sprays in integrated mite-control programs because of its low toxicity to predator mites. In some seasons in which rainfall has been negligible during the late summer, the fruit occasionally shows a buildup of the carrier used in the wettable powder. Imidan is effective in controlling codling moth, apple maggot, redbanded leafroller, plum curculio, peach twig borer, and oriental fruit moth on apple, pear, peach, apricot, nectarine, and plums to be used for prunes. It has been ineffective against phosphate-resistant populations of pear psylla. It has a high bee-poisoning hazard.

5.6.2 Carbamates

Carbamates are presently represented by 3 insecticides widely used on fruit trees.

Carbaryl (Sevin) applications made within 30 days after petal fall have a pronounced thinning effect on most apple varieties. Sevin does not thin pears. It is a broad-spectrum material that acts as a stomach as well as contact poison and controls various fruit insects, including organophosphate-resistant pests such as white apple leafhopper. It is one of the low-hazard insecticides and can be used until 1 day before harvest on most fruit crops, as well as in home orchards. Sevin is very toxic to bees and, therefore, should not be used just before bloom; it is also toxic to certain predator mite species.

Methomyl (*Lannate) spray injury to foliage and fruit resulting in fruit drop has been observed on Early McIntosh-type varieties. This material is highly toxic to predator mites and, when used in a seasonal program, has promoted the buildup of woolly apple aphid. It has been registered for controlling organophosphate-resistant apple aphid, rosy apple aphid, leafrollers, tufted apple bud moth, lesser appleworm, white apple leafhopper, and tentiform leafminer, as well as codling

moth. Although methomyl has broad-spectrum activity, its short residual activity (5-7 days) makes it less effective against fruit feeders (such as plum curculio, apple maggot, or codling moth) than are organophosphate materials. *Lannate has a 96 hour reentry period for peaches, 72 hours for apples, and 48hours for pears. It has a high bee-poisoning hazard.

Oxamyl (*Vydate) is a combination insecticide, nematicide, and acaricide with systemic properties, which translocates throughout the leaves and into the roots of fruit trees. It is formulated as a methanol-based liquid for foliar or drench treatment of newly planted trees, primarily for nematode control. It is recommended on bearing apple trees as a foliar spray for control of spotted tentiform leafminer, aphids, leafhoppers, and mites. It is a mite suppressant requiring back-to-back applications for effective control. When applied between petal fall and 30 days thereafter, thinning may occur. *Vydate is not a broad-spectrum insecticide, but is hard on mite predators. It has a moderate bee-poisoning hazard.

5.6.3 Pyrethroids

This group of insecticides has broad-spectrum activity and considerable efficacy at low dosage. These compounds are similar in terms of biological activity, residual effectiveness, toxicity, and effects on nontarget organisms. In addition to being directly toxic to insects, pyrethroids are also repellent. They are generally very persistent, and some are reportedly more effective at cooler temperatures. Although mammalian toxicity of most pyrethroids is relatively low, direct exposure can cause allergic reactions such as skin irritations and difficulty in breathing. Fish are highly sensitive to pyrethroid insecticides. Therefore, drift or runoff to bodies of water should be avoided when spraying. Pyrethroids can have undesirable effects on nontarget organisms in the orchard. Most pyrethroids, when used postbloom, have a temporary suppressive effect on spider mites, but populations often recover quickly, resulting in outbreaks. Predator mites are very sensitive to pyrethroid insecticides and are repelled for many weeks by the residue. Postbloom use of these compounds on apple or pear can also result in outbreaks of the woolly apple aphid on apple and Comstock mealybug on apple or pear. Currently, Cornell does not recommend multiple applications of pyrethroids in regular cover-spray programs on any fruit crop because of secondary pest problems and the increased likelihood of resistance development. However, pyrethroids are valuable for the control of special pest problems on fruit that are difficult to control with organophosphate or carbamate insecticides. To extend the field life of these compounds and delay development of resistance, they should not be applied more than once or twice/season in an orchard.

*Bifenthrin (*Bifenture, *Brigade, *Fanfare) is labeled for use on pears. This is a relatively established pyrethroid in other crops, and was one of the first that demonstrated mite control in addition to the efficacy profile common to other members of this family. Besides European and twospotted spider mites, the label also includes aphids, codling moth, green fruitworm and leafrollers, leafhoppers, plant and stink bugs, and plum curculio. Pear psylla is not on the label. This material has a high bee poisoning hazard.

Cyfluthrin (*Baythroid) is registered for use on all pome and stone fruits in New England. This synthetic pyrethroid has activity on a broad range of the major insect pest species in tree fruit crops, including leafhoppers, internal Lepidoptera, leafrollers, plum curculio, apple maggot, sawflies, true bugs, San Jose scale crawlers, American plum borer, black cherry aphid, and cherry fruit fly. It has a high bee poisoning hazard.

Esfenvalerate (*Asana XL). *Asana XL is a purified ester of fenvalerate with generally better activity, which is reflected in its low labeled usage rates. *Asana XL is registered for control of apple, pear, and stone fruit pests. It is particularly useful for prebloom insect control on apple and against pear psylla; however, tolerance or resistance to fenvalerate has been documented in some New York pear psylla populations. It has a high bee-poisoning hazard.

Fenpropathrin (*Danitol) is labeled for control of insect pests of pome and stone fruits, including leafminers, leafhoppers, leafrollers, tarnished plant bug, aphids, stink bugs, plum curculio, internal leps, and apple maggot, with activity also against European red mite. It has a high bee poisoning hazard.

Gamma-Cyhalothrin (*Proaxis) is identical to lambda-cyhalothrin, below, in that they both contain the same a.i., but, whereas *Warrior is a mixture of both the active and inactive isomer, *Proaxis contains only the active ("resolved") isomer. It is formulated as a 0.5 lb a.i. /gal capsule suspension, but because 1 gal of *Warrior contains the same amount of active isomer as 1 gal of *Proaxis, the labeled uses, rates, and restrictions of the two products are identical. It has a high bee-poisoning hazard.

Lambda-Cyhalothrin (*Lambda-Cy, *Taiga Z, *Voliam Xpress, *Warrior) is labeled for control of insect pests of all tree fruits, including leafrollers, codling moth, oriental fruit moth, lesser appleworm, green fruitworm, leafminers, apple maggot, cherry fruit flies, plum curculio, plant bugs, leafhoppers, aphids, pear psylla, peachtree borers, American plum borer, Japanese beetle and San Jose scale. It has a high bee poisoning hazard.

Permethrin (*Ambush, *Perm-Up, *Pounce) is labeled for control of insect pests of cherries, pears, and peaches. On apples, use is restricted to prebloom and petal fall

applications. Its recommended use is similar to that of esfenvalerate. It has a high bee-poisoning hazard.

5.6.4 Neonicotinoids

Neonicotinoid insecticides are chemically related to nicotine. The neonicotinoids show reduced toxicity compared with earlier classes of broad-spectrum materials such as organophosphates and carbamates. Most neonicotinoids show much lower toxicity in mammals than insects, but some breakdown products are toxic to some non-target species, including beneficial insects. Neonicotinoids are currently represented by four single-a.i. products widely used on tree fruits in New England, plus as components of several pre-mix formulations containing more than one active ingredient (refer to section 5.6.5).

Acetamiprid (Assail) belongs to the neonicotinoid group of insecticides (along with Provado and Actara). It was registered by the US EPA under the reduced risk pesticide policy and is considered a replacement for older OP insecticides. Assail has a spectrum of effectiveness across several insect groups, and is active against pests such as plum curculio, apple maggot, internal leps, aphids, leafhoppers, leafminers, San Jose scale, European apple sawfly and mullein plant bug, plus pear pests such as pear psylla and Comstock mealybug. It has low toxicity to honey bees and most beneficial insects, although some flaring of mites has been reported by researchers.

Clothianidin (Belay) is labeled for post bloom applications on pome fruits and peaches, but no other stone fruit crops. These uses are currently on a supplemental label which must be in the possession of the user at the time of application. Belay is effective on tarnished plant bug and stink bugs, including the brown marmorated stink bug. This product is toxic to bees exposed to treatment and for more than 5 days following treatment. Do not apply this product to blooming, pollen-shedding or nectar-producing parts of plants if bees may forage on the plants during this time period.

Dinotefuran (Scorpion) is labeled for control of aphids, leafhoppers, peach tree borer, plum curculio, and stink bugs on peaches and nectarines. The rate applied affects the length of control. Use the higher rate where infestations occur later in crop development. Scorpion may be mixed and/or alternated with commonly used insecticides for resistance management.

Imidacloprid (Admire Pro, *Leverage 360) is a broad spectrum contact and locally systemic chloronicotinyl insecticide with low mammalian toxicity. It is primarily effective against aphids, whiteflies, thrips, scales (crawlers), pyslla, leafhoppers, mealybugs, some beetle and weevil species, and leafminers. The original Provado formulation has been replaced by AdmirePro, which is labeled on pome and stone fruits for aphids (except woolly apple aphid), leafminers, leafhoppers, San Jose scale, pear psylla, mealybug, Japanese beetle, cherry fruit flies and San Jose scale. It has also shown activity against pear midge when applied at petal fall. It is additionally labeled for use as a soil-applied product against woolly apple aphid. This material has no effect on any mites, beneficial or phytophagous, but is hard on Stethorus. High bee-poisoning hazard, exhibiting toxicity on contact plus repellency and hive disorientation.

Compatibility note: may be mixed with other pesticides, although a preliminary test of compatibility with candidate materials is recommended. When preparing tank mixtures, add wettable powders first, then AdmirePro and other flowables, and emulsifiable concentrates last.

Thiacloprid (Calypso) is a neo-nicotinoid registered for use on apple, pear and quince, exhibiting both systemic activity and crop safety. Its mode of action is through interference with the nicotinergic acetylchloline receptor, and it controls pests by both contact and stomach activities. Calypso has activity on apples against aphids (except woolly apple aphid), leafminers, leafhoppers, mirid bugs, codling moth, oriental fruit moth, plum curculio, apple maggot, and European apple sawfly. It will also suppress scale insects (crawler stage). On pears, it is active against pear psylla, aphids, codling moth, mealybugs, leafminers, and the pear midge. It will also suppress scale insects on pears. Calypso has a low acute toxicity to warm-blooded animals and a low bee poisoning hazard; however, it is highly toxic to marine/estuarine invertebrates.

Thiamethoxam (Actara) is a broad-spectrum neonicotinoid material labeled for use in pome and stone fruits against a number of chewing and sucking pests. It moves rapidly into plant mesophyll tissues, where it is locally systemic and protected from rapid degradation. It shows activity against plum curculio, aphids, European apple sawfly, leafminers, leafhoppers, mealybugs, cherry fruit fly, stink bugs, plant bugs, thrips, and pear psylla. Although it has little effect on predatory mites or beneficial insects, it is toxic to fish and aquatic invertebrates, and highly toxic to bees exposed to direct treatment, although relatively non-toxic when dried. It is therefore categorized as having a moderate bee poisoning hazard. When making multiple applications to pome and stone fruits, do not exceed a total of 0.172 lbs a.i. of thiamethoxam-containing products per acre per growing season.

5.6.5 Pre-Mixes

Pre-mix products are formulations of insecticides sold as pre-mixed combinations of at least two active ingredients that are available as single-a.i. products. For best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the

combination of active ingredients and modes of action contained in the product.

Chlorantraniliprole/Lambda-Cyhalothrin (*Voliam Xpress) is labeled against a wide range of pests of pome fruit and stone fruit. It is a combined formulation of chlorantraniliprole, the a.i. found in Altacor, plus the pryrethroid lambda-cyhalothrin, the a.i. in *Warrior. The pome fruit label includes internal worms and leafrollers, aphids (excluding woolly apple aphid), apple maggot and cherry fruit fly adults, leafhoppers, leafminers, plum curculio, Japanese beetle, pear psylla, plant bugs, stink bugs, and other caterpillars. The stone fruit label also includes peachtree and American plum borers. It has a high bee poisoning hazard.

Chlorantraniliprole/Thiamethoxam (Voliam Flexi) is registered for use against a range of pests in pome and stone fruits. This product is a mixture of thiamethoxam, the a.i. of Actara, and chlorantraniliprole, the a.i. found in Altacor and *Voliam Xpress. The label lists lepidopteran pests such as codling moth and oriental fruit moth, obliquebanded leafroller, leafminers and green fruitworm; plum curculio; European apple sawfly; leafhoppers and aphids (except woolly apple aphid); pear psylla; plus (in stone fruits only) cherry fruit fly, stink bugs, tarnished plant bug and thrips. It has a 12-hr REI, and a PHI of 35 days in pome fruits, 14 days in stone fruits. No more than a total of 14 oz/acre of formulated product may be applied per season; this use corresponds to the 0.172 lb a.i./acre of thiamethoxam allowed, whether applied as Voliam Flexi, Actara, or *Endigo. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds; it may not be applied between early pink and petal fall in apples, between green cluster and petal fall in pears, and between swollen bud and petal fall in stone fruit.

*Beta-Cyfluthrin/Imidacloprid (*Leverage 360) is labeled against a wide range of pests of pome fruit and stone fruit. It is a combined formulation of imidacloprid, the a.i. found in Admire Pro, plus the pyrethroid beta-cyfluthrin. The pome fruit label includes internal worms and leafrollers, aphids (except woolly apple aphid), apple maggot (combined with a sticker), sawfly, plum curculio, San Jose scale crawlers, and plant bugs; the stone fruit label adds Japanese beetle, American plum borer, and cherry fruit fly, among others. This product may not be applied prebloom. It has a high bee poisoning hazard.

Flubendiamide + Buprofezin (Tourismo) is labeled for use in stone fruits and pome fruits against many Lepidoptera, including leafrollers, codling moth, oriental fruit moth, lesser appleworm, fruitworms and leafminers. The flubendiamide is in the same class of ryanodine receptor modulators (IRAC Group 28) as chlorantraniliprole, found in Altacor and *Voliam Xpress. Buporfezin is the same ai as Centaur. It is an insect growth regulator for the control of the nymphal stages of San Jose scale, mealybugs, leafhoppers and pear psylla. It works by inhibiting chitin biosynthesis, suppressing oviposition by adults, and reducing viability of eggs. Treated susceptible pests may remain alive on the plant for 3-7 days, but feeding damage during this time is typically very low. It is not disruptive to beneficial insects and mites, and has a low bee-poisoning hazard.

Lambda-Cyhalothrin/Thiamethoxam (*Endigo) is registered in pome fruits and stone fruits against a range of pests. This is a pre-mix, combining lambda-cyhalothrin, the a.i. in *Warrior, with thiamethoxam, the a.i. in Actara. The pome fruit label includes leafhoppers, leafminers, stink bugs, plant bugs, Japanese beetle, internal worms, apple maggot and sawflies. The stone fruit label includes aphids, stink bugs, plant bugs, Japanese beetle, and borer species. Because of pollinator restrictions, do not apply in apples/pears during pink bud/green cluster through bloom, or in stone fruits from swollen bud through bloom. Do not apply more than 28 fl oz/A per season; PHI is 35 days in pome fruits, 14 days in stone fruits; REI = 24 hr. It has a high bee poisoning hazard.

Thiamethoxam/Abamectin (*Agri-Flex) is registered for use against a range of pests in apples and pears. This product is a mixture of thiamethoxam, the a.i. of Actara, and abamectin, the a.i. found in *Agri-Mek. In apples, its label lists plum curculio, European apple sawfly, green aphids, mealybugs, leafminers and leafhoppers, pear psylla (in pears), and mites. The label states that it must be mixed with a nonionic adjuvant or horticultural spray oil (not a dormant oil). It has a 12-hour REI, and a PHI of 35 days. This is a restricted-use product, and no more than a total of 17 fl oz/acre of formulated product may be applied per season; this use corresponds to the total amount of 0.258 lb a.i./acre of thiamethoxam allowed, whether applied as *Agri-Flex, Voliam Flexi, Actara, or *Endigo. Do not make more than 2 applications per season. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds; it may not be applied between early pink and petal fall in apples, or between green cluster and petal fall in pears.

5.6.6 Other Materials

*Abamectin (*Agri-Mek) is a natural fermentation product containing a macrocyclic glycoside, used on pome and stone fruits as an acaricide/insecticide. When used as currently recommended, it controls European red mite and pear psylla, and aids in the control of spotted tentiform leafminer. Abamectin is toxic to bees and predator mites on contact, but the foliar residue dissipates quickly, making it essentially non-toxic to these species after a few hours (low bee-poisoning hazard).

(§)Azadirachtin (Aza-Direct, Neemix 4.5, Azatin XL) is derived from the seeds of the neem tree, *Azadirachta indica*, which is widely distributed throughout Asia and Africa. Azadirachtin has been shown to have repellent, antifeedent, or growth regulating insecticidal activity against a large number of insect species and some mites. It has also been reported to act as a repellent to nematodes. Neem extracts have also been used in medicines, soap, toothpaste and cosmetics. It shows some activity against leafminers, leafhoppers, mealybugs, aphids, caterpillars, tarnished plant bug and pear psylla, but repeated applications at short intervals are probably necessary for acceptable control of most pests. Azadirachtin is relatively short-lived and mammalian toxicity is low (rat oral LD50 >10,000). It can be used up to and including the day of harvest and reentry is permitted without protective clothing after the spray has dried. It is relatively nontoxic to beneficials, but toxic to fish, aquatic invertebrates, and bees exposed to direct treatment, although relatively non-toxic when dried. It is therefore categorized as having a moderate bee poisoning hazard. Check with your organic certifying agency to confirm the acceptability opf specific azadirachtin compound for organic production before use.

§Bacillus thuringiensis (Bt, Dipel, Deliver, Biobit, Javelin, Agree) is a microbial insecticide specifically for the control of caterpillars. It contains spores and crystalline endotoxin that must be ingested by larvae with high gut pH to provide control. It is effective against many fruit pests, including leafrollers and fruitworms. Although this material will control codling moth and other internal lepidopteran apple pests, it does not provide as effective control as do most conventional insecticides. One exception is the obliquebanded leafroller, which has become so difficult to control with conventional toxicants that the Bt products work at least as well as any material available. This material is exempt from requirements for a tolerance on all raw agricultural commodities, thus it can be sprayed up until harvest. It is harmless to humans, animals, and beneficial insects, including the honey bee.

Buprofezin (Centaur) is an insect growth regulator registered in pome and stone fruits for the control of the nymphal stages of San Jose scale, mealybugs, leafhoppers and pear psylla. It works by inhibiting chitin biosynthesis, suppressing oviposition by adults, and reducing viability of eggs. Treated susceptible pests may remain alive on the plant for 3-7 days, but feeding damage during this time is typically very low. It is not disruptive to beneficial insects and mites, and has a low bee-poisoning hazard.

Chlorantraniliprole (Rynaxypyr) (Altacor) belongs to a new chemical class, the anthranilic diamides, which activate the insect's ryanodine receptors, stimulating release of calcium from muscle tissues, and causing paralysis and death. Altacor is labeled for the control of a range of insect pests in pome and stone fruits, including codling moth, oriental fruit moth, and obliquebanded leafroller. Other species listed on the label include green fruitworm, spotted tentiform leafminer, apple sawfly, European corn borer, and suppression of apple maggot, cherry fruit fly, white apple leafhopper, and plum curculio. It has low toxicity to bees, beneficial mites, birds, fish and mammals.

§Codling Moth Granulosis Virus (Carpovirusine, Cyd-X) These products contain an insecticidal baculovirus, *Cydia pomonella* granulovirus, which is specific to the larval form of the codling moth, and is registered for use in apples, pears, and (Cyd-X only) plums. This biological insecticide must be ingested in order to be effective, after which the viral occlusion bodies dissolve in the larval midgut and release infectious virions. These enter the cells lining the digestive tract, where they replicate; eventually, the other tissues are infected and the larva stops feeding and eventually (within 3–7 days) dies. After death, the larva disintegrates, releasing billions of new occlusion bodies, which may infect other codling moth larvae upon ingestion. No adverse effect to fish, wildlife or beneficial organisms has been observed; it has a low bee-poisoning hazard.

*Emamectin benzoate (*Proclaim) is registered for use on pome fruits. This restricted-use material is a soluble granule formulation of emamectin benzoate, which is a second-generation avermectin insecticide related to *Agri-Mek. The primary target pests are leafrollers, leafminers, and fruitworms; however, the label also lists suppression of codling moth, oriental fruit moth, lesser appleworm, pear psylla, and spider mites (European red mite and twospotted spider mite). In 2007, it was granted a 2(ee) registration for the control of 1st generation (only) codling moth in apples. *Proclaim is translaminar, being absorbed quickly into the leaf tissue, and forming a reservoir of a.i. against plant-feeding pests. Although it is most effective when ingested, limited contact activity does exist for a short period after application. Addition of a penetrating adjuvant such as horticultural mineral oil or a nonionic surfactant is recommended. It has a high bee poisoning hazard.

*Endosulfan (*Thionex) is a long-residual period chlorinated hydrocarbon registered for use on peaches, pears, apples, plums, cherries, and other fruit crops. Used as a preplant as well as seasonal treatment on stone fruits for control of peachtree borers, it is also effective against aphids, white apple leafhopper, adult leafminers, green fruitworms, cutworms, and, in some areas, tarnished plant bug. This material is useful in integrated mite control programs because of its low toxicity to predator mites. It is highly toxic to fish and should not be used near any body of water. Because of its long residual effectiveness, the days-to-harvest intervals are longer and the number of applications/ season more restricted

than for other materials. No phytotoxic or fruit finish problems have been observed with either the EC or WP formulations. *Thionex has a moderate bee-poisoning hazard.

[Note: **EPA has mandated a stop-use date of July 31, 2013 for endosulfan in pears**.]

Flonicamid (Beleaf) is labeled against aphids and plant bugs for pome fruit and stone fruit; the label classifies it as a member of the pyridinecarboxamide family, an IRAC Section 9C material, which is defined as "Unknown or non-specific mode of action – selective feeding blockers". Researchers have reported good efficacy against green peach aphid and tarnished plant bug in peaches. The label also lists apple aphid, black cherry aphid, rosy apple aphid, spirea aphid and woolly apple aphid. It has a low bee poisoning hazard.

Flubendiamide (Belt) is labeled for use in stone fruits and pome fruits against many Lepidoptera, including leafrollers, codling moth, oriental fruit moth, lesser appleworm, fruitworms and leafminers. The a.i. is in the same class of ryanodine receptor modulators (IRAC Group 28) as chlorantraniliprole, found in Altacor and *Voliam Xpress. PHI is 14 days in pome fruits and 7 days in stone fruits; REI = 12 hr. It has a low bee poisoning hazard. Refer to the label for additional aerial and buffer zone restrictions.

Indoxacarb (Avaunt) is a broad-spectrum oxadiazine labeled in apples and pears against plum curculio, apple maggot, and European apple sawfly, with some activity also on Lepidoptera such as codling moth, oriental fruit moth and leafminers, as well as leafhoppers. The active ingredient is activated by the insect to an insecticidal form only upon ingestion or absorption through the cuticle, after which it causes paralysis by interference with the sodium flow into nerve cells. It has generally slight to no effects on beneficial insects and mites, but is highly toxic to bees exposed to direct treatment and relatively non-toxic when dried. It is therefore categorized as having a moderate bee poisoning hazard.

§Insecticidal soaps (M-Pede) are concentrates made from biodegradable fatty acids and are contact insecticides that can be effective against such soft-bodied arthropods as aphids, mealybugs, and psyllids. They can provide suppression of pear psylla when used in a seasonal spray program, but the residual period is short, and uniform drying conditions are required to prevent droplet residues on the fruit surface. They have a low bee-poisoning hazard.

§Kaolin (Surround) is a naturally occurring clay mineral that has many uses as a direct and indirect food additive, in food contact items, cosmetics and toiletries, and as an inert ingredient in many pesticide formulations. When applied, the 95WP crop protectant forms a white, mineral-based particle film intended to reduce the damage to plants caused by certain arthropod and disease pests, as well as environmental stress caused by solar effects. In research trials in apples, it has shown some preventive efficacy against plum curculio, internal Lepidoptera such as codling moth and oriental fruit moth, leafrollers, phytophagous mites, leafhoppers, and apple maggot. In pears, it can additionally suppress pear psylla, and in stone fruits it reduces feeding damage from Japanese beetle. Frequent applications (7–10-day intervals) and maximal coverage are advised in New England while there is active foliar growth. Surround has a low bee poisoning hazard.

Methoxyfenozide (Intrepid) is the more-active successor to Confirm (tebufenozide); it imitates the natural insect molting hormone, and works by initiating the molting process within a few hours of ingestion. The premature molt makes it impossible for the larva to complete the shedding of the original exoskeleton. The larva is trapped within the old cuticle and death occurs, usually within 2–5 days, due to starvation and dehydration. Intrepid is labeled for use in apples and pears, principally against obliquebanded leafroller, although activity against oriental fruit moth, codling moth and lesser appleworm is also exhibited. Intrepid is essentially safe to birds, fish, and most beneficials; however, it is toxic to aquatic invertebrates. It has a low bee-poisoning hazard.

Novaluron (Rimon) is an insect growth regulator for the control of a range of apple pests including codling moth, oriental fruit moth, obliquebanded leafroller, spotted tentiform leafminer, and redbanded leafroller. This product is an insect growth regulator that disrupts chitin synthesis in immature insects and eggs deposited on residues; it has no effect on adult stages, and must be ingested to be effective. Four applications per season are allowed. Novaluron is moderately to highly toxic to many beneficial arthropods, but relatively non-toxic to predatory mites. It has a moderate bee poisoning hazard.

(§)Pheromones for mating disruption Synthetic pheromones are available for disrupting the chemical communication of certain insect pests, thereby preventing them from mating and producing larvae that injure the crop. Pest-specific pheromones are released from dispensers or microcapsules placed or sprayed in the orchard before the initiation of flight, and can reduce or in some cases eliminate the need for supplementary insecticidal sprays. This approach works best in large (5-10A or more), rectangular plantings, where the pheromone concentration in the air is more uniform and can be maintained at a high level. Border insecticide sprays may be needed in orchards adjacent to sources of adult immigration or in other high pressure situations.

(§)Pyrethrin or Pyrethrum (PyGanic, Pyrenone) is produced in the flowers of *Chrysanthemum*

cinerariaefolium and is the forerunner of the synthetic pyrethroid insecticides. It is available as an emulsifiable concentrate, (PyGanic), or synergized by piperonyl butoxide (Pyrenone). Pyrethrin is labeled against a large number of pests. It may be moderately to highly effective against leafhoppers, aphids, pear psylla, apple maggot, codling moth, true bugs, caterpillars, mealybugs, plum curculio, and thrips. It is quickly broken down in the environment and may be used up to and including the day of harvest. Pyrethrin is relatively non-toxic to humans and other mammals, although the dust produces allergy attacks in people who are allergic to ragweed pollen. The acute oral LD50 is 1200 to 1500 mg/kg. It is toxic to fish, and has a low bee-poisoning hazard.

Pyriproxyfen (Esteem), which is registered for use in all pome and stone fruits, is a juvenile hormone analog (a type of insect growth regulator) that interferes with the insect's normal metamorphosis and kills by retarding its growth and causing sterility; ovicidal activity is also exhibited. It shows translaminar properties, so applications on the top surface of the leaf will affect insects on the bottom surface. While it has no activity on adult insects, hatching of eggs laid by treated adults will be suppressed. Although leafrollers and codling moth appear on the label, results from preliminary field trials in the region suggest that it has greatest efficacy on San Jose scale, pear psylla, leafminers and aphids. It has low toxicity or is non-toxic to most beneficial species, and has a low bee poisoning hazard.

Rynaxypyr (see Chlorantraniliprole)

Spinetoram (Delegate) is a new spinosyn insecticide related to spinosad (below), but which has been chemically modified to be more active and effective against a broader range of insects. It has efficacy against internal feeding Lepidoptera such as codling moth and oriental fruit moth, plus leafrollers and leafminers. It is also labeled for control of pear psylla, thrips, and cherry fruit fly, and shows suppression of apple maggot and plum curculio. Like spinosad, it acts by disrupting insect nerve function. It is nontoxic to birds, fish, aquatic invertebrates, and most beneficial arthropods. It has a low bee-poisoning hazard.

(§)Spinosad (Entrust) is a mixture of spinosyn A and spinosyn D molecules, a naturally derived group of toxicants from a species of Actinomycete bacteria. Spinosad, which acts as both a contact and a stomach poison, is available for use in apples, pears and stone fruits, primarily against obliquebanded leafroller, although activity against spotted tentiform leafminer is also exhibited. Spinosad is essentially nontoxic to birds, fish, aquatic invertebrates, and most beneficials. It has a low bee-poisoning hazard.

Spirotetramat (Movento) is a tetramic acid registered for the control of a number of indirect pests in pome fruits and stone fruits, primarily aphids (including woolly apple aphid), mealybugs, pear psylla, and San Jose scale. It has systemic activity, exhibiting 2-way movement in the plant, both upwards in the xylem to new shoots and leaves, and downwards in the phloem to the root tissues. Its mode of action is as a Lipid Biosynthesis Inhibitor (LBI), and it is active by ingestion against immature insects feeding on treated plants. Additionally, adult females have exhibited reduced fecundity and offspring survival. Movento is not toxic to bees or beneficial arthropods, and poses low risk to wildlife, including fish and birds.

Thiamethoxam/Lambda-cyhalothrin (see Lambda-cyhalothrin/Thiamethoxam)

5.7 Acaricides

Of the species of mites found on fruit trees in New England, only the European red mite and the twospotted spider mite are abundant and widely enough distributed to be major problems.

Mites are not insects, and because they are not affected by most insecticides, special chemicals, known as acaricides, have been developed for their control. With few exceptions, acaricides are not effective against insects. Therefore, growers who want to control mites in their orchards should **(A)** use oil during the half-inch green to tight cluster period, or an acaricide at the tight cluster to pink bud stage, and then **(B)** regularly monitor mite populations on the foliage from petal fall until harvest, applying an acaricide and/or an insecticide that will provide some suppression when mite numbers exceed the threshold for that period (refer to Figs. 4–6). For further information on the use of these materials, their limitations, and the precautions to be observed, refer to the Comments sections in the spray recommendations.

Abamectin (*Agri-Mek). Refer to "Other Materials" section.

Acequinocyl (Kanemite) is registered for control of European red mite and twospotted spider mite in apples and pears. This material, which is a member of the quinoline family, represents new chemistry and a novel mode of action, against which no resistance has yet been demonstrated in mite populations. It has activity against all life stages and is recommended for use against threshold populations, normally those occurring in summer. Two applications per season are allowed; it is nominally safe to predatory mites and has a low bee poisoning hazard.

Bifenazate (Acramite) is a carbazate that acts as a contact acaricide against both the motile stages of mites and the larvae and nymphs that hatch from treated eggs. Because this represents a new class of chemistry, there

is no cross-resistance of this material demonstrated with other currently used acaricides. It is effective against both European red mite and twospotted spider mite, exhibiting a rapid knockdown of contacted motile forms and a relatively long residual efficacy period. It is labeled in New England for use on apples, pears, peaches, nectarines, plums and prunes. Only one application per year is permitted. It is moderately toxic to honeybees upon direct contact, but low in toxicity by foliar residue: it therefore has a moderate bee poisoning hazard.

Clofentezine (Apollo) is a tetrazine compound used as a contact acaricide that acts primarily as an ovicide/larvicide; it is particularly effective against winter eggs of European red mite. Following early season applications, it gives excellent residual control. Its use in apples is restricted to no later than 45 days before harvest, but in pears, cherries, peaches and apricots it may be used up until 21 days before harvest. It is safe to bees (low bee-poisoning hazard), beneficial insects, and predatory mites. It is not an effective adulticide.

Etoxazole (Zeal) acts like an insect growth regulator by inhibiting molting, and has very good activity against all life stages of European red mite and twospotted spider mite when applied preventatively or at threshold. It stops egg, larva and nymph development on contact and sterilizes adults; its translaminar movement into the leaf tissue ensures longer residual activity and action against mites feeding on plant surfaces not directly contacted by the spray application. It is labeled for use on pome fruits and stone fruits. Only one application per year is permitted on pome fruit; two applications allowed on stone fruits. It has a low bee-poisoning hazard.

Fenpyroximate (Portal) is a phenoxypyrazole acaricide and insecticide labeled for use in apples and pears to control European red mite, twospotted spider mite, pear rust mite, leafhoppers, mealybugs and pear psylla. Portal belongs to the METI (Mitochondrial Electron Transport Inhibitor) class of compounds. For effective resistance management, Portal should be used in rotation with other modes of action. The active ingredient in Portal, fenpyroximate, works by blocking cellular respiration, which gives it activity against all motile stages of mites: larvae, nymphs, and adults. Portal may not be used before petal fall; it has a 2 application per season maximum. It is classified as a reduced-risk material, and has a low bee-poisoning hazard.

Hexakis or Fenbutatin Oxide (*Vendex) is an organotin compound registered for the control of a wide range of plant-feeding mites on several fruit crops, including strains that are resistant to some other miticides. Where resistance to Plictran has been found, it is highly likely that resistance to this material is also present. *Vendex is nontoxic to honey bees, and is relatively nontoxic to predatory mites. It can be readily dispersed and can be used in conventional, dilute or concentrate, sprayers. Agitation is required during mixing and spraying. Thorough coverage of foliage and fruit is necessary for optimum mite control. This product is compatible with insecticides. It is not to be applied more than 4 times/season or more than 3 times between petal fall and harvest. This product is corrosive and may cause skin irritation, respiratory irritation, and eye damage. Use protective clothing and goggles as described on the label. Do not graze treated areas or contaminate food or feedstuffs. *Vendex is toxic to fish and has a low bee-poisoning hazard.

Hexythiazox (Savey, Onager) is a carboxamide compound used as a contact and stomach-poison acaricide. It is effective against eggs and larvae of European red mite; it will not kill adults. It is registered for a single application in all pome and stone fruits, and may be used up to 28 days before harvest. It provides excellent residual control, and is safe to bees (low bee-poisoning hazard), beneficial insects, and predatory mites.

(§)Petroleum Oil Emulsions have been applied in the dormant and/or prebloom period for many years to control certain scales and other insects, as well as the European red mite. Although oil was once largely supplemented or replaced by new pesticides, it is still strongly recommended for red mite control, and has been used with increasing frequency during the past few years. Newer acaricides often prove unreliable as the mite populations develop resistance to them; mites are generally unable to develop resistance to oil. The type of oil, as well as its viscosity and other characteristics, has an important influence on its effectiveness in pest control and its phytotoxicity. Oils in the 60- to 70-second viscosity range have historically been recommended as the preferred products for effective mite control with minimum phytotoxicity to fruit trees. However, because of blending processes used by petroleum refiners, it now appears that the viscosity of a given product is a less reliable indicator of suitability than is the 50% distillation temperature, with a value of 412 +/- 8° F being preferred for prebloom use. Table 5.7.1 gives the specifications for narrow range plant-spray oils currently available that permit relatively safe use on apple foliage during the summer months. An oil is a physical pesticide, effective only when the film deposited covers every egg or young mite. Therefore, thorough spraying and complete coverage of the entire tree are essential. A prebloom oil is recommended at 2 gal/100 from the 1/2-inch green to the tight cluster stage. A concentration of 1 gal/100 is advised from the tight cluster to the pink stage because mite eggs become more susceptible as the season advances. In apple orchards that have received an early season oil spray, a summer oil can effectively suppress mite populations when applied at petal fall and in subsequent cover

Table 5.7.1. Optimum properties of representative narrow-range oils available in the US[1]

Specification	Sunspray Ultra-Fine	Orchex 796 (Omni Supreme)	NR 415	NR 440	Volck Supreme	Gavicide Super 90
Distillation temperature (°F at 0.2 psi) ASTM D-1160						
50%	414	440	415	440	476	440
10%–90% range	65	68	60	80	85	55
Unsulfonated Residue (% min.) ASTM D-483	92	92	92	92	99	93
API gravity ASTM D-4052	32	35.1	32	31	34.8	33
Viscosity SUS (sec at 100° F) ASTM D-446	68	74	70	100	105	86
Pour point (°F) ASTM D-97	10	6	20	20	10	5

[1]Davidson et al. (Davidson NA, Dibble JE, Flint ML, Marer PJ, Guye A. 1991. Managing insects and mites with spray oils. University of California Publication 3347. 47 p.) used the term 'narrow-range' to refer to paraffinic oils with ≥ 92% UR and ASTM D 1160-based 10%-90% distillation ranges of <111° F at 0.2 psi. and the then-recently formulated 'supreme oils' alike, and regarded the latter to be as safe as 'narrow-range' products for use on plants, but stated that they may pose more of a phytotoxicity problem on water-stressed plants because of their greater persistence. The term 'supreme oil' is now widely recognized as meaning a paraffinic product that would now be classified as an Agricultural Mineral Oil (AMO). Some of these products, and some Horticultural Mineral Oils (HMO's), have very high UR values (99.9%) that meet criteria required for US Food and Drug Administration classification as food grade medicinal (pharmaceutical) paraffins

sprays at rates of 1 to 2 gal/100 gal of finish spray solution. Although generally compatible with most crop protection chemicals, oil should never be mixed with fungicides containing sulfur, such as Captan or Bravo.

Refer to Section 17.4 for guidelines in determining potential compatibility. Apple variety, moisture stress, and spray drying conditions should be taken into account to minimize any possible effects on foliage quality and fruit finish. Summer oils can increase the incidence of scarf skin in varieties such as Red Rome, Jonathan, and Stayman. Oil has a low bee-poisoning hazard.

Use this procedure for mixing a fungicide-insecticide-oil combination:

1. Fill the spray tank 1/4 full with water and add the liquid or wettable powder pesticide.
2. Resume filling the tank and add the self-emulsifying oil. Continue agitation.
3. Do not allow mixture to stand without agitation.

When using the tank-mix oils, first combine the wettable powder or liquid pesticides with 100 gal of water containing the emulsifying agent. Then add the oil to the mixture. Agitate vigorously while spraying

Pyridaben (Nexter) is a pyridazinone compound used as a selective contact acaricide-insecticide in apples and pears, plus all stone fruits, with effectiveness against motile forms of mites and pear psylla; it does not kill eggs. It is recommended for use to control postbloom mite and psylla populations, and is an effective late season rescue material. Nexter is toxic to fish and aquatic invertebrates, and has a high bee-poisoning hazard.

Formulation available and EPA registration number: Nexter (Gowan) 75WS: 81880-4-10163.

Spirodiclofen (Envidor) is registered in pome and stone fruit to control red mites, two spotted mites, and rust mites. This group 23 miticide (lipid biosynthesis inhibitor) is active by contact against all developmental stages of mites, including eggs, nymphs and female adults. Best used as a preventative/early threshold material.

5.8 Fumigants and Nematicides for Tree Fruits

Whenever a new orchard is being planted in an old orchard site, preplant soil fumigation should be considered. Nematodes, particularly *Pratylenchus penetrans* (the lesion nematode), can seriously injure the roots of a newly planted tree, restricting its growth and future productivity. This type of injury is most common on cherries, but all fruit trees are susceptible to some extent. Nematodes are more likely to build up to damaging levels in sandy and loamy soils than in heavier soil types. The dagger nematode, *Xiphenema americanum*, can also cause serious losses at population levels too low to cause serious root injury by its transmission of the virus that causes stem pitting of stone fruits, the constriction disease on Stanley prune trees, and apple union necrosis on trees grown on MM.106 rootstock.

Where apples are being replanted following apples, soilborne microorganisms can damage young tree roots and severely reduce the growth of the new trees. This effect can

occur in all soil types, regardless of nematode levels. Trees in such situations frequently show a significant growth increase following preplant treatment with a broad-spectrum fumigant that kills fungi and other microorganisms as well as nematodes.

Although fumigants are frequently cost-effective, their potential benefits are often lost when they are applied to soils that are cold and wet or are otherwise poorly prepared. For best results, the site should be plowed as deeply as possible (at least 12 in.) after the old orchard is removed, and all old roots that turn up should be discarded. The land should then be limed, fertilized, fitted, and planted with a cover crop such as creeping red fescue, perennial ryegrass, or sudangrass. The land should be cover cropped for at least 1 yr, preferably 2 or 3. Near the end of July during the year before new trees are to be planted, the cover crop should be plowed under and nitrogen added to improve its decomposition. Poor decomposition of the cover crop or other weeds will reduce the effectiveness of the fumigant. The site should then be disked repeatedly to keep down weeds and work the soil into seedbed condition. The soil should be loose to a depth of at least 10 in. and free of any large, hard clods that the fumigant can't penetrate. Fumigants are generally most effective if applied while the soil is relatively warm and dry. The best time for fumigation is mid-August to early September, although materials may still be effective is applied until mid-October under some conditions. In N.Y. State soils, best results have been obtained with broad-spectrum soil fumigants (Table 5.8.1).

For cost effectiveness, fumigants should be applied in bands 8 ft wide centered over the row. The material should be injected to a depth of 12 in. with shank applicators 6 to 8 in. apart for VapamHL and 10 to 12 in. apart for *Telone C-17 or *Telone C-35. Rolling or cultipacking after treatment will help seal the surface and improve the activity of the fumigant. Before the trees are planted in the spring, the soil should be disked, care being taken not to throw unfumigated soil onto the treated band.

Postplant Nematicides. Where soil analysis shows high populations of parasitic nematodes in a young orchard, a postplant application of a nematicide may be justified. Currently, 2 chemicals are registered on nonbearing trees for such a purpose (Table 5.8.2): (1) *Oxamyl (*Vydate 2L) - mix 2 qt *Vydate 2L plus 4 oz of a surfactant/100 gal of water and apply as a foliar spray to the point of runoff. Make 4 applications on a 14- to 21-day schedule, beginning at first full leaf (about the time that petal fall occurs on mature trees). (2) *fenamiphos (*Nemacur), for the control of lesion nematode on apple, peach, and cherry trees. Apply to the soil surface within the drip line of the trees, at the rate of 5–6.5 gal of the 3S formulation or 100–130 lb of the 15G formulation/treated A. The treatment is made once (May until early June) each year for at least 2 successive years. Preharvest intervals for *Nemacur are 75 days for apples and 45 days for peaches and cherries.

Table 5.8.1. Preplant nematicidal and broad-spectrum soil fumigants.

Soil Fumigant	Trade Name	Rate/ Treated A (gal)
Nematicidal Soil Fumigants		
*1-3-dichloropropene	*Telone II	10-15
Broad-Spectrum Soil Fumigants		
*chloropicrin plus *1,3-dichloropropene	*Telone C-17	32-42
*chloropicrin plus *1,3-dichloropropene	*Telone C-35	39-50
sodium methyldithiocarbamate	Vapam HL	37.5-75

* Restricted-use pesticide; may be purchased and used only by certified applicators

Table 5.8.2. Post-plant nematicides.

Product	Trade Name	Application Method	Rate/ Treated A
*oxamyl	*Vydate L	Foliar or ground (non-bearing only)	2-4 pt/A (foliar) or 1 gal/ treated acre (ground)
*fenamiphos	*Nemacur 3S	Soil	5-6.5 gal/treated A

* Restricted-use pesticide; may be purchased and used only by certified applicators

6 Disease Management

6.1 Apple Scab Fungicides

Apple scab fungicides can control disease through four different types of activity: protection, after-infection activity, presymptom activity, and postsymptom activity. Understanding these activities and knowing which fungicides exhibit them can help a grower determine the materials that are likely to give the best results under a certain set of conditions.

Protection. Protection refers to the ability of fungicide residues to kill or inactivate scab spores (and thereby prevent infection) when the residue is already on or in the leaf or fruit before the infection takes place. A good protective fungicide must exhibit satisfactory retention, that is, the fungicide residue must stick to the leaf surface or be retained within to resist excessive washing away of the deposits by rain. On the other hand, a good protective fungicide should also have good redistribution properties, that is, fungicide residues should have a tendency to be washed by rain and redeposited on previously unprotected tissue. Ideally, a fungicide should stick well enough not to be washed off the tree, but should be redistributed well enough during rains to protect new growth.

After-infection activity. After-infection activity refers to the ability of a fungicide to kill or stop the growth of the fungus and thereby prevent the establishment of scab lesions, if applied within a given period after the start of a wetting period. It is expressed as the period of time from the beginning of a wetting period within which the fungicide must be applied to stop infection. The data given in Table 6.1.2 are accurate at average temperatures of 50-60° F. At lower temperatures, the periods of after-infection activity for contact fungicides are longer than those listed.

Presymptom activity. Presymptom activity can be thought of as an extension of after-infection activity. When applied following an infection period, but beyond the time limits of its after-infection activity listed in Table 6.1.3, a fungicide with significant presymptom activity will allow small chlorotic lesions to develop; however, it will inhibit or greatly reduce the production of secondary spores from those lesions. Thus, if applied too late to completely stop infection, it will still greatly reduce the amount of inoculum available for secondary spread.

Postsymptom activity. Postsymptom activity refers to the ability of a fungicide, when applied to an actively sporulating scab lesion, to prevent or greatly inhibit the further production of secondary scab spores from that lesion. Because such applications do not kill the fungus, but merely arrest its development, they must be repeated to maintain this suppression. As with presymptom activity, this has the obvious benefit of reducing the pressure for the spread of secondary scab.

Table 6.1.1. Activity spectrum of apple fungicides.

			Ratings for the Control of						
Trade Name (Active Ingredient)	**Fungicide Family**	**FRAC code‡**	*Scab*	*Powdery Mildew*	*Cedar Apple Rust*	*Black/ White Rot*	*Sooty Blotch/ Fly speck*	*Bitter Rot*	*Mite Suppres-sion[h]*
Cabrio (pyraclostrobin)	QoI	11	4	3	2	3	4	3	
Captan, Captec (captan) [g]	Phthalimide	M4	4	0	0	1	3	2[e]	3[e]
Champ, COCS, Cuprofix, Kocide (copper) **(§)[j]**	Inorganic	M2	3	0	0	_	_	_	_
Dithane (mancozeb)	Dithiocarbamate	M3	3[d]	0	4	3	4	4	0
Ferbam Granuflo (ferbam)	Dithiocarbamate	M3	2	0	2	1	2	1	0
Flint (trifloxystrobin)	QoI	11	4[c]	4	2	3	4	2	0
Fontelis (penthiopyrad)	SDHI	7	4	3	3	__	__	__	
Indar (fenbuconazole) [f]	DMI (SI)	3	4[c]	3	4	0	2	0	
Inspire Super MP (difenoconazole + cyprodinil) [f]	DMI (SI) + AP	3	4[c]	3	4	0	4	0	
Luna Sensation (fluopyram + trifloxystrobin)	SDHI + QoI	7 + 11	4	4	3	?	?	?	
Luna Tranquility (fluopyram + pyrimethanil)	SDHI + AP	7 + 11	3	3	2	?	?	?	
Manzate (mancozeb)	Dithiocarbamate	M3	3[d]	0	4	3	4	4	0

Table 6.1.1. Activity spectrum of apple fungicides.

Trade Name (Active Ingredient)	Fungicide Family	FRAC code‡	Ratings for the Control of						
			Scab	*Powdery Mildew*	*Cedar Apple Rust*	*Black/ White Rot*	*Sooty Blotch/ Fly speck*	*Bitter Rot*	*Mite Suppres-sion[h]*
Merivon (fluxapyroxad + pyraclostrobin)	SDHI + QoI	7 + 11	4	4	3	?	?	?	
Penncozeb (mancozeb)	Dithiocarbamate	M3	3[d]	0	4	3	4	4	0
Polyram (metiram)	Dithiocarbamate	M3	3[d]	0	4	3	4	4	0
Pristine (pyraclostrobin + boscalid)	QoI + SDHI	11 + 7	4	3	2	3	4	3	—
Procure triflumizole [f]	DMI (SI)	3	4[c]	4	4	0	0	0	—
Rally (myclobutanil) [f]	DMI (SI)	3	4[c]	4	4	0	0	0	—
Scala (pyrimethanil) [f]	AP	9	2[f]	—	0	0	0	0	—
Sovran (kresoxim-methyl)	QoI	11	4[c]	4	2	3	4	2	0
Sulfur (sulfur) §	Inorganic	M2	2	2	0	1	1	–	0
Syllit (dodine)	Guanidine	M7	2[b,c]	0	1	1	1	0	0
Topguard (flutriafol)	DMI (SI)	3	4[c]	4	4	0	0	0	—
Topsin M (thiophanate-methyl)	Benzimidazole	M1	2[b,c]	2[c]	0	4	4	1	2
Vangard (cyprodinil)	AP	9	2 f	1		0	0	0	0
Vintage (fenarimol) [f]	DMI (SI)	3	4[c]	4	4	0	0	0	
Ziram (ziram)	Dithiocarbamate	M3	2	0	2	1	3	1	—

Key to control ratings:

— = Unknown or does not apply **0** = none, **1** = slight, **2** = fair, **3** = good, **4** = excellent

Notes:

To manage resistance and improve efficacy tank mix with captan or an EBDC

[**b]** Activity downgraded because of resistance concerns.

[c] Resistance is documented or suspected in many orchards

[d] Indicates efficacy at the 1 lb/100 gal rate; efficacy increases to 4 with the 2 lb/100 gal rate.

[e] Limited residual activity. Efficacy rating of "good" assumes regular reapplication during periods of heavy disease pressure. More effective against sooty blotch, less effective against fly speck.

[f] Activity of these materials is highly rate-dependent. Stated efficacies assume a rate of 9 fl oz/A for Vintage SC 5 oz/A for Rally, 9 oz/A for Procure 50WS, 5oz/A for Vangard, and 10 oz/A for Scala, 4 fl oz/A Inspire + 4 fl oz/A cyprodinil.

[g] 24hr REI for some formulations.

[h] These indicate the degree of mite suppression of the product when used on a full-season schedule.

[i] AP = anilinopyrimidine; DMI = demethylation inhibitor, also known as SI = sterol inhibitor; QoI = quinone outside inhibitor or strobilurin; SDHI = succinate dehydrogenase inhibitor.

[j] Copper used for control of fireblight immediately before or at green tip will protect against scab infections for 5 to 7 days. It may also reduce resistant scab populations.

§ = potentially acceptable in certified organic programs. Not all formulations of the active ingredient are acceptable in certified organic programs.

‡ = The Fungicide Resistance Action Committee FRAC: www.frac.info/frac/index.htm is an organization committed to prolonging the effectiveness of fungicides at risk for resistant development and to minimizing crop loss due to resistance development. With the exception of lettered codes, fungicides with the same FRAC code have a similar chemistry modes of action and the propensity for cross-resistance development.

Information compiled from 48-hr residue tests conducted at the New York State Agricultural Experiment Station, except where noted. Pesticides with a long residual period, like pyrethroids, will have a more negative impact than pesticides with short-lived residue, like some organophosphates.

Table 6.1.2. Relative toxicity of apple fungicides to beneficials.

	Beneficial Species[3]		
Active Ingredient (Trade Name)	Bees[1]	*Amblyseius fallacis*[2]	*Typhlodromus pyri*[2]
Cabrio (pyraclostrobin)	L	—	—
Captan, Captec (captan)	L	L	L
Dithane, Manzate, Manzate Max, Penncozeb (mancozeb)	L	M-H[a]	M-H[a]
Ferbam (ferbam)	L	—	—
Flint (trifloxystrobin)	L	L	L
Fontelis (penthiopyrad)	L	—	—
Indar (fenbuconazole)	L	L	L
Inspire (difenoconazole)	L	L	L
Luna Sensation (fluopyram + trifloxystrobin)	L	L	L
Luna Tranquility (fluopyram + pyrimethanil)	L	L	L
Merivon (fluxapyroxad + pyraclostrobin)	L	—	—
Polyram (metiram)	L	—	—
Pristine (pyraclostrobin + boscalid)	L	—	—
Procure (triflumizole)	L	—	—
Rally (myclobutanil)	L	L	L
Scala (pyrimethanil)	L	L	L
Sovran (kresoxim-methyl)	L	L	L
Sulfur – Several trade names (sulfur)	L	L	L
Syllit dodine	L	L	L
Tebuzol (tebuconazole)	L	L	L
Topguard (flutriafol)	L	L	L
Topsin M (thiophanate-methyl)	L	L	L
Vangard (cyprodinil)	L	—	—
Vintage (fenarimol)	L	L	L
Ziram (ziram)	L	M-H[a]	M-H[a]

[1]Bees = honeybees

[2] A predatory mite found throughout New England

[3] Information on other beneficial species, such as *Stethorus punctum* or *Aphidoletes aphidimyza*, does not exist.

Key to toxicity ratings:

L = (bees) not hazardous to honey bees at any time. 1 hr to 1 day residual toxicity (all others) low impact on population (less than 30% mortality after 48 hr).

M = moderate impact on population (between 30% and 70% mortality after 48 hr).

H = high impact on population (more than 70% mortality after 48 hr).

— = no data.

Note:

[a] Low to moderate impact from several early season (through 1C) applications; moderate to high impact from summer applications.

Table 6.1.3. Characteristics of apple scab fungicides.

Fungicide and Rate/100 Gal (assuming 300 gpa for std. trees)	Protection	Retention	Redistribution	After-Infection Activity (hr) [4]	Pre-symptom	Post-symptom
Captan, Captec (captan) 50WP 2 lb; 80WDG 1.25 lb; 4L 1 qt.	VG	VG	G	18-24	none	none
copper (Champ, COCS, Cuprofix, Kocide) recommended rates.	G	G	G	?	_	_
Dithane (mancozeb) DF Rainshield; M45, 2 lb; F45 Rainshield, 1.6 qt. [3]	VG	VG	G	18-24	none	none
Ferbam Granuflo (ferbam) 0.9 lb	G	G	G	15-20	none	none
Flint (trifloxystrobin) 50WP 0.67 oz	VG	E	G	48-72[2]	none	G
Fontelis (penthiopyrad) 6.7 fl oz	E	E	F-G	48	?	F
Indar 2F (fenbuconazole) 2.33 fl oz	VG	VG	G	none	E	VG
Inspire Super (difenoconazole + cyprodinil) 1.33 fl oz.	VG	VG	G	48	E	VG
liquid lime sulfur 1.5-2 gal §	F	F-G	F-G	72-96	none	F
Luna Sensation (fluopyram + trifloxystrobin) 1.9 fl oz	E	E	F-G	48	?	F
Luna Tranquility (fluopyram + pyrimethanil) 5.3 fl oz	E	E	F-G	48	?	?
Manzate (mancozeb) Prostick, 2 lb; Max 1.6 qt [3]	VG	VG	G	18-24	none	none
Merivon (fluxapyroxad + pyraclostrobin) 1.8 fl oz	E	E	G	48	?	F
Penncozeb (mancozeb) 75DF 2 lb;[3]	VG	VG	G	18-24	none	none
Polyram (metiram) 80WP, 2 lb [3]	VG	VG	G	18-24	none	none
Procure (triflumizole) 480 SC, 2.5 oz [1]	F	VG	P	72-96	E	G-VG
Rally (myclobutanil) 40WP, 2 oz [1]	F	VG	P	72-96	E	G-VG
Scala (pyrimethanil) 600SC, 3.3 oz	G	G	?	48-72		
Sovran (kresoxim-methyl) 50WP, 1.33 oz	VG	E	G	48-72[2]	none	none
sulfur, 5 lb actual §	F	F-G	F-G	none	none	G
Syllit (dodine) 3.4 FL, 12 oz [1]	VG	VG	G	18-24	none	none
Topguard (flutriafol) 4.3 fl oz					E	VG

Table 6.1.3. Characteristics of apple scab fungicides.

Fungicide and Rate/100 Gal (assuming 300 gpa for std. trees)	Protection	Retention	Redistribution	After-Infection Activity (hr) [4]	Pre-symptom	Post-symptom
Topsin M (thiophanate-methyl) 70WP, 6 oz [1]	F	G	P-F	18-24		
Vangard (cyprodinil) 75WG, 1.67 oz	G	G	?	48-72	E	VG
Vintage (fenarimol) 1EC, 3-4 fl oz [1]	F	VG	P	72-96	E	G-VG
Ziram (ziram) 76DF1 1/2 lb	F-G	P-F	F-G	15-20	none	none

[1] Not effective against resistant strains of the fungus.
[2] The after-infection activity of Sovran and Flint may be only 48 hr in orchards with resistant populations of apple scab.
[3] Note that efficacy will drop if the lower rate program is used.
[4] Given the wide spread prevalence of fungicide resistance in regional populations of apple scab, one should not rely on post-infection activity.
§ potentially acceptable in certified organic programs.
(§) not all formulations of the active ingredient are acceptable in certified organic programs.
Key: **P** = poor, **F** = fair, **G** = good, **VG** = very good, **E** = excellent.

6.2 Notes on Apple Scab Management

6.2.1 Implications of Inoculum Dose

Economic losses to apple scab in commercial orchards usually appear following convergence of three factors:

1. High levels of carry-over inoculum are present in leaf litter in the orchard.
2. Weather conditions favor ascospore infections between green tip and bloom.
3. Fungicide protection is inadequate to prevent infections at some point between green tip and bloom.

The importance of high inoculum levels as a contributor to scab epidemics cannot be over-emphasized. No one can control the weather, and bad weather may interfere with fungicide applications. However, several methods are available for reducing inoculum in orchards. Any one of these methods can reduce inoculum by at least 70%, thereby converting high-inoculum orchards into moderate or low-inoculum orchards. Using one of these inoculum reduction strategies does not eliminate the need for fungicide protection beginning at green tip, but it reduces risks of control failures in bad scab years.

6.2.2 Orchard Sanitation for High-Inoculum Orchards.

The inoculum dose in overwintering leaves can be reduced by using any one of the following methods:

a) Apply 40 lb/A of urea fertilizer (mixed in 100 gal of water/A) after harvest, either before leaf-fall, in autumn after leaf-fall, or sometime after snow melt but before bud break. Urea softens senescent and fallen leaves and stimulates their microbial breakdown, promoting faster removal by earthworms that feed on them. It may also directly suppress ascospore formation. Treat the entire orchard, including the ground cover in the row middles. Apply the spray using either an air blast sprayer with the upper nozzles turned off or a boom sprayer set up to spray both under the trees and the row middles. Reduce subsequent nitrogen fertilizer rates by the amount of N applied under the drip line of the tree rows. Ignore the amount of N applied to the row middles, as the ground cover will use this.
b) Shred overwintering leaves using a flail mower set low enough to contact the fallen leaves. Leaves must be raked or blown from under trees, or the mower must be offset to reach them. Shredded leaves decay more quickly; flail-mowing leaves in spring disorients many of the leaf pieces so they eject ascospores toward the soil instead of up into the air. Prunings can be chopped at the same time. However, the low mower settings required to effectively shred leaves may leave row middles so denuded as to be slippery or muddy at the time when early fungicide sprays are needed.
c) Apply 2.5 ton/A of lime in early winter after leaves have fallen from trees. Lime raises the pH of fallen leaves enough to increase the rate of microbial breakdown of the fallen leaves.

6.2.3 Determining Inoculum Levels in Orchards

In research trials, the first fungicide spray for apple scab has been safely delayed until as late as tight cluster in orchards where scab was very well controlled throughout the previous season and the predicted ascospore dose (PAD) was therefore very low. To apply this option, an assessment of foliar scab must be made as close as possible to the time of leaf fall in autumn since late leaf infections can be an important source of inoculum for the following season. It is not safe to assume that there were few or no infections in an orchard based on casual observations during harvest or late sprays. Even packout evaluations of scab do not adequately estimate the scab present in an orchard. If a grower is going

to take advantage of low-inoculum and delay the first fungicide, it is critical that the amount of scab be measured using the method that has been shown to measure the amount of inoculum that is in the block the next spring.

6.2.3.1 PAD Sampling Directions

STEP 1: Assess the orchard for leaf scab after harvest but before leaf-fall:

- **Examine 10 trees** selected randomly from the entire orchard (usually every nth tree; e.g., in an orchard with 1000 trees, examine every 100th tree).
- On trees that are **9 to 12 ft. tall, examine 10 extension shoots on 10 trees selected throughout the block.** For example, in a 1000 tree block, examine every 100th tree; in a 500 tree block, examine every 50th tree.
- Shoot extensions should be selected randomly from high, low, exterior, and interior parts of the tree canopy. If sucker shoots are present, randomly select one sucker shoot.
- On trees approximately **6 ft. tall, examine 5 extension shoots/tree on 20 trees** if the tree size and shape provide an adequate sampling of the canopy.
- For very high density plantings with trees **3 to 6 ft. tall and sparse canopy, examine 2 extension shoots/tree on 50 trees**.
- On each extension shoot, examine the upper and lower surface of each leaf. Record the **number of scabbed leaves**. If a lesion or spot is doubtful, it should be considered a scab lesion and the leaf should be counted as a scabbed leaf.
- Total the **number** of scabbed leaves you have recorded and use Figure 6.1.1 or Figure 6.1.2 to determine if further sampling is necessary, or whether the sample size is sufficient to predict the "scab-risk" of the orchard.

STEP 2: If sanitation practices will **NOT** be considered, refer to Figure 6.2.1. If sanitation practices will be considered, refer to Figure 6.2.2.

Limit this strategy to small or moderately-tall trees on semi-dwarfing rootstock. ***Old blocks of standard trees should not be candidates for this delayed-spray approach.*** In addition, ***this strategy is risky for orchards where apple scab is resistant to dodine and SI fungicides*** because no fungicides with pre-symptom activity will be available to compensate for any errors. The green tip spray should never be omitted in orchards where PAD assessments were not completed the previous autumn.

6.2.4 Determining Scab Infection Periods.

The Revised Mills Table (Table 6.2.1) shows the minimum duration of wetting required at various temperatures for initiation of apple scab infections. Both ascospores and conidia infect at similar rates when tested at equivalent temperatures and inoculum doses. Therefore, a single set of conditions can be used for determining minimum wetting requirements for both primary and secondary infections. Longer wetting at any given temperature often causes more disease, and a 2- to 6-fold increase in severity generally results when wetting is extended beyond the minimum times specified in the table. Also, inoculum doses are generally much lower for ascospores than for conidia, so the severity of infection at any given combination of temperature and wetting duration is usually greater when secondary inoculum is present, as compared with early in the season, when only ascospores are present.

6.2.5 Day vs. Night Release of Ascospores.

Extensive research has shown that under most circumstances, over 95% of the available ascospores are not released until after sunrise when rain begins after sunset. Thus, it is often safe to assume that in low inoculum orchards (as defined above) primary infection periods begin at dawn when rain begins at night. This assumes that the low percentage of night-released ascospores, coupled with the already low seasonal "crop" of ascospores at low-inoculum sites, is insignificant. However, secondary spores (conidia) are not affected by light or darkness. Therefore, DO NOT ignore wetting hours during darkness if scab infections have already been observed in the orchard or if you are not certain of excellent control for all previous infection periods.

6.2.6 Seasonal Ascospore Maturity and Discharge.

Ascospore maturity is estimated from degree-day accumulations. Degree-days should be recorded from the date when 50% of the fruit buds on McIntosh trees are between silver tip and green tip. The base temperature for degree-day accumulation is 32°F; thus, if the average temperature (high plus low divided by two) for a given day is 50°F, ascospores at various degree-day accumulations is given in Table 6.2.2. The table also lists the "90% confidence interval" for the estimated maturity.

To determine when the ascospore supply is exhausted according to the model, use the following rule: After the cumulative percentage of matured ascospores reaches 95% (740 accumulated degree-days), the season's supply of ascospores will be depleted after "favorable" rain (daytime rain of more than 0.10 inches with temperatures greater than 50°F).

During extended dry periods, ascospore development may stop. It is estimated that after seven days of dry weather, there is no further ascospore development until at least 0.1 in. of rain falls, at which point development resumes. However, tree development continues, meaning that in years with a dry spring, ascospores may be available for some period of time after fruit set.

The model is useful for describing the beginning, peak, and end of ascospore maturation in general terms, but unusual weather conditions may contribute to significant ascospore discharges earlier than or later than the model predicts. Note that the model uses 90% confidence limits to bracket ascospore maturity estimates. For example, at 740 DD, there is a 90% chance that the proportion of matured ascospores is somewhere between 79-99%. For any model prediction, there is also a 10% chance that actual ascospore maturity will be outside of the confidence limits due to unusually advanced or retarded spore maturity. Orchard Radar and NEWA estimate ascospore maturity for specific locations.

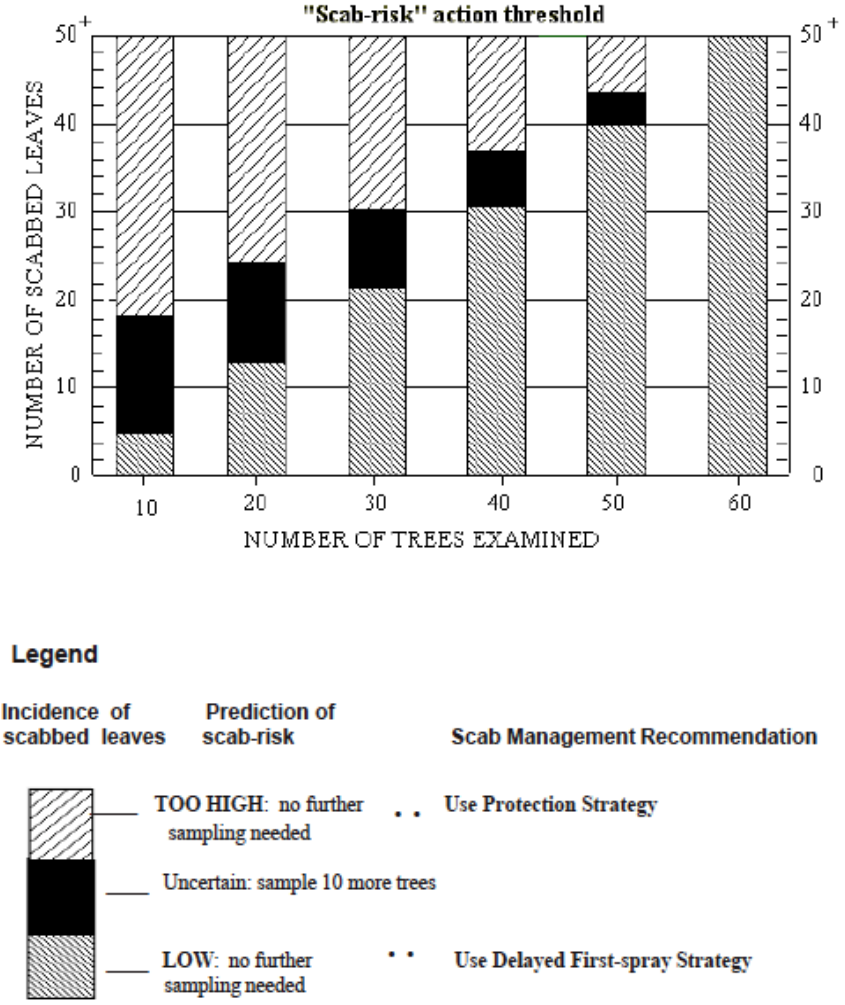


Figure 6.2.1. Sequential sampling chart for determining level of scab risk in an orchard block. Use this chart if sanitation practices will NOT be considered.

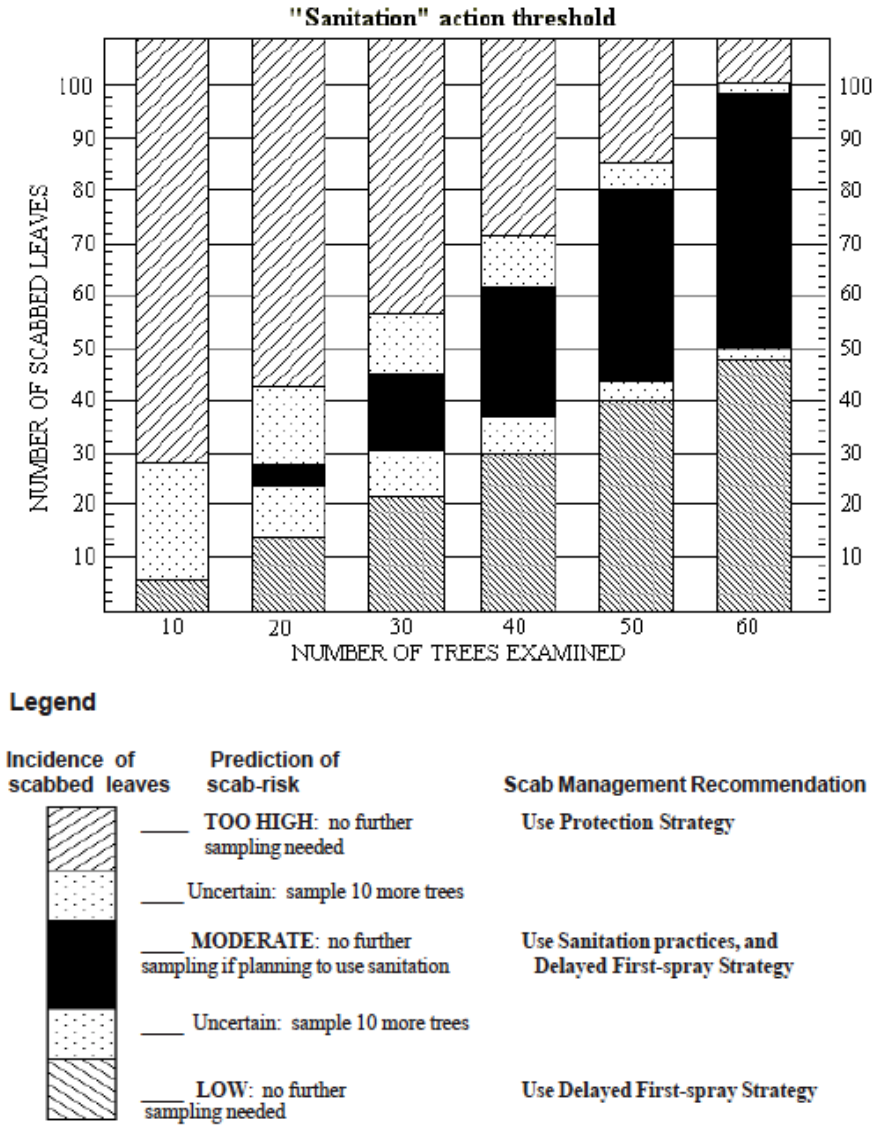


Figure 6.2.2. Sequential sampling chart for determining level of scab risk in an orchard block when sanitation practices will be considered.

Table 6.2.1. Revised Mills Table. Approx. hours of wetting necessary to produce primary apple scab infections, and approx. number of days required for lesions to appear, at different average temperatures.

Temperature (˚F)	Hours [1]	Lesions Appearance (days) [2]
34	41	–
36	35	–
37	30	–
39	28	–
41	21	–
43	18	17
45	15	17
46	13	17
48	12	17
50	11	16
52	9	15
54–56	8	14
57–59	7	12–13
61–75	6	9–10
77	8	–
79	11	–

[1] Refer to Notes on Apple Scab Management for computing wetting intervals for primary infection when rain begins at night in low-inoculum orchards. Data of MacHardy & Gadoury (1989); and Stensvand, Gadoury, & Seem (1997).

[2] Number of days required for lesions to appear after infection has been initiated. No further wetting is required. Additional days may be required if conditions are unfavorable for lesion development (prolonged periods above 80° F or very dry weather).

Table 6.2.2. Cumulative percentage of ascospores matured at various degree-day (base 32° F) accumulations.

Degree-days [1]	Cumulative ascospores matured (%)	90% Confidence interval for estimate [2]
35	1	0–7
110	3	0–14
145	5	1–19
215	10	2–32
325	25	7–55
450	50	21–80
575	75	46–94
685	90	69–98
740	95	79–99
790	97	86–100
865	99	93-100

[1] Degree-days should be recorded from the date when 50% of McIntosh fruit buds are between silver tip and green tip. The base temperature for degree-day accumulation is 32° F. Data of Gadoury & MacHardy, 1982.

[2] The width of the 90% confidence interval is a statistical measure of the precision of estimated maturity. It is the range within which the estimate should fall 90% of the time.

Table 6.2.3. Activity spectrum of stone fruit fungicides.

						Control of						
						Brown Rot						
	Fungicide Family/FRAC code‡	*Registered for use on:*				**Blossom Blight**	**Fruit Rot**	**Cherry Leaf Spot**	**Powdery Mildew**	**Black Knot**	**Peach Leaf Curl**	**Peach Scab**
Fungicide		**Apricot**	**Cherry**	**Peach**	**Plum**							
Abound [a]	Strobilurin(QoI)/ 11	+	+	+	+	3	3	3	4	—	—	3
Applause 720 [f]	Chloronitrile/M5	+	+	+	+	—	—	4[g]	0	4[g]	4[g]	4[g]
Bravo [f]	Chloronitrile/M5	+	+	+	+	3	—	4[g]	0	4[g]	4[g]	4[g]
Captan[d]	Phthalimides/M4	+	+	+	+	3	2-3	3	0	3	—	3
Copper § [e]	Inorganic/M2	+	+	+	+	—	—	3	2	1	3	—
Echo [f]	Chloronitrile/M5	+	+	+	+	3	—	4[g]	0	—	4[g]	4[g]
Elevate	Hydroxyanilide/ 17	+	+	+	+	3	2	—	—	—	—	—
Elite	DMI (SI)/3	—	+	+	—	4[h]	4[h]	3[h]	3	0	—	—
Equus 720 [f]	Chloronitrile/M5	+	+	+	+	3	—	4[g]	0	4[g]	4[g]	4[g]
Ferbam	Dithiocarbamate/ M3	—	+	+	—	—	2	2	0	—	4	1
Gem	Strobilurin(QoI)/ 11	+	+	+	+	—	—	3	4	—	—	3
Indar	DMI (SI)/3	+	+	+	—	4[h]	4[h]	3[h]	3	—	—	3
Pristine	Strobilurin(QoI)/ 11	+	+	+	+	4	4	4	4	—	—	—
Quash	DMI (SI)/3	+	+	+	+	4	4	—	3	—	—	—
Rally	DMI (SI)/3	+	+	+	+	2[h]	1[h]	4[h]	4	—	—	—

Table 6.2.3. Activity spectrum of stone fruit fungicides.

Fungicide	Fungicide Family/FRAC code‡	Registered for use on:				Control of						
						Brown Rot		Cherry Leaf Spot	Powdery Mildew	Black Knot	Peach Leaf Curl	Peach Scab
		Apricot	Cherry	Peach	Plum	Blossom Blight	Fruit Rot					
Rovral, Iprodione	Dicarboximide/2	+	+	+	+	4	—	2	0	—	—	—
Scala	Anilino-pyrimidines/9	+	—	+	+	3	1	—	—	—	—	—
Sulfur §	Inorganic/M2	+	+	+	+	2	1	1	2	0	—	3
Syllit	Guanidine/M7	—	+	+	—	—	1[g]	2	0	—	—	—
Tebuzol [j]	DMI (SI)/3	—	+	+	—	4[h]	4[h]	3[h]	3	0	—	—
Thiram [k]	Dithiocarbamate/ M3	—	—	+	—	1	1	—	—	—	3	3
Tilt	DMI (SI)/3	+	+	+	+	4[h]	4[g] [h]	3[h]	3	—	—	—
Topsin M, Thiophanate-methyl, T-methyl	Benzimidazole/1	+	+	+	+	—[b]	—[b]	—[b]	2	2	—	3[b]
Vangard	Anilino-pyrimidines/9	+	+/—	+	+	3	—	—	—	—	—	—
Ziram	Dithiocarbamate/ M3	+	+	+	—	2	1	2	—	—	3	2

Key to Control Ratings: — = does not apply , ?=unknown, **0** = none, **1** = slight; **2** = fair; **3** = good; **4** = excellent.

[a] Abound extremely phytotoxic to certain apple varieties. DO NOT spray Abound where spray drift may reach apple trees; do not spray when conditions favor drift beyond intended area of application; do not use spray equipment to spray apple trees that previously had been used to spray Abound.

[b] Because of widespread resistance to thiophanate-methyl, these fungicides are NOT recommended for brown rot control.

[c] Do not use on tart cherry.

[d] Do not use on sweet cherry. Some captan products (more recent labels) have a 24-hr REI.

[e] Leaf injury may occur on Schmidt, Emperor Francis, and Giant sweet cherry varieties from sprays applied between petal fall and harvest. Injury may occur on 'Stanley' or Japanese-type plums if applied repeatedly early season.

[f] See special requirements for eye protection for 7 days after application.

[g] Significant timing or crop restrictions; check label.

[h] May fail to provide brown rot and/or leaf spot control in orchards where pathogens have developed resistance.

[i] Efficacy estimated based on individual performance of component active ingredients, Elite and Flint.

[j] Only the 45 DF formulation labeled for peaches.

[k] Only the Thiram Granuflo formulation labeled for peaches.

§ Potentially acceptable in certified organic programs. However not all formulations of the active ingredient are acceptable in certified organic programs.

‡ The Fungicide Resistance Action Committee (FRAC: www.frac.info/frac/index.htm) is an organization committed to prolonging the effectiveness of fungicides at risk for resistant development and to minimizing crop loss due to resistance development. With the exception of lettered codes, fungicides with the same FRAC code have a similar chemistry (modes of action) and the propensity for cross-resistance development.

Table 6.2.4. Approximate number of hours of leaf wetness required for cedar apple rust infections to occur on leaves of susceptible cultivars.

Average Temp (˚F)	Degree of Infection [1]	
	Light	*Severe*
36	24	—
40	12	24
43	8	10
46	6	7
50	5	6
54	4	5
58	3	5
61	3	4
64	3	4
68-76	2	4
79+	—	–

[1] Based on the data of Aldwinckle, Pearson, & Seem, Cornell University assumes that cedar apple rust inoculum (orange, swollen galls) is available at the start of the rain. If inoculum is not already present (dry period prior to the rain), add 4 hr at temps above 50˚ F and 6 hr at temps of 46-50˚ F. Infection is unlikely at temps below 46˚ F if inoculum is not already present.

Table 6.2.5. Approximate hours of continuous leaf wetness necessary to produce cherry leafspot infection.

Average Temp (˚F)	Degree of Infection		
	Light (hours)[b]	*Moderate (hours)[b]*	*Heavy (hours) [b]*
50	18	27	36
55	11	19	26
60	6	14	20
65	5	12	19
70	6	14	22
75	10	20	31

Determined by S. Eisensmith and A. Jones, Michigan State University.

[b] Hours of wetness from the beginning of a rain. Assumes significant level of inoculum present.

7 Insect and Mite Management

Table 7.1.1. Efficacy ratings of pome fruit insecticides. *(Key is below Table 7.1.2)*

IR-AC	Trade Name (active ingredient)	AM	Aph	EAS	Int	GF	LH	OBL	PC	PP	RAA	RBL	Δ SB/ BMSB	SJS	TLM	TPB	WAA
4A	**Actara** (thiamethoxam)	1	1	3	1	—	3	0	3	3	3	0	2+/3	0	2	2	—
4A	**Admire Pro, Pasada, Sherpa** (imidacloprid)	1	3	—	—	—	3	—	—	2	3	—	2/2+	2	3	2	2
4A+ 6	***Agri-Flex** (abamectin & thiamethoxam)	1	3	3	1	—	3	0	3	3	3	—	—/1	—	3	1	—
6	***Agri-Mek, *Abacus, *Abba, *Epi-Mek** , ***Temprano** [a] (abamectin)	—	—	—	—	—	3	—	—	3	—	—	—/1	—	3	—	—
28	**Altacor** (chlorantraniliprole)	2	1	3	3	3	—	3	0	—	—	3	—/1	2	3	1	—
3A	***Asana** (esfenvalerate)	3	2	2	2+	3	3	2+	2	2	2	3	2+/2	1	3	3	1
4A	**Assail** (acetamiprid)	3	3	2	3	—	3	0	2	2	3	0	2+/3	2	3	2	2
22A	**Avaunt** (indoxacarb)	2	1	2	2	2+	3	0	3	—	0	2+	2+/1	0	2	2	—
UN	§**Aza-Direct**, §**Azatin,** §**Trilogy**(azadirachtin)	—	2	1	2	1	2	1	0	—	2	1	1/1	1	3	1	1
3A	***Battalion, *Decis** (deltamethrin)	2+	1	2+	2+	2+	3	2	2	3	2+	3	2+/—	1	3	2+	1
3	***Baythroid,** ***Tombstone** (cyfluthrin)	3	2	2	2+	3	3	2+	2	3	2+	3	3/2+	1	3	3	1
4A	**Belay** (clothianidin) w/ supplemental label	—	3	—	2+	—	3	—	?	3	3	—	—/3	—	3	—	—
9C	**Beleaf** (flonicamid)	—	3	—	—	—	—	—	—	—	—	—	2+/1	—	—	3	2
28	**Belt** (flubendiamide)	1	—	—	3	3	—	3	1	—	—	3	—/1	—	3	—	—
3A	***Bifenture, *Brigade, *Fanfare** (bifenthrin) [Pears only]	—	2+	—	2+	2+	—	—	2	2+	—	3	3/3	2	—	3	—
11	(Bt, *Bacillus thuringiensis* toxin): §**Biobit**, §**Deliver**, §**Dipel**, §**Javelin**, §**XenTari**	0	0	0	2	3	0	3	0	0	0	3	0/0	0	0	0	0
4A	**Calypso** (thiacloprid)	3	3	3	3	—	3	1	3	3	3	1	2+/2	2	3	1	2
—	§**Cyd-X** (codling moth granulosis virus) [b]	0	0	0	3	—	0	—	0	0	0	—	—	0	0	0	0
16	**Centaur** (buprofezin)	—	—	—	—	—	2	—	—	3	—	—	—/1	3	—	—	—
3A	(cyhalothrin): ***Warrior** ***LambdaCy, *Proaxis, *Silencer**	3	2	2	2+	3	3	2+	2	2	2	3	3/2+	1	3	3	3
3A	***Danitol** (fenpropathrin)	3	2	2	2+	3	3	2+	2	2	2	3	2+/3	1	3	3	1
5	**Delegate** (spinetoram)	2	0	—	3	3	—	3	2	3	—	3	—/1	—	3	—	—
1B	***Diazinon, *AG500, *AG600** (diazinon)	3	1	—	2	2	1	0	2	0	3	0	2+/1	2	1	1	3
1B	**Dimethoate** (dimethoate) [Pears only]	3	2	—	3	2	3	0	2	0	2	0	2/3	2	1	2	—
3A+ 4A	***Endigo** (cyhalothrin & thiamethoxam)	3	2	2	2+	3	3	2+	2	2	2	3	3/3	2	3	3	—
5	**§Entrust** (spinosad)	2	0	—	2	3	0	3	0	—	0	3	—	—	2	0	—
7C	**Esteem** (pyriproxyfen)	0	0	—	2	0	0	0	0	3	3	0	—/1	3	2	0	—

Table 7.1.1. Efficacy ratings of pome fruit insecticides. *(Key is below Table 7.1.2)*

IR-AC	Trade Name (active ingredient)	AM	Aph	EAS	Int	GF	LH	OBL	PC	PP	RAA	RBL	Δ SB/ BMSB	SJS	TLM	TPB	WAA
1B	**Imidan** (phosmet)	3	1	3	3	1	1	1	3	0	1	3	2/1	2	1	1	1
18	**Intrepid** (methoxyfenozide)	0	0	—	2	—	0	3	0	—	0	3	—/1	0	2	0	—
1A	***Lannate** (methomyl)	2	2	1	3	3	3	2+	2	0	1	3	3/3	2	3	1	1
3A+ 4A	***Leverage** (cyfluthrin & imidacloprid)	3	3	2	3	3	3	2+	3	2	3	3	2+/3	2	3	3	1
1B	**Lorsban, Nufos, Yuma** (chlorpyrifos) [c]	—	—	(3)	(2)	3	(1)	(3)	(3)	0	2	2	(2+/ 2+)	(3)	1	1	—
—	**§M-Pede** (insecticidal soap, potassium fatty acid)	0	2+	0	0	0	1	0	0	2	1	0	—/1	1	0	0	—
23	**Movento** (spirotetramat)	—	3	—	—	—	—	—	—	3	3	—	—/0	3	—	—	3
3A	***Mustang Max** (zeta cypermethrin)	?	2+	2+	2+	?	3	2+	?	2+	?	3	3/2	—	3	3	—
21A	**Nexter** (pyridaben)	—	0	—	—	—	2	—	—	3	—	—	—	—	—	—	—
—	"Oil, dormant": §**JMS Stylet,** §**Omni,** §**PureSpray** etc. (petroleum distillate)	—	2	—	—	—	—	—	—	2+	2	—	—	3	—	—	—
—	"Oil, summer": §**JMS Stylet** §**Omni,** §**PureSpray** etc. (petroleum distillate)	—	—	—	1	—	—	—	—	—	—	—	—	2	1	—	1
3A	(permethrin): ***Ambush**, ***Perm-Up**, ***Pounce** [c]	—	(2)	(2)	—	3	(3)	(2+)	(2)	2	2	(3)	(3/2)	1	(3)	3	—
21A	**Portal** (fenpyroximate)	—	—	—	—	—	?	—	—	3	—	—	—	—	3	—	—
6	***Proclaim** (emamectin benzoate)	0	0	—	2	3	0	3	1	2	0	3	—/1	0	3	0	—
3A	§**Pyganic, Pyrenone** [d] (pyrethrin)	—	—	—	—	—	—	—	—	—	—	?	—	—	—	—	—
15	**Rimon** (novaluron)	—	—	—	3	—	2	3	—	—	—	3	—/1	—	3	2	—
1A	**Sevin** (carbaryl)	2	1	2	2	1	3	2	2	0	1	1	2/2	2	1	1	1
—	**§Surround** (kaolin)	2	1	—	2	2	1	1	2	2	0	1	1/2	2	2	0	—
2A	***Thionex** (endosulfan) [a]	0	2	—	0	3	3	2	0	0	2	2	3/3	1	1	1	2
16+ 28	**Tourismo (**flubendiamide & buprofezin)	1	—	—	2+	3	—	3	1	2	—	3	—/1	2+	3	—	—
4A+ 28	**Voliam Flexi** chlorantraniliprole & thiamethoxam)	2	3	3	3	3	3	3	3	3	3	3	2+/3	2	2	1	—
3A+ 28	***Voliam Xpress** (chlorantraniliprole & cyhalothrin)	2	2	3	3	3	3	3	3	2	2	3	2+/2+	1	3	3	—
1A	***Vydate** (oxamyl) [a]	0	2	—	0	—	2	0	0	0	2	—	2+/2+	1	3	1	1
3A	***Warrior –** see cyhalothrin																

Table 7.1.2. Efficacy ratings of pome fruit miticides (and insecticides with miticide activity)

IRAC	**Trade Name** (active ingredient)	ERM	TSM	ARM	PRM
6	***Agri-Mek, *Abacus, *Abba, *Epi-Mek, *Temprano** etc. (abamectin)	3	2	3	3
UN	**Acramite** (bifenazate)	3	3	0	0
10A	**Apollo** (clofentezine)	3	1	1	1
UN	§**Aza-Direct**, §**Azatin,** §**Trilogy** (azadirachtin)	1	1	1	—
3A	***Danitol** (fenpropathrin) [e]	1+	—	—	—
23	**Envidor** (spirodiclofen)	3	3	3	3
20B	**Kanemite** (acequinocyl)	3	3	—	—
21A	**Nexter** (pyridaben)	3	2	2	2
—	"Oil, dormant": §**JMS Stylet,** §**Omni,** §**PureSpray** etc. (petroleum distillate)	3	—	—	2
—	"Oil, summer": §**JMS Stylet** §**Omni,** §**PureSpray** (petroleum distillate)	3	1	2	2
21A	**Portal** (fenpyroximate)	3	3	3	3
6	***Proclaim** (emamectin benzoate)	2	2	—	—
10A	**Savey, Onager** (hexythiazox)	3	1	1	1
—	**§Surround** (kaolin)	2	—	—	—
2A	***Thionex** (endosulfan)	—	—	2+	2
12B	**Vendex** (fenbutatin oxide, hexakis)	1+	2+	2	2
1A	***Vydate** (oxamyl)	2	2+	2+	2+
10B	**Zeal** (etoxazole)	3	3	0	0

KEY TO TABLES 7.1.1 AND 7.1.2

IRAC = Insecticide **R**esistance **A**ction **C**ommittee Mode of Action classification.

Arthopod pest populations are more likely to exhibit cross-resistance to pesticides within the same IRAC group number.

1A = Carbamates, 1B = Organophosphates, 2A = Organochlorines, 3A = Pyrethroids and pyrethrins, 4A = Neonicotinoids, 5 = Spinosyns, 6 = Avermectins, 7 = Juvenile hormone mimics, 9 = Homopteran feeding blockers, 10 = Mite growth inhibitors, 11 = Midgut disruptors, 12 = ATP inhibitors, 15 & 16 = Chitin inhibitors, 18 = Ecdysone agonists, 20 & 21 = Mitochondrial inhibitors, 22 = Sodium channel blockers, 23 = Acetyl CoA inhibitors, 28 = Diamides, UN = unknown.

Efficacy Ratings:

3 = Good, 2+ = Fair to Good, 2 = Fair, 1+ = Poor to Fair, 1 = Poor, 0 = Little or no effect, — = Unknown or not used for this pest.

? = Pest listed on label but no efficacy rating available. Results may depend on timing, dose, or pest density

( ) = Pesticide cannot be used at typical timing at which this pest is treated.

Pest Abbreviations:

AM = Apple maggot
Aph = Spirea aphid and apple aphid
ARM = Apple rust mite
BMSB = Brown marmorated stink bug
EAS = European apple sawfly
ERM = European red mite
GFW = Green fruitworms
Int = Internal Leps (Codling moth, Oriental fruit moth, & Lesser appleworm)
LH = White apple & Potato leafhoppers
OBL = Obliquebanded leafroller
PC = Plum curculio
PP = Pear psylla
PRM = Pear rust mite
RAA = Rosy apple aphid
RBL = Redbanded leafroller
SB = Brown, dusky brown, and green stink bugs
SJS = San Jose scale
TLM = Spotted tentiform leafminer
TPB = Tarnished plant bug
TSM = Twospotted spider mite
WAA = Woolly apple aphid

Footnotes

***** = Restricted-use pesticide; only certified applicators may purchase, use requires supervision of a certified applicator.

§ = Potentially acceptable in certified organic programs.

Δ = Efficacy ratings for stink bugs may not apply equally for all stink bug species. SB refers to brown, dusky brown, and green stink bugs. Brown marmorated stink bug has not damaged tree fruit crops in New England as of 2012, but has become an important pest of tree fruit and other crops in the Mid-Atlantic states. BMSB ratings from the *Pennsylvania Tree Fruit Production Guide*.

[a] Abamectin rated "Good" for control of Pearleaf blister mite. Thionex and Vydate rated "Fair".

[b] = Granulosis virus has good efficacy against codling moth, fair against oriental fruit moth, and is not effective on lesser appleworm.

[c] Chlorpyrifos (Lorsban, Nufos) cannot be used as canopy sprays after petal fall. Permethrin (Ambush, Perm-Up, Pounce) cannot be used for any application after petal fall. Efficacy ratings are for prebloom application, which may not be an optimum or typical threshold timing for control of the pests listed.

[d] Pyrethrin has much shorhter residual activity than alternative products.

[e] Danitol less effective against late season mite populations.

Table 7.1.3. Relative toxicity of pome fruit insecticides and miticides to beneficial arthropods.

		Beneficial Species			
Trade Name (active ingredient)	Honeybee[1]	*Amblyseius fallacis*[2]	*Typhlodromus pyri*[2]	*Stethorus punctum*[3]	*Aphidoletes aphidimyza*[4]
Acramite (bifenazate)	M	M	M	L	L
Actara (thiamethoxam)	M	L	L	L	L
Admire Pro, Pasada, Sherpa (imidacloprid)	H	L	L	M	L
***Agri-Flex** (abamectin/thiamethoxam)	M	M	M	M	L
***Agri-Mek, *Abacus, *Abba, *Epi-Mek, *Temprano** etc. (abamectin)	L	M	M	M	L
Altacor (chlorantraniliprole)	L	L	L	L	L
Apollo (clofentezine)	L	L	L	L	L
***Asana** (esfenvalerate)	H	H	H	H	M
Assail (acetamiprid)	L	M	L	M	M
Avaunt (indoxacarb)	M	L	L	L	L
§**Aza-Direct**, §**Azatin**, §**Trilogy** (azadirachtin)	M	L	L	L	L
***Battalion, *Decis** (deltamethrin)	M	H	H	H	M
***Baythroid, *Tombstone** (cyfluthrin)	H	H	H	H	H
Belay (clothianidin) w/ suppl. label	H	L	L	M	L
Beleaf (flonicamid)	L	L	L	?	?
Belt (flubendiamide)	L	L	L	L	L
***Bifenture, *Brigade, *Fanfare** (bifenthrin) [Pears only]	M-H	?	?	?	?
(Bt, *Bacillus thuringiensis* toxin): §**Biobit**, §**Deliver**, §**Dipel**, §**Javelin, §XenTari**	L	L	L	L	L
Calypso (thiacloprid)	L	L	L	M	L
§**Cyd-X** (granulosis virus) [a]	L	L	L	L	L
Centaur (buprofezin)	L	L	L	M	L
(cyhalothrin): ***Warrior *Lambda-Cy, *Proaxis, *Silencer**	H	H	H	H	H
***Danitol** (fenpropathrin)	H	H	H	H	H
Delegate (spinetoram)	L	M	M	L	L
***Diazinon, *AG500 *AG600** (diazinon)	H	M	M	M	H
Dimethoate (dimethoate) [Pears only]	H	H	H	M	H
***Endigo** (cyhalothrin & thiamethoxam)	H	H	H	H	H
§**Entrust** (spinosad)	L	L	L	L	L
***Envidor** (spirodiclofen)	H	L	L	M	?
Esteem (pyriproxyfen)	L	L	L	M	L
Imidan (phosmet)	H	L	L	L	M
§**M-Pede** (potassium fatty acid)	L	L	L	L	L
Intrepid (methoxyfenozide)	L	L	L	L	L
Kanemite (acequinocyl)	L	L	L	L	?
***Lannate** (methomyl)	H	H	H	M	H
***Leverage** (cyfluthrin/ imidacloprid)	H	H	H	H	H
Lorsban, Nufos (chlorpyrifos) [b]	H	M	M	L	L
§**M-Pede** (potassium fatty acid)	L	L	L	L	L
Movento (spirotetramat)	L	L	L	L	L
***Mustang Max** (zeta cypermethrin)	H	H?	H?	H?	?
Nexter (pyridaben)	H	M	L-M	M	M
"Oil, dormant": §**JMS Stylet,** §**Omni,** §**PureSpray** etc. (petroleum distillate)	L	?	?	L	L

Table 7.1.3. Relative toxicity of pome fruit insecticides and miticides to beneficial arthropods.

		Beneficial Species			
Trade Name (active ingredient)	Honeybee[1]	*Amblyseius fallacis*[2]	*Typhlodromus pyri*[2]	*Stethorus punctum*[3]	*Aphidoletes aphidimyza*[4]
"Oil, summer": §**JMS Stylet** §**Omni,** §**PureSpray** etc. (petroleum distillate)	L	L-M[a]	L-M[b]	L	L
(permethrin): ***Ambush**, ***Perm-Up**, ***Pounce** **[**b]	H	H	H	H	L
Portal (fenpyroximate)	L	L	L	M	?
***Proclaim** (emamectin benzoate)	H	L	L	?	?
§**Pyganic, Pyrenone** [c] (pyrethrin)	M	?	?	?	?
Rimon (novaluron)	M	L	L	H	?
Savey, Onager (hexythiazox)	L	L	L	?	?
Sevin (carbaryl)	H	M	L	H	H
§Surround (kaolin)	L	L	L	L	L
***Thionex** (endosulfan) [e]	M	L	L	M	M
Vendex (fenbutatin oxide, hexakis)	L	L	L	L	L
Voliam Flexi (chlorantraniliprole & thiamethoxam)	M	L	L	L	L
***Voliam Xpress** (chlorantraniliprole & cyhalothrin)	H	H	H	H	H
***Vydate** (oxamyl) [e]	M	H	H	L	M
Zeal (etoxazole)	L	M	M	L	L

KEY TO TABLE 7.1.3:

[1] Honeybee = *Apis mellifera*

[2] *A. fallacis* and *T. pyri* are mite predators of pest mites

[3] *S. punctum* is a ladybird beetle predator of mites.

[4] *A. aphidimyza* is an cecidomyiid fly larva predator of aphids.

Honeybee toxicity ratings:

L = Low; not hazardous to honey bees at any time. 1 hr to 1 day residual toxity
M = Moderate; not hazardous if applied either in evening or early morning when honey bees are not foraging, except during periods of high temperature. 3 hr to 1 day residual toxicity
H = High; hazardous to honey bees at any time. 1 day to 2 week residual toxicity.
? = unknown

Toxicity ratings for other beneficial species:

L = low impact on population (less than 30% mortality).
M = moderate impact on poppulati (between 30% and 70% mortality).
H = high impact on opulation (more than 70% mortality).

Footnotes:

[a] = low impact on immatures, moderate impact on eggs.
[b] = low impact on adults, moderate impact on eggs and immatures. Population recovery within 7 days.
[c] = Dependent on rate.

Information compiled from 48-hr residue tests, and in some cases field tests, at the NYS Agricultural Experiment Station. Pyrethroids and other pesticides with long residual periods have greater impact than those with a shorter residual.

Table 7.1.4. Activity spectrum of stone fruit insecticides.

Insecticide	IRAC‡	APB	Aphids	CFF	JB	OFM	PC	PTB/ LPTB	ΔSB/ BMSB	SWD	TPB	WFT
Actara	4A	—	2	2	2	—	3	—	2+/3	—	2	—
Admire Pro (imidacloprid)	4A	0	3	0	2+	0	1	0	2/2+	2	2	—
Altacor (chlorantraniliprole)	28	—	—	2	—	3	0	—	—/1	—	1	—
*Ambush, *Pounce (permethrin); except plums or apricots	3	—	—	3	—	2+	2	2	3/2	—	3	2
*Asana (esfenvalerate)	3	1	–	3	—	2+	2	3	2+/2	3	3	2
Assail (acetamiprid)	4A	—	3	3	3	3	2	—	2+/3	2	2	—
Avaunt	22	—	—	—	3	3	3	—	2+/0	—	2	—
§Aza-Direct, Azatin (azadirachtin)	18B	—	2	—	0	2	0	2	1/1	—	1	—
*Baythroid (cyfluthrin)	3	—	3	3	—	2+	2	3	3/2+	3	3	—
Belay (clothianidin) – peach only	4A	—	—	—	—	—	2+	—	—/3	—	3	—
Beleaf (flonicamid)	9C	—	3	—	—	—	—	—	2+/0	—	3	—
Belt (flubendiamide)	28	—	—	—	—	3	1	—	—/1	—	—	—
Centaur (buprofezin)	16	—	—	—	—	—	—	—	—/1	—	—	—
(cyhalothrin): *Warrior *Lambda-Cy, *Proaxis, *Silencer	3	3	1	3	3	1	2+	2	3	3/2+	--	3
*Danitol (fenpropathrin)	3	—	—	—	—	2-3	2	—	3/3	3	3	—
Delegate (spinetoram)	5	—	—	3	—	3	2	—	—/1	3	—	3
*diazinon	1B	—	1	3	—	1	2	0	2+/1	3	1	—
*Endigo (cyhalothrin & thiamethoxam	3A/4A	—	—	—	—	—	2	—	3/3	—	3	—
§Entrust (spinosad)	5	—	—	—	—	—	0	—	—	3	0	3
Imidan (phosmet); except sweet cherries	1B	—	1	3	1	2+	3	0	2/1	3	1	—
Intrepid	18	—	—	—	—	2+	0	—	—/0	—	0	—
*Lannate (methomyl) – peach only	1A	—	2	—	—	2	2	1	3/3	3	1	3
Leverage (cyfluthrin/imidacloprid)	3/4A	0	3	3	3	3	3	3	2+/3	3	3	—
Lorsban (chlorpyrifos) except apricots or plums	1B	3	2	3	—	—	(3)	3	(2/2+)	—	(1)	—
malathion	1B	—	2	1	1	1	2	0	—	2+	1	—
§M-Pede (insecticidal soap, potassium fatty acids)	—	0	2-3	0	0	0	0	0	—/1	—	0	—
Mustang Max (zeta cypermethrin	3A	—	—	—	—	—	—	—	3/2	3	3	—
Proaxis (gamma cyhalothrin)	3A	—	—	—	—	—	2	—	3/2+	—	3	—
Sevin (carbaryl)	1A	—	3	3	3	2	2	0	2/2	3	1	1
§Surround (kaolin)	—	—	—	1	2	1	2	2	—	1/2	—	0	—
Tourismo (flubendiamide/ buprofezin	28/16	—	—	—	—	3	1	—	—/1	—	1	—
Voliam Flexi (chlorantraniprole & thiamethoxam	4A/28	—	—	—	—	3	2+	—	2+/3	—	2+	
*Voliam Xpress (chlorantraniliprole/lambda-cyhalothrin)	3/28	2	3	3	3	3	3	3	2+/2+	—	3	2

Key on next page.

KEY TO TABLE 7.1.4:

Efficacy ratings:

— = unknown or does not apply in this case; **0** = Not effective; **1** = Poor; **1⁺** = Poor to Fair; **2** = fair; **2⁺** =Fair to Good; **3** = Good
( ) = Pesticide cannot be used at typical timing at which this pest is treated.
* Restricted-use pesticide; may be purchased and used only by certified applicators, or used by someone under the supervision of a certified applicator.
§ = Potentially acceptable in certified organic programs
‡ = IRAC (**I**nsecticide **R**esistance **A**ction **C**ommittee) Mode of Action Classification Group: Arthropod pest populations are more likely to exhibit cross-resistance to materials within the same group.
Δ = Efficacy ratings for stink bugs may not apply equally for all stink bug species. SB refers to brown, dusky brown, and green stink bugs. Brown marmorated stink bug has not damaged tree fruit crops in New England as of 2012, but has become an important pest of tree fruit and other crops in the Mid-Atlantic states. BMSB ratings from the *Pennsylvania Tree Fruit Production Guide*.

Key to pests:

APB = American plum borer
Aphids = Black cherry, green peach aphids
BMSB = Brown marmorated stink bug
CFF = Cherry fruit flies
JB = Japanese beetle
OFM = Oriental fruit moth
PC = Plum curculio
PTB/LPTB = Peach tree borer/Lesser peach tree borer
SB =Brown, Dusky brown and Green stink bugs (native species).
SWD = Spotted wing drosophila
TPB = Tarnished plant bug
WFT = Western flower thrips

Table 7.1.5. Cumulative degree-days for early season fruit phenology and arthropod pest events[1].

Pest Event or McIntosh Bud Stage (key events shaded)	[1]Average DD43 after McIntosh 50% Green Tip	Approximate Average Date 1970–2000					
		Middlefield CT	Greenville RI	Belcher-town MA	Hollis NH	South Burlington VT	Monmouth ME
***PPS** – egg laying starts on first days with high temperatures over 50F, not well correlated with cumulative DD43.	Rough average is about 7 days before GT	March 30	March 30	April 4	April 6	April 12	April 17
McIntosh 50% Green Tip	0	**April 6**	**April 6**	**April 11**	**April 13**	**April 19**	**April 24**
Plum – Swollen Bud	8	April 7	April 7	April 12	April 14	April 20	April 25
RBLR – 1st adult catch	23	April 10	April 11	April 16	April 17	April 24	April 28
Peach – Bud Burst	34	April 12	April 13	April 18	April 19	April 26	April 30
Green Fruitworm – peak flight	38	April 13	April 14	April 18	April 20	April 26	April 30
Pear – Bud Burst	39	April 13	April 14	April 19	April 20	April 26	April 30
STLM – 1st adult catch	42	April 14	April 14	April 19	April 21	April 27	May 1
Sweet Cherry – Bud Burst	45	April 14	April 15	April 20	April 21	April 27	May 1
Plum – Bud Burst	55	April 16	April 17	April 21	April 23	April 29	May 3
McIntosh Half Inch Green	56	**April 16**	**April 17**	**April 21**	**April 23**	**April 29**	**May 3**
Rosy apple aphid – 1st nymphs	68	April 18	April 19	April 23	April 25	May 1	May 4
Peach – Half Inch Green	73	April 18	April 19	April 24	April 25	May 1	May 5
STLM - 1st egglaying	87	April 20	April 21	April 26	April 27	May 3	May 6
Sweet Cherry – White Bud	99	April 22	April 23	April 27	April 29	May 5	May 8

Table 7.1.5. Cumulative degree-days for early season fruit phenology and arthropod pest events[1].

Pest Event or McIntosh Bud Stage (key events shaded)	[1]Average DD43 after McIntosh 50% Green Tip	Approximate Average Date 1970–2000					
		Middlefield CT	Greenville RI	Belcher-town MA	Hollis NH	South Burlington VT	Monmouth ME
Tarnished Plant Bug active	101	April 22	April 23	April 27	April 29	May 5	May 8
Plum – Green Cluster	102	April 22	April 23	April 28	April 29	May 5	May 8
Peach – Pink	108	April 23	April 24	April 28	April 30	May 6	May 9
Pear – Green Cluster	112	April 23	April 25	April 29	April 30	May 6	May 9
OBLR – larvae active	115	April 24	April 25	April 29	May 1	May 6	May 10
McIntosh Tight Cluster	116	**April 24**	**April 25**	**April 29**	**May 1**	**May 6**	**May 10**
Plum – White Bud	118	April 24	April 25	April 29	May 1	May 7	May 10
PPS – egg hatch begins	130	April 25	April 27	May 1	May 2	May 8	May 11
Sweet Cherry – Bloom	155	April 28	April 29	May 3	May 5	May 10	May 14
OFM – 1st adult catch	156	April 28	April 29	May 3	May 5	May 11	May 14
ERM – overwinterd egg hatch	163	April 29	April 30	May 4	May 6	May 11	May 14
Pear – White Bud	163	April 29	April 30	May 4	May 6	May 11	May 14
Peach – Bloom	173	April 30	May 1	May 5	May 7	May 12	May 15
McIntosh extended Pink	176	**April 30**	**May 1**	**May 5**	**May 7**	**May 12**	**May 15**
RBLR – 1st flight peak	176	April 30	May 1	May 5	May 7	May 12	May 15
Plum – Bloom	183	May 1	May 2	May 6	May 8	May 13	May 16
McIntosh King Bloom	213	**May 3**	**May 5**	**May 9**	**May 10**	**May 16**	**May 19**
STLM – 1st flight peak	215	May 4	May 5	May 9	May 10	May 16	May 19
Pear – Bloom	223	May 4	May 6	May 10	May 11	May 16	May 19
McIntosh Full Bloom	263	**May 8**	**May 9**	**May 13**	**May 14**	**May 20**	**May 23**
CM – set pheromone traps	263	Apple bloom					
OBLR – larval sample date	263	Apple bloom					
Sweet Cherry – Petal Fall	264	May 8	May 9	May 13	May 14	May 20	May 23
*MPB – egg hatch begins	266	May 8	May 9	May 13	May 15	May 20	May 23
Plum – Petal Fall	271	May 8	May 10	May 14	May 15	May 20	May 23
Peach – Petal Fall	285	May 9	May 11	May 15	May 16	May 21	May 24
LAW – 1st adult catch	291	May 10	May 11	May 15	May 16	May 22	May 25
Pear – Petal Fall	304	May 11	May 12	May 16	May 17	May 23	May 26
WAL – nymphs active	310	May 11	May 13	May 16	May 18	May 23	May 26
Sweet Cherry – Fruit Set	313	May 11	May 13	May 17	May 18	May 23	May 26
APB – 1st adult catch	324	May 12	May 14	May 17	May 19	May 24	May 27
OFM – 1st flight peak	326	May 12	May 14	May 18	May 19	May 24	May 27
*MPB – 50% egg hatch	330	May 13	May 14	May 18	May 19	May 24	May 27
McIntosh 95% Petal Fall	352	**May 14**	**May 16**	**May 19**	**May 21**	**May 26**	**May 29**
Plum – Fruit Set	353	May 14	May 16	May 19	May 21	May 26	May 29
Pear – Fruit Set	369	May 15	May 17	May 21	May 22	May 27	May 30

[1] See notes at the end of Table 7.1.6.

Table 7.1.6. Cumulative degree-days for late season arthropod pest events.

Pest Event or McIntosh Bud Stage (key events shaded)	[1]Average DD43 after McIntosh 50% Petal Fall	Approximate Average Date 1970–2000					
		Middlefield CT	Greenville RI	Belcher-town MA	Hollis NH	South Burlington VT	Monmouth ME
McIntosh 95% Petal Fall	0	**May 14**	**May 16**	**May 19**	**May 21**	**May 26**	**May 29**
ERM – start 1st gen. sampling. Threshold = 1 ERM per leaf.	Apple Petal Fall						
STLM – sampling window 1st gen. sapfeeding mines begins.	Apple Petal Fall						
CM – 1st adult catch	16	May 15	May 17	May 21	May 22	May 27	May 30
SJS – 1st adult catch	49	May 17	May 19	May 23	May 24	May 29	June 1
CFF – set traps	49	May 17	May 19	May 23	May 24	May 29	June 1
*MPB – 90% egg hatch	68	May 19	May 20	May 24	May 25	May 30	June 2
McIntosh Fruit Set	82	**May 20**	**May 21**	**May 25**	**May 26**	**May 31**	**June 3**
LAW – 1st flight peak	82	May 20	May 21	May 25	May 26	May 31	June 3
PC – apple cutting observed	82	May 20	May 21	May 25	May 26	May 31	June 3
PPS – hardshell stage	96	May 20	May 22	May 26	May 27	June 1	June 4
LPTB – 1st adult catch	111	May 21	May 23	May 27	May 28	June 2	June 5
SJS – 1st flight peak	177	May 25	May 27	May 30	May 31	June 5	June 8
***ERM** – end of 1st gen. optimum sample period	213	May 27	May 29	June 1	June 2	June 7	June 10
STLM – optimum sampling & control window ending	213	May 29	May 31	June 4	June 5	June 10	June 13
*OFM – 1st gen. treatment date	259	May 29	May 31	June 4	June 5	June 10	June 13
CM – 1st flight peak	312	June 1	June 3	June 6	June 7	June 12	June 15
APB – 1st flight peak	326	June 2	June 3	June 7	June 8	June 13	June 16
*RATB – egglaying begins	388	June 5	June 7	June 10	June 11	June 16	June 19
OBLR – 1st adult catch	430	June 7	June 8	June 12	June 13	June 18	June 21
***CM** – 1st gen. optimum single treatment date (3% egg hatch)	436	June 7	June 9	June 12	June 13	June 18	June 21
***PC** – end of movement from external sites into orchards	500	June 10	June 12	June 15	June 16	June 21	June 24
***ERM** – start 2nd gen. samplng. Threshold = 2.5 ERM per leaf	501	June 10	June 12	June 15	June 16	June 21	June 24
OBLR – 1st flight peak	518	June 11	June 13	June 16	June 17	June 22	June 25
PTB – 1st adult catch	592	June 14	June 16	June 19	June 20	June 25	June 28
STLM – start of 2nd flight	603	June 14	June 16	June 20	June 21	June 25	June 29
DWB – 1st adult catch	615	June 15	June 17	June 20	June 21	June 26	June 29
***ERM** – end of 2nd gen. optimum sample period	644	June 16	June 18	June 22	June 23	June 27	July 1
SJS – 1st crawlers appear	651	June 17	June 18	June 22	June 23	June 27	July 1
*RATB – egg hatch begins	697	June 18	June 20	June 24	June 25	June 29	July 3
*OBLR – egg hatch begins	776	June 22	June 23	June 27	June 28	July 3	July 6
*DWB egg hatch begins	818	June 23	June 25	June 29	June 30	July 4	July 8
*RATB – peak egglaying begins	876	June 26	June 27	July 1	July 2	July 6	July 10

Table 7.1.6. Cumulative degree-days for late season arthropod pest events.

Pest Event or McIntosh Bud Stage (key events shaded)	[1]Average DD43 after McIntosh 50% Petal Fall	Approximate Average Date 1970–2000					
		Middlefield CT	Greenville RI	Belcher-town MA	Hollis NH	South Burlington VT	Monmouth ME
***ERM** – 3rd gen. sampling. June threshold 2.5, July 5.0	895	June 26	June 28	July 2	July 3	July 7	July 11
LPTB – peak catch	897	June 26	June 28	July 2	July 3	July 7	July 11
OFM – 2nd flight begins	925	June 27	June 29	July 3	July 4	July 8	July 12
RBLR – 2nd flight begins	937	June 28	June 30	July 4	July 4	July 9	July 13
AM – 1st catch	980	June 30	July 1	July 5	July 6	July 11	July 14
OBLR – summ. larvae sample	1030	July 1	July 3	July 7	July 8	July 12	July 16
*ERM – end of 3rd gen. optimum sample period	1090	July 4	July 5	July 9	July 10	July 15	July 19
CM – 1st flight ending	1098	July 4	July 6	July 10	July 10	July 15	July 19
STLM – 2nd flight peak	1111	July 4	July 6	July 10	July 11	July 15	July 19
*OFM – 2nd gen first treatment	1135	July 5	July 7	July 11	July 12	July 16	July 20
DWB – peak adult catch	1219	July 8	July 10	July 14	July 15	July 20	July 24
LAW – 2nd flight begins	1237	July 9	July 11	July 15	July 16	July 20	July 24
*RATB – peak egglaying ends	1254	July 9	July 11	July 15	July 16	July 21	July 25
OFM – 2nd flight peak	1257	July 10	July 12	July 16	July 16	July 21	July 25
STLM – 2nd gen. sapfeeder mines, first sample	1293	July 11	July 13	July 17	July 18	July 22	July 27
*RATB – peak egg hatch begins	1301	July 11	July 13	July 17	July 18	July 23	July 27
RBLR – 2nd flight peak	1305	July 11	July 13	July 17	July 18	July 23	July 27
SJS – 2nd flight begins	1320	July 12	July 14	July 18	July 19	July 23	July 28
APB – 2nd flight begins	1331	July 12	July 14	July 18	July 19	July 24	July 28
STLM – 2nd gen. sapfeeder mines, second sample if needed	1443	July 16	July 18	July 22	July 23	July 28	August 1
CM – 2nd flight begins	1446	July 16	July 18	July 22	July 23	July 28	August 2
*OFM – 2nd gen., second trtmt.	1458	July 17	July 19	July 23	July 24	July 29	August 2
*STLM – 2nd gen. sapfeeder, third sample if needed	1753	July 27	July 29	August 3	August 4	August 9	August 14
DWB – peak egg hatch	1810	July 29	July 31	August 5	August 6	August 11	August 17
APB – 2nd flight peak	1821	July 29	July 31	August 5	August 6	August 12	August 17
SJS – 2nd flight peak	1841	July 30	August 1	August 6	August 7	August 13	August 18
CM – 2nd flight peak	1860	July 31	August 2	August 7	August 8	August 13	August 19
*RATB – peak egg hatch ends	1861	July 31	August 2	August 7	August 8	August 13	August 19
AM – peak flight	1907	August 1	August 4	August 9	August 9	August 15	August 21
***CM** – 2nd gen. optimum single treatment date (7% egg hatch)	1972	August 4	August 6	August 11	August 12	August 18	August 24
CMB – 2nd gen. crawlers	1974	August 4	August 6	August 11	August 12	August 18	August 24
OBLR –2nd flight begins	1982	August 4	August 6	August 11	August 12	August 19	August 24
STLM – 3rd flight begins	1983	August 4	August 6	August 11	August 12	August 19	August 24
***WALH** – 2nd gen. nymphs	1993	August 5	August 7	August 12	August 13	August 19	August 25
OFM – 3rd flight begins	2063	August 7	August 9	August 15	August 15	August 22	August 28

Table 7.1.6. Cumulative degree-days for late season arthropod pest events.

Pest Event or McIntosh Bud Stage (key events shaded)	[1]Average DD43 after McIntosh 50% Petal Fall	Approximate Average Date 1970–2000					
		Middlefield CT	Greenville RI	Belcher-town MA	Hollis NH	South Burlington VT	Monmouth ME
STLM – 3rd flight peak	2324	August 17	August 19	August 25	August 26	Sept. 4	Sept. 12
SJS – 2nd gen. crawlers	2326	August 17	August 19	August 25	August 26	Sept. 4	Sept. 12

Notes for Table 7.1.5 and Table 7.1.6.

1, Baskerville-Emin formula used to calculate degree-days with a 43F base.

* DD43 for these events are based on temperature model estimates from season-long hourly weather data from six New England orchard sites in 2011 and 2012. The average DD43 assocation for model output dates was used to translate these models into cumulative DD43 equivalents. For models for which the only difference is the base temperature, this correlation is strong. For mite development and other models based on other temperature relationships, the average DD43 correlation serves as a less precise but still useful estimate.

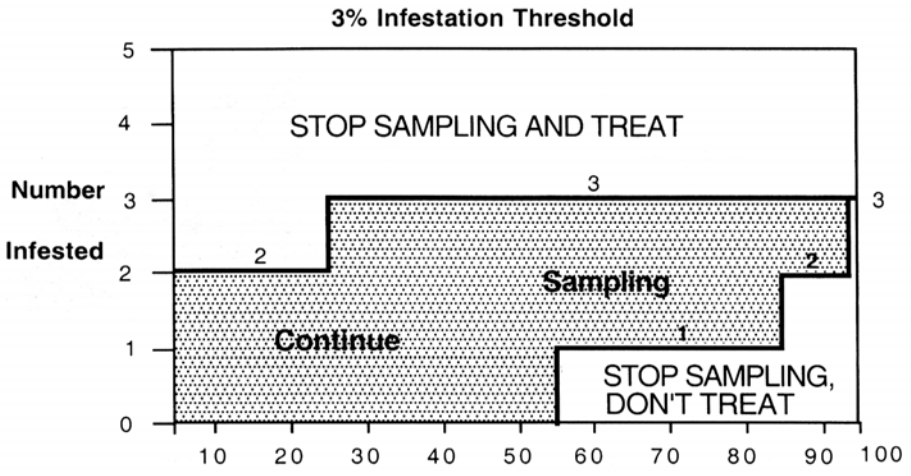
Abbreviations: AM = Apple maggot, APB = American plum borer, CFF = Cherry fruit fly, CM = Codling moth, CMB = Comstock mealybug, DWB = Dogwood borer, ERM = European red mite, LAW = Lesser appleworm, LPTB = Lesser peach tree borer, MPB = Mullein plant bug,
OBLR = Obliquebanded leafroller, OFM = Oriental fruit moth, PC = Plum curculio, PTB = Peach tree borer,
RBLR = Redbanded leafroller, SJS = San Jose scale, STLM = Spotted tentiform leafminer, WAL = White apple leafhopper.

Except as noted above for items with *, information in this table is drived from field observations by Dave Kain, Art Agnello et al. at the New York Agricultural Research Station in Geneva NY. Converting values to relative timing after McIntosh Green Tip and Petal Fall has been a reliable way to apply DD43 targets defined in Geneva NY to New England orchards for several indicator pests and bud stages. The same approach is applied here to a full list of pest and budstage events. However, differences in day length, non-linear responses to temperature extremes, and other site specific interactions can shift pest and tree phenology in addition to degree day accumulation. In some cases, the average McIntosh budstage model dates shown do not exactly match anecdotally reported observer average dates, but model budstage dates are displayed as reference points for estimates of other budstage and pest events. While subject to limitations, the table is a useful reference to forecast pest and tree phenology events at different New England sites for scheduling scouting and sampling.

Year to year variation in seasonal weather has a greater effect of +/– 0 to 12 days or more variation on the actual current year date. Comparing the date of the most recent McIntosh bud stage with the value shown for a nearby site in the table provides a simple and reasonably accurate way to adjust dates for the current year. For example, if the date of 95% McIntosh Petal Fall occurs 5 days earlier (or later) than the date shown, then subtract (or add) 5 days from subsequent dates displayed in the table to adjust for current year deviation. Looking ahead, estimated dates are based on climatic average temperatures. If the forecast is for above (or below) average temperatures, the expected date shifts earlier (or later).

Pesticide application and other management decisions should be made on direct observations.

Figure 7.1.1 - Obliquebanded Leafroller Sampling Form



- Examine 10 bud clusters (overwintering generation) or expanding terminals (1st summer generation) per tree for live OBLR larvae. For the 1st summer generation, sample at ~600 degree-days (43°F base) after the 1st moth flight in your area; if you do not have access to this information, use July 5 as an estimated best sample date in WNY (5-7 days earlier in ENY and Long Island).

- Sample every other tree starting with a random tree and continuing down the row. Remember that you are NOT counting OBLR larvae, but sites infested with LIVE OBLR. If trees are >10ft tall, try to include some samples from the upper canopy, or from watersprouts.

- If the total number of infested samples falls in the "Continue Sampling" zone, sample another tree. If the total falls in the "Stop Sampling, Don't Treat" zone, sampling is stopped and no treatment is recommended. If the total falls in the "Stop Sampling and Treat" zone, sampling is stopped and treatment is recommended. Refer to the Apple Pesticide Spray Table for a choice of pesticide materials.

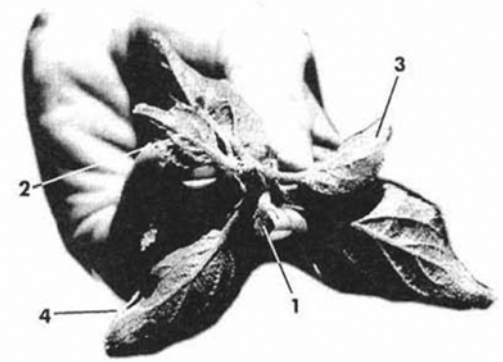
- Continue sampling until you REACH one of the boldface staircase lines in the chart above, or until you have examined a maximum of 100 clusters. If you reach the intersection of the two lines by the 100th sample, withhold treatment.

- If a no-treat decision is made for 1st summer generation larvae, resample again in 3-5 days (after approximately 100 DD more have accumulated). A second no-treat decision indicates that no treatment is recommended against this brood of OBLR.

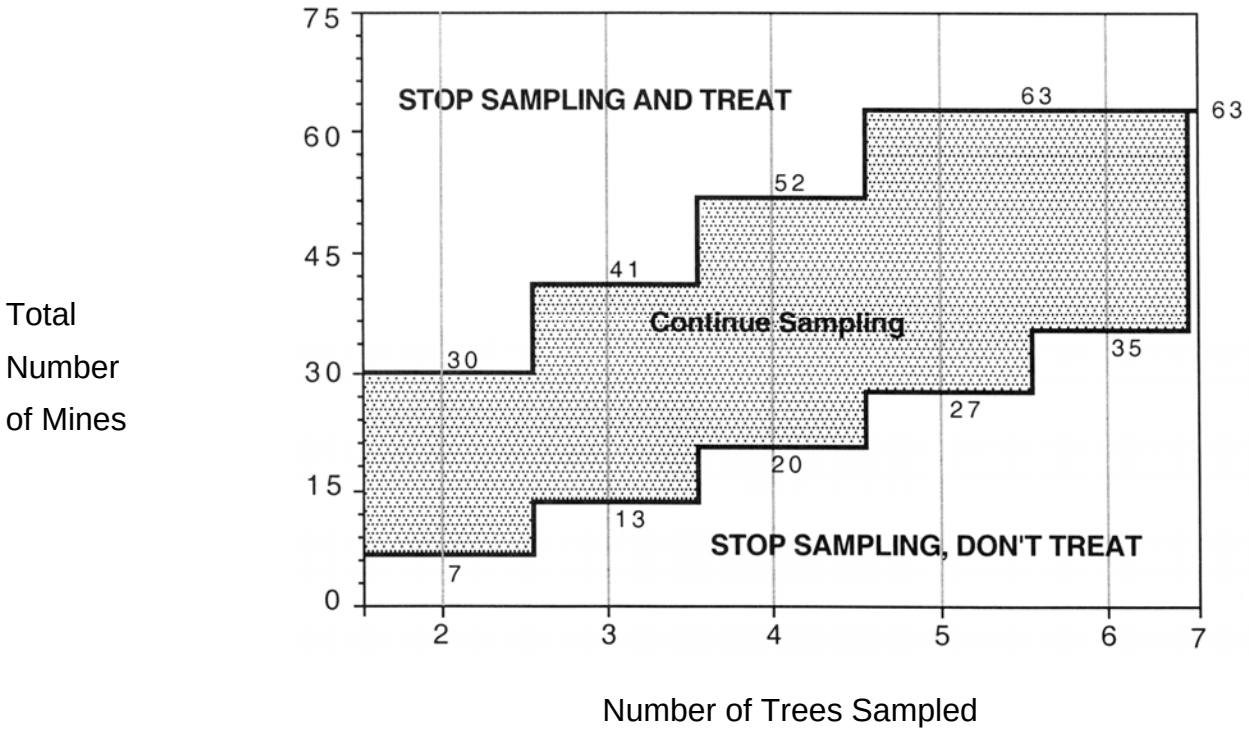
Use this table to keep track of your samples

Total Number Examined		# Infested	Total Number Examined		# Infested
10	……...	_____	60	……...	_____
20	……...	_____	70	……...	_____
30	……...	_____	80	……...	_____
40	……...	_____	90	……...	_____
50	……...	_____	100	……...	_____

Figure 7.1.2 - STLM Petal Fall Sampling Form



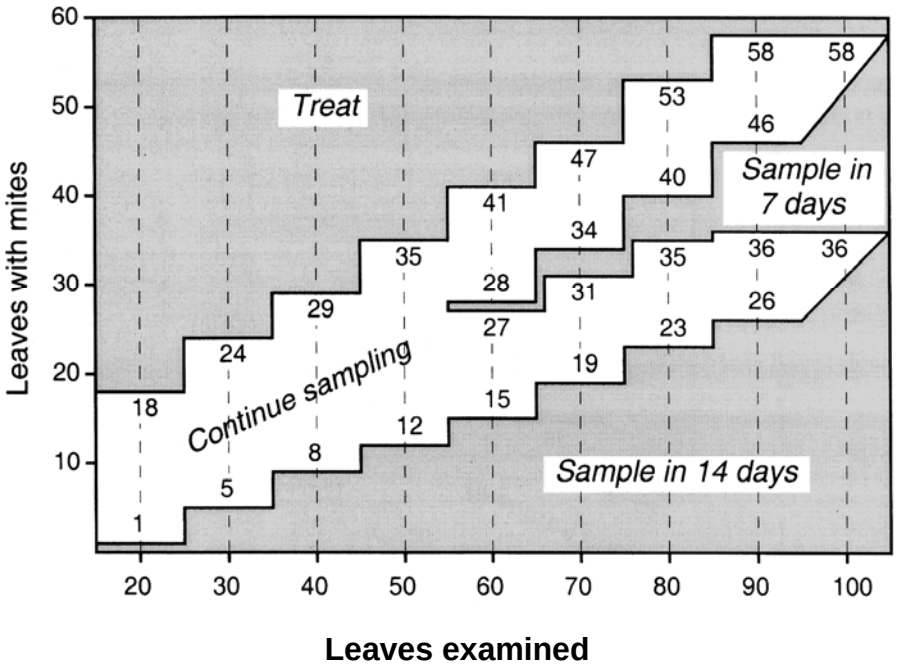
- If STLM eggs were not sampled during the pink or early bloom stage, a decision on 1st generation control can still be made by sampling sap-feeding mines at petal fall. After all the blossoms have fallen, start near one corner of the block, and go to every other tree until you have sampled enough trees to reach a decision. Select 3 fruit clusters from around the canopy of each tree sampled.
- Using a magnifier, count the mines on the undersides of the 2nd, 3rd, and 4th leaves in each cluster, counting leaves in the order they unfolded (see diagram at right).
- After 2 trees have been sampled, begin comparing the accumulated total number of mines found with the decision lines shown in the chart below for that number of trees.



- If the number of mines falls in the "Continue Sampling" zone, sample another tree. If the total is in the "Stop Sampling, Don't Treat" zone, sampling is stopped and no treatment is recommended. If the total is in the "Stop Sampling and Treat" zone, sampling is stopped and a treatment is recommended at petal fall. If 7 trees are sampled and the total number of mines equals 63, the population is below threshold.

Refer to the Apple Pesticide Spray Table for a choice of pesticide materials.

Figure 7.1.3 – Mite Sampling Chart
Threshold = 2.5 mites/leaf
(June 1 - 30)



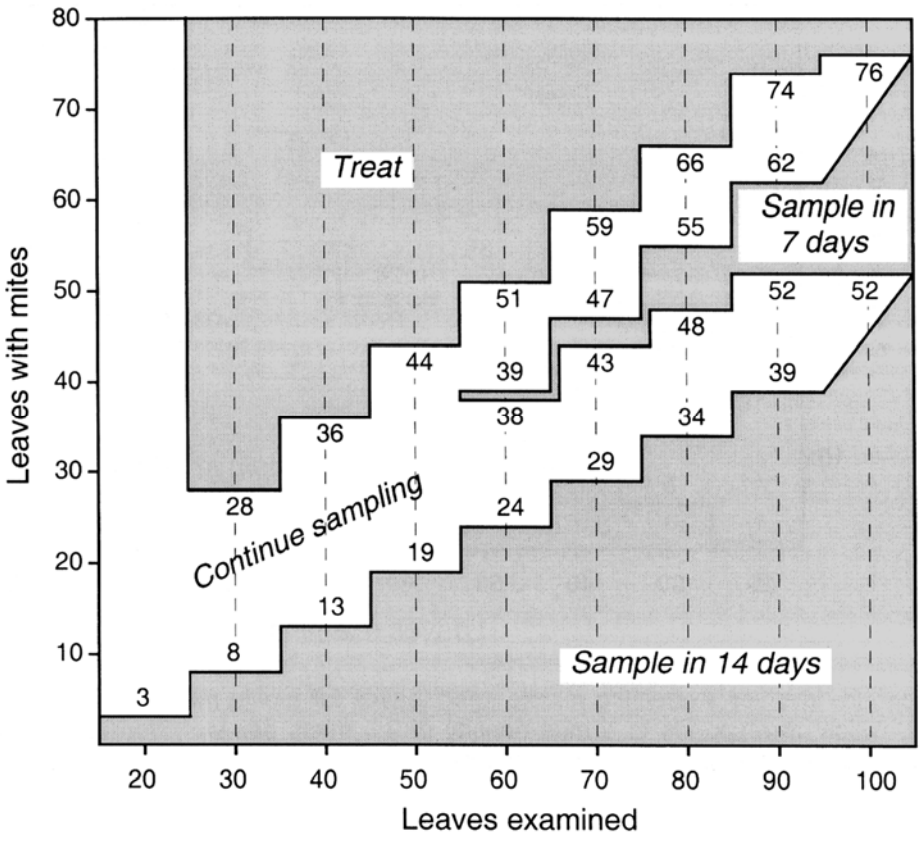
- This procedure involves examining middle aged leaves for motile mites (any stage except eggs). Use this chart, which corresponds to a mite density of 2.5 mites per leaf, from June 1 until June 30. You will not be counting mites, but will only determine whether they are present or absent on each leaf sampled.

- Starting with a random tree and sampling every other tree, collect 4 leaves in a plastic bag from each of 5 trees, choosing from each quadrant of the canopy. To make sure the leaves are of an intermediate age, pick them from the middle of the fruit cluster.

- Using a magnifier, examine the top and bottom surface of each leaf for motile mites, and keep track of the number of leaves containing motile mites. When all 20 leaves have been examined, compare this number with the numbers on the above decision guide. If the number of leaves with mites is equal to the values on the stairstep lines, the decision is the one shown in the area immediately below the value (example: For "29" after sampling 40 leaves, the decision is "Continue sampling"; for "8" the decision is to "Sample in 14 days").

- When the counts fall into any of the shaded regions, sampling is stopped and a decision is made to either treat, or else re-sample in 7 or 14 days. If the counts fall in the "Continue sampling" zone, take and examine more leaf samples in batches of 10 (5 per tree) until the counts fall into one of the shaded regions. If you reach one of the resample zones, the population is below threshold, and should remain so for at least the number of days stated. Return at the designated time and conduct another sample. If the -7 day" resample date falls during the 5.0 mites/leaf Threshold period, you can wait for a total of 14 days before resampling.

Figure 7.1.4 - Mite Sampling Chart
Threshold = 5.0 mites/leaf
(July 1 - 31)

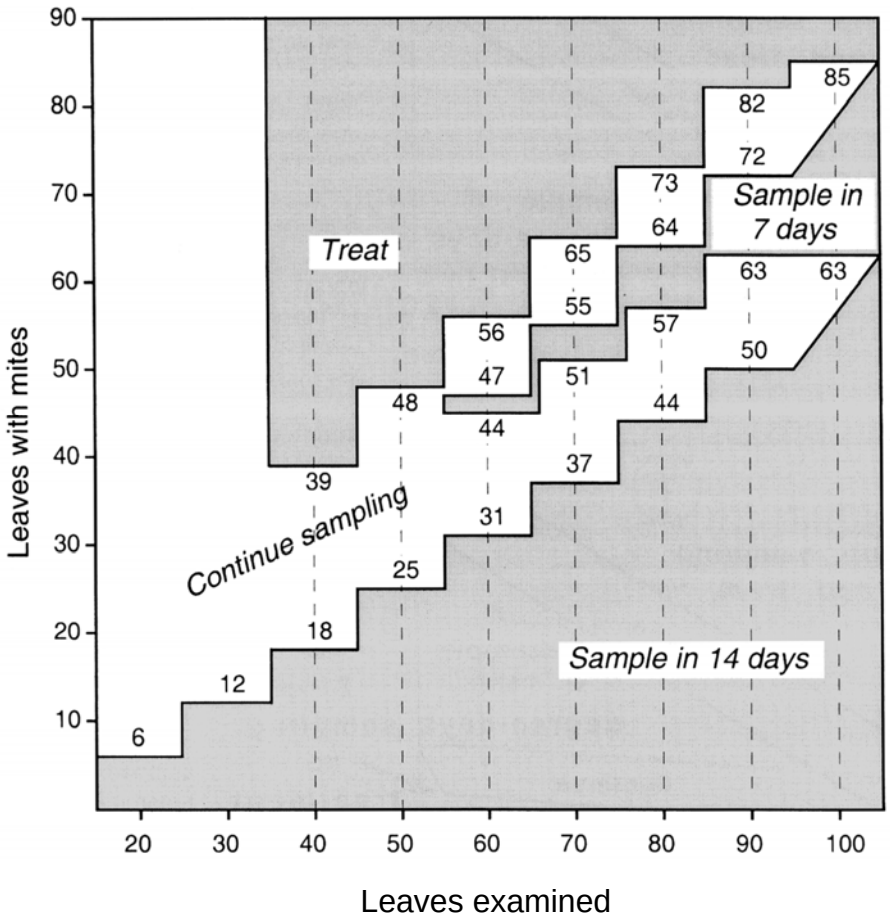


- This procedure involves examining middle aged leaves for motile mites (any stage except eggs). Use this chart, which corresponds to a mite density of 5.0 mites per leaf, from July 1 until July 31. You will not be counting mites, but will only determine whether they are present or absent on each leaf sampled.

- Starting with a random tree and sampling every other tree, collect 4 leaves in a plastic bag from each of 5 trees, choosing from each quadrant of the canopy. To make sure the leaves are of an intermediate age, pick them from the middle of the fruit cluster or foliar terminal.

- Using a magnifier, examine the top and bottom surface of each leaf for motile mites, and keep track of the number of leaves containing motile mites. When all 20 leaves have been examined, compare this number with the numbers on the above decision guide. If the number of leaves with mites is equal to the values on the stairstep lines, the decision is the one shown in the area immediately below the value (example: For "36" after sampling 40 leaves, the decision is "Continue sampling"; for "13" the decision is to "Sample in 14 days"). When the counts fall into any of the shaded regions, sampling is stopped and a decision is made to either treat, or else re-sample in 7 or 14 days. If the counts fall in the "Continue sampling" zone, take and examine more leaf samples in batches of 10 (5 per tree) until the counts fall into one of the shaded regions. If you reach one of the resample zones, the population is below threshold, and should remain so for at least the number of days stated. Return at the designated time and conduct another sample. If the "7 day" resample date falls during the 7.5 mites/leaf Threshold period, you can wait for a total of 14 days before resampling.

Figure 7.1.5 - Mite Sampling Chart
Threshold = 7.5 Mites/Leaf
(August 1 - 15)

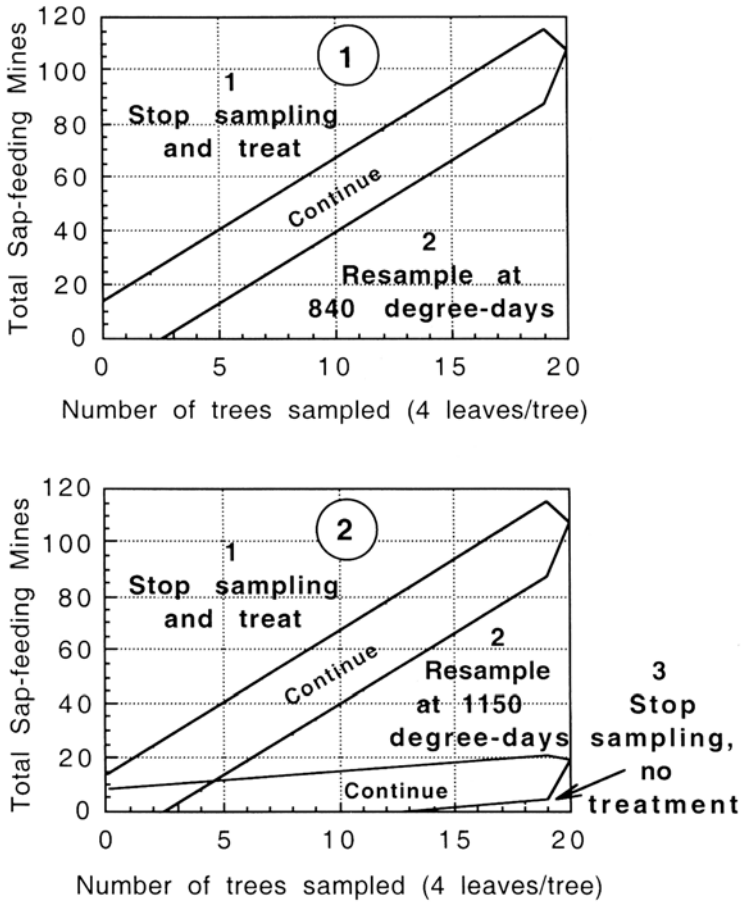


- This procedure involves examining middle aged leaves for motile mites (any stage except eggs). Use this chart, which corresponds to a mite density of 7.5 mites per leaf, from August 1-15. You will not be counting mites, but will only determine whether they are present or absent on each leaf sampled.

- Starting with a random tree and sampling every other tree, collect 4 leaves in a plastic bag from each of 5 trees, choosing from each quadrant of the canopy. To make sure the leaves are of an intermediate age, pick them from the middle of the fruit cluster or foliar terminal.

- Using a magnifier, examine the top and bottom surface of each leaf for motile mites, and keep track of the number of leaves containing motile mites. When all 20 leaves have been examined, compare this number with the numbers on the above decision guide. If the number of leaves with mites is equal to the values on the stairstep lines, the decision is the one shown in the area immediately below the value (example: For "39" after sampling 40 leaves, the decision is "Continue sampling"; for "18" the decision is to "Sample in 14 days"). When the counts fall into any of the shaded regions, sampling is stopped and a decision is made to either treat, or else re-sample in 7 or 14 days. If the counts fall in the .Continue sampling" zone, take and examine more leaf samples in batches of 10 (5 per tree) until the counts fall into one of the shaded regions. If you reach one of the resample zones, the population is below threshold, and should remain so for at least the number of days stated. Return at the designated time and conduct another sample. If the resample date falls after August 15, there should be no further need for additional samples or miticide sprays this season.

Figure 7.1.6 - STLM Summer Sampling Form



Because of variability in this pest's development from one site to the next, more than one sampling session may be needed to reach a treatment decision for 2nd generation STLM. The first sample should be taken at 690 degree-days (base 43°F) after the start of the 2nd moth flight (or approximately 25-30 days). In central MA, use July 9 as an approximate sampling date if you don't have access to pheromone trap catch data.

Start near one corner of the block and sample trees along a diagonal, moving toward the opposite corner of the block. At each tree, count all the **sap-feeding** mines on 4 mature terminal leaves randomly selected from around the outside of the canopy. Sampled leaves should be those located near the middle of the terminals. After sampling 3 trees, start comparing the accumulated total number of mines found with the appropriate chart for the sampling session and proceed as follows:

SAMPLING DONE AT 690-840 DD

If the number of mines falls in the "Continue" zone on **Chart 1**, sample another tree and check again. If the total is above this zone (area 1). sampling is stopped and a treatment is recommended. If the total is below this zone (area 2), stop sampling and sample the block again at approximately 840 DD (about 31 days) after the start of the 2nd flight.

SAMPLING DONE AT 840-1149 DD, IF NECESSARY

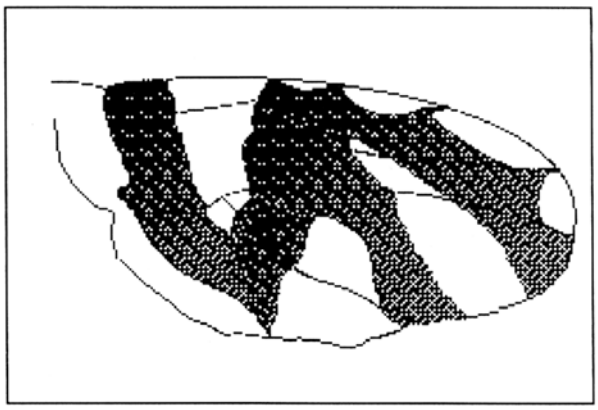
If it is necessary to sample the population a second time, refer to Chart 2 after sampling the 3rd tree. If the accumulated total falls in one of the "Continue" zones, sample another tree and check again. If the count falls in area 1, a treatment is recommended and no further sampling is necessary. If the count falls in area 2, stop sampling and sample the block again at approximately 1150 DD (about 42 days) after the start of the 2nd flight. If the count falls in area 3, treatment is not recommended and no further sampling is necessary.

SAMPLING DONE AT 1150 OR MORE DD, IF NECESSARY

If it is necessary to sample a third time, refer again to **S**, the same as in the first sampling session. This time, however, if the accumulated total number of mines falls in area 2, treatment is not recommended and no further sampling is required for this brood of STLM.

Refer to the Apple Pesticide Spray Table for a choice of pesticide materials if a treatment is elected.

Figure 7.1.7 – Apple Maggot Monitoring Form



On or before July 4, and possibly earlier in blocks with early harvest cultivars, hang 3 to 4 sticky red sphere traps per block in trees along the perimeter closest to an abandoned orchard or a stand of woods. If no abandoned trees or woodlands are nearby, choose the southern edge of the block. Use of supplementary apple volatile lures increases t he sensitivity of the traps and provides earlier warning of a developing threat from apple maggot (AM) damage. A layer of stickum about 1/8" thick provides extended stickiness without causing dripping off during hot weather. A thinner layer may not remain fully effective after 2-3weeks in the field.

Trap trees should be spaced at least 30 ft from each other. Place the traps in the outer canopy so that they are visible from outside the tree, at least 6 ft. high. Position the traps so that they are surrounded by fruit and foliage, but strip leaves as needed to create an open pocket at least 12 inches diameter around the trap to prevent foliage from sticking to it as the wind move branches, and to increase visibility. Ideally, there should be some fruit below the trap to capture female AM as they move from adjacent fruit.

No treatment is recommended until the trap catch threshold is reached. Check the traps 1-2 times per week for AM flies, which can be distinguished from similar species by the pattern of dark bands on their wings (right), a white spot on the thorax between the wings, and by a horizontal light colored stripe extending backward from the margin of the compound eyes.

If the cumulative average total of 5 AM flies per trap is reached (i.e. cumulative total of 15 AM on three baited traps, or 20 AM on four baited traps), a spray of a suitable insecticide is recommended immediately. After an insecticide application, the traps can be ignored for 7-14 days. The length of the residual period depends on the material used and the accumulation and intensity of rainfall after application. **If supplementary bait lures are NOT used, a lower threshold of 1 – 2 AM flies per trap is necessary.**

When residue from the previous application is considered to no longer be effective, remove AM, other insects and debris from the traps and begin resuming checking them to see when/if the threshold is reached again.

After about a month in the field traps may need to be recoated with stickum.

For most blocks, traps can be taken down at the end of August, but for blocks of late harvested cultivars with a history of AM damage, it may be useful to leave traps up until September 10 if it is feasible to make a late treatment if needed, or if detecting AM pressure in the block would otherwise be of use in harvest or marketing decisions.

Date checked	Number of AM Flies caught since last check or residue depletion	Cumulative Avg. AM caught per trap since last check or resiude depletion
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Figure 7.1.9. Average Timing for Apple Events for New England

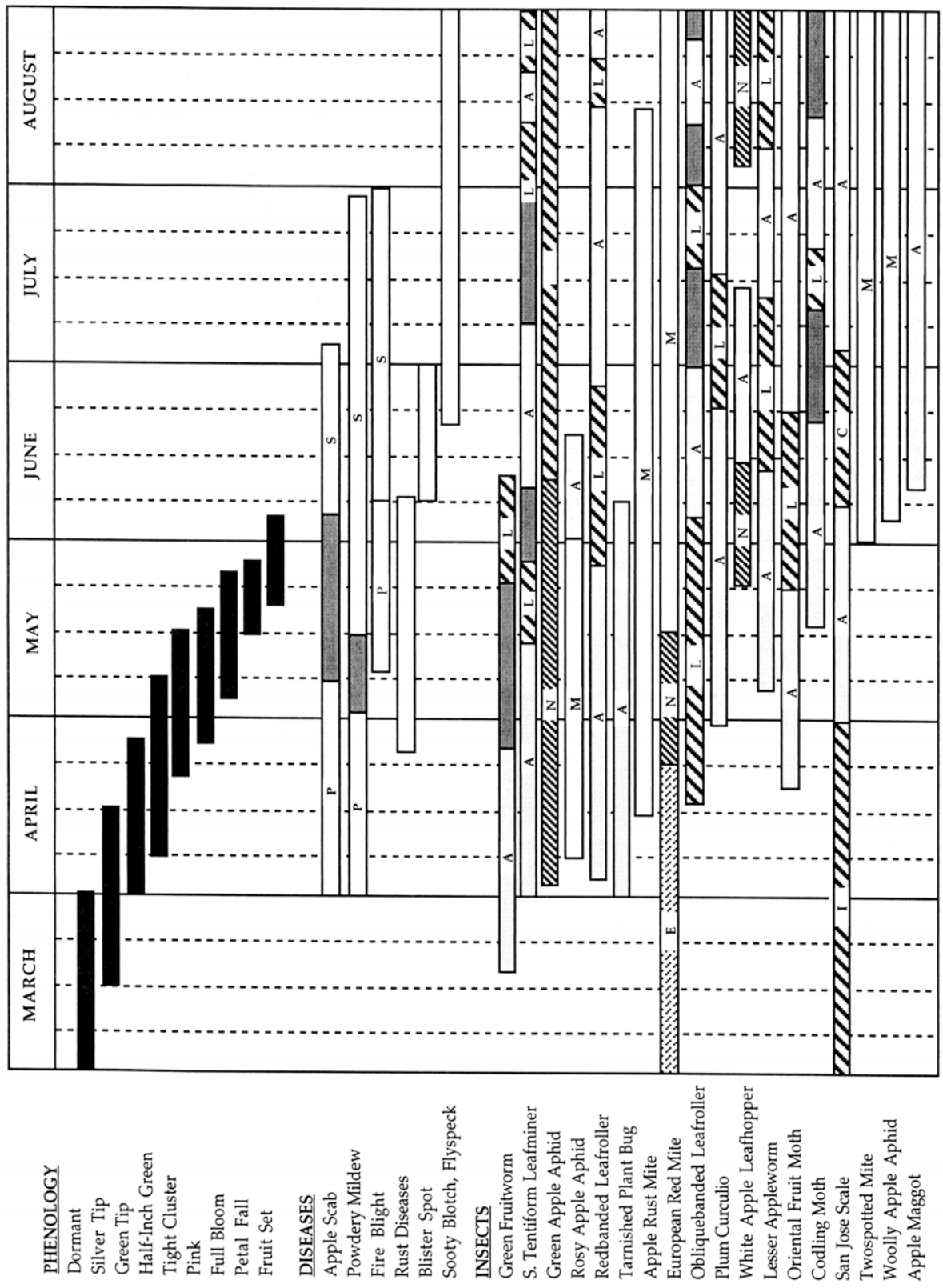
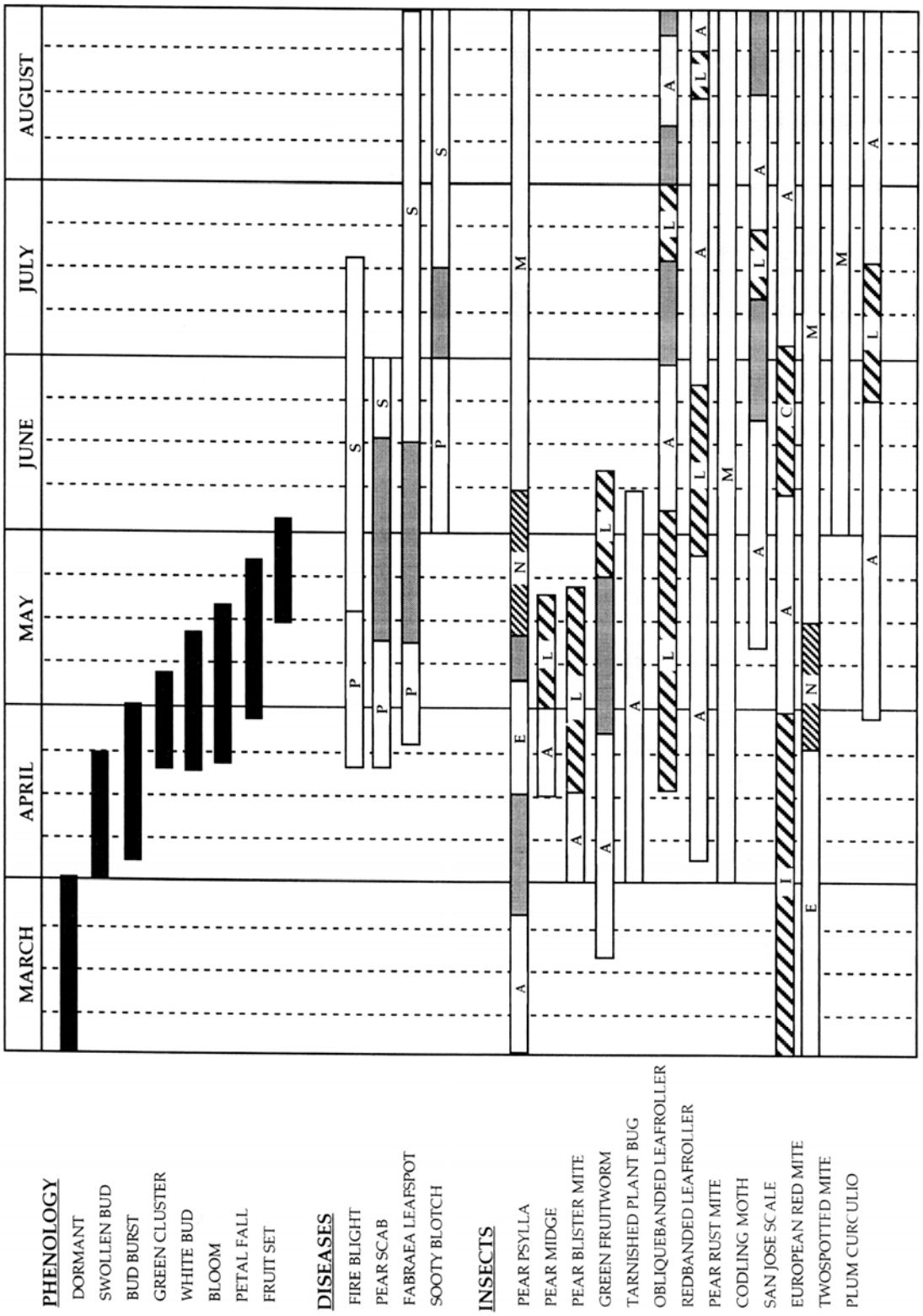


Figure 7.1.10. Average Timing for Pear Events for New England



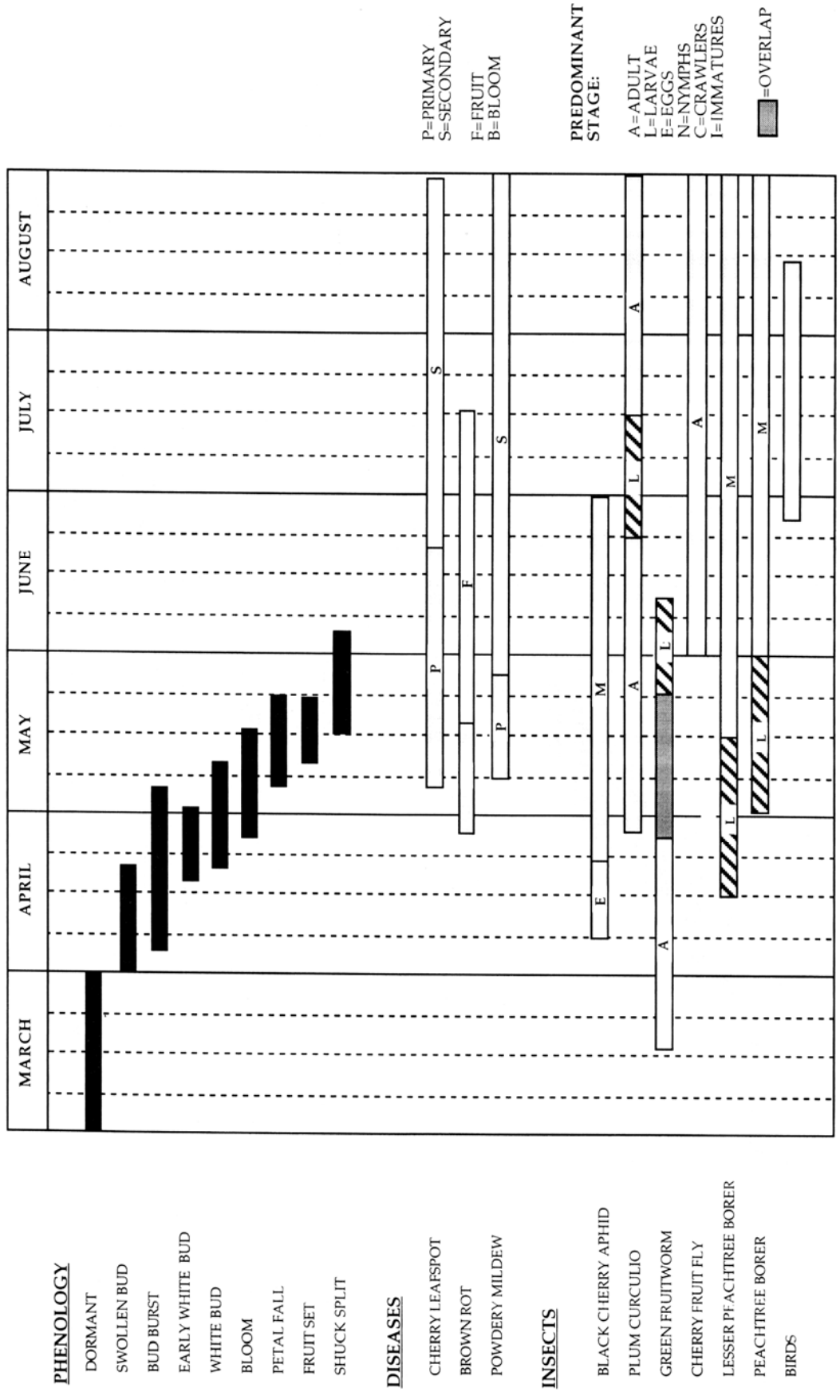


Figure 7.1.11. Average Timing for Cherry Events for New England

Figure 7.1.12. Average Timing for Peach Events for New England

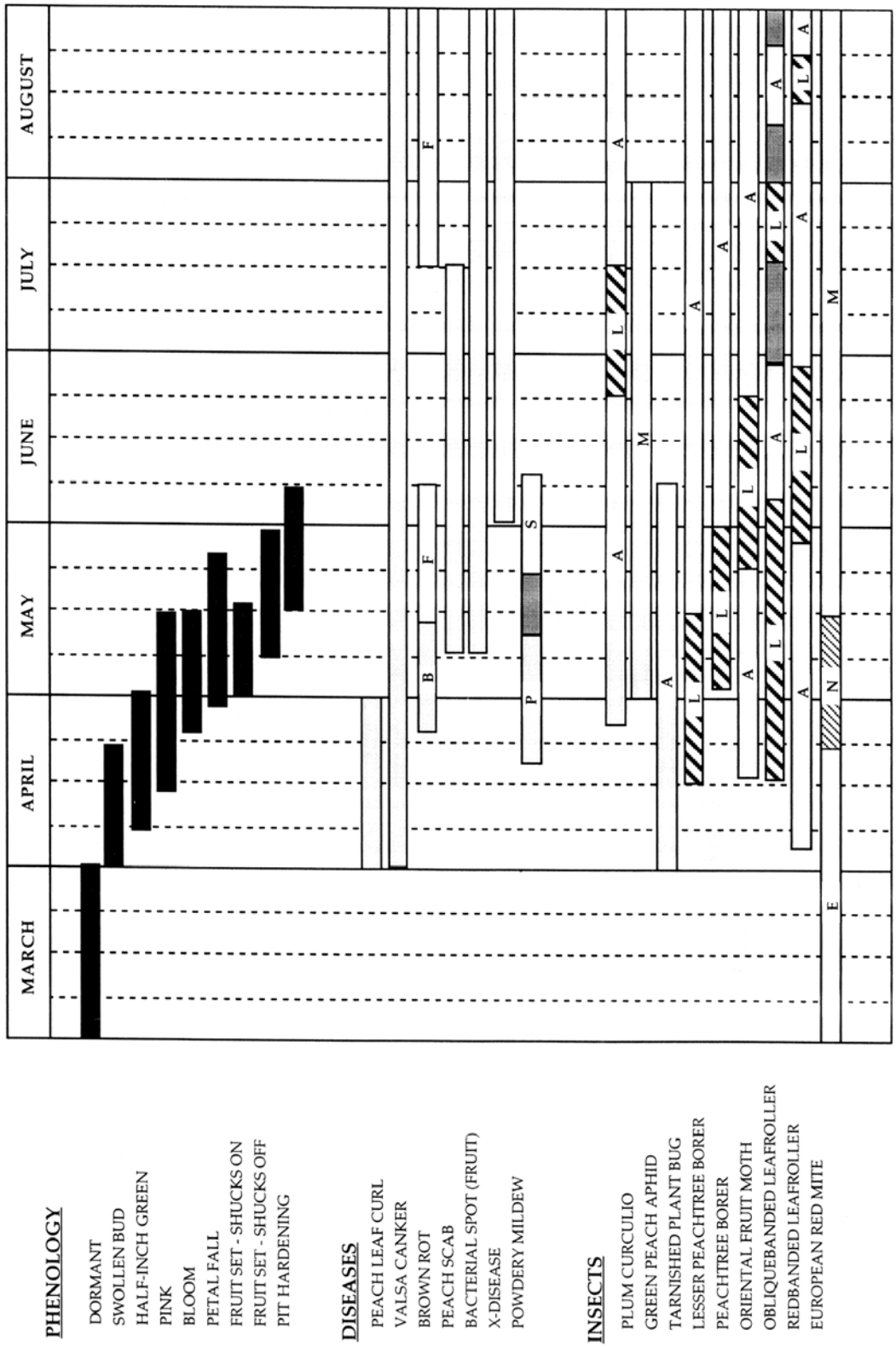
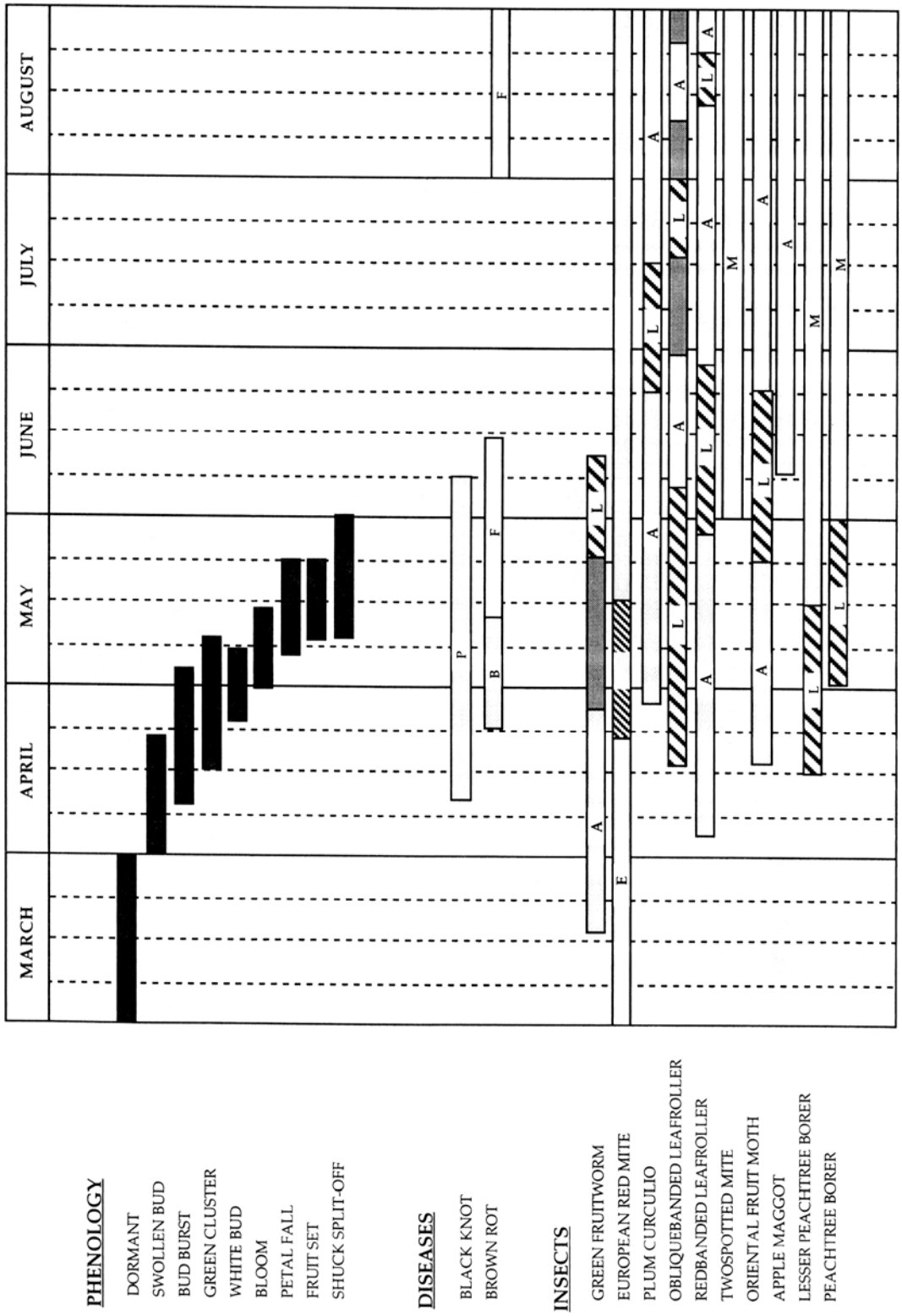


Figure 7.1.13. Average Timing for Prune and Plum Events for New England



8 Weed Management

8.1 Calibration to Ensure Correct Herbicide Rate

Herbicide labels indicate rate of application as amount of product per acre; that is, per acre actually treated. Only if you broadcast herbicide over the entire orchard floor will the treated acreage equal the orchard acreage. Follow the instructions below to assure application of the correct herbicide rate.

8.1.1 Calculating Nozzle Flow Rate

Travel Speed:
For most situations, 2–2.5 mph is best (176–220 ft. /min.).

Pressure:
Use low pressure (20–35 psi) to minimize formation of small droplets, because small droplets can drift off target.

Spray Volume per Treated Acre:
Generally, low rates (20–30 gals./acre or less) are more suitable for postemergence herbicides, where runoff from weeds would reduce effectiveness. Higher rates, 40–50 gals./acre, may provide better coverage and control when using preemergence herbicides.

Nozzles:
Avoid nozzles that produce fine mist. Generally, hollow cone nozzles produce the finest droplets, flat sprays are second, and full cone nozzles produce the coarsest spray. Use air-induction nozzles if available in the desired spray pattern.

A single boomless off-center flat spray nozzle, or a flooding nozzle, may be suitable for some orchards, but one or more regular flat spray nozzles on a boom may be better where branches are close to the ground.

Shields:
By adding a shield over the spray boom, thin, young bark of fruit trees may be protected when using glyphosate or other herbicides that can injure fruit tree bark. If weeds are tall when treated and spring back into the tree branches after application under a shield, glyphosate can still be picked up through the leaves of the trees.

Use the following formula to determine nozzle flow rate in gal./min., then consult a nozzle manufacturer's chart to select the proper nozzle.

8.1.2 Definition of Terms

1. **Gallons per Treated Acre (G/TA)** = Amount of herbicide spray you want to apply per treated acre.
2. **Swath (S)** = Width of the sprayed area in feet.
3. **Travel Speed (TS)** = Feet traveled per minute.
4. **Nozzle flow rate** (gallons per minute) = (Gallons per Acre x Swath x Travel Speed) divided by 43,560

Nozzle Flow Rate = (G/TA x S x TS) / 43,560

Example 1:
What nozzle flow rate do you need to apply 25 gallons of herbicide spray mix per treated acre, using a 3-foot-wide swath and a travel speed of 220 feet per minute (=2.5 miles per hour)?

Nozzle flow rate
= (25 x 3 x 220) divided by 43,560
= (16,500) divided by 43,560
= 0.38 gallons per minute.

If using 2 nozzles, select 2 that will give 0.19 gallon per minute each at the selected pressure.

8.1.3 Checking Herbicide Sprayer Output

Spray Pattern:
Check uniformity of spray pattern, using corrugated fiberglass roofing panels as a spraying surface. Spray from the same height as will be used in the orchard. Compare liquid volume collected in each trough.

Actual Spray Volume:
With proper nozzles installed, travel a measured distance at the selected speed and pump pressure. Use this formula to determine the actual spray volume in gallons per treated acre.

Gallons per Treated Acre:
= (Gallons sprayed during trial run x 43,560) divided by (Feet traveled during trial run x Swath width in feet).

Example:
You emptied a tank containing exactly 3 gallons in a distance of 1,200 feet. The treated swath was 3 feet wide. How many gallons of spray are you applying per treated acre?

Gallons per Treated Acre
= (3 x 43,560) divided by (1,200 x 3)
= (130,680) / (3,600)
= 36.3 gallons

If you want to apply 4 lbs. of herbicide per acre, then in this case you would add 4 lbs. of herbicide to each 36 gallons of water in the tank.

Agitation:
If herbicides are allowed to settle or separate in the sprayer tank, distribution in the orchard will not be uniform. Provide constant agitation when using wettable powders, or any other insoluble formulation (emulsions, emulsifiable

concentrates, dry flowables, liquid flowables, and suspensions). Use defoaming adjuvant when needed to control excessive foam.

8.2 Groundcover Management

Management of the orchard floor is an essential and often expensive piece of the overall orchard management scheme. A poorly designed and managed orchard floor will increase costs in several important ways, including increased mowing costs, reduced yield due to weed competition, and wear and tear on equipment. Several orchard floor management options to consider are:

1. Clean Cultivation/Fall Cover

This option can be effective with young trees, in particular as a management system that eliminates weed competition and encourages tree growth. These benefits do not come without cost. Soil erosion in particular is a real risk. Late summer seeding to a fall cover crop such as spring oats is essential to limit erosion. This fall cover must be planted early enough to allow ample autumn growth to protect soil from cold penetration in winter. Loss of organic matter with this system is another liability–soil organic matter is broken down quickly with repeated cultivation. In addition to these potential risks, calcium availability to trees may be reduced and soil compaction problems may develop.

2. Mulch

Mulching offers some attractive potential benefits, including improved soil moisture retention and weed suppression. Unfortunately, mulching also offers a couple of key liabilities that make it impractical as a general orchard practice. Perhaps most importantly, mulch provides an ideal habitat for voles (mice). Also, while the use of mulch will increase levels of organic matter and key nutrients including potassium and magnesium, its use will likely lead to reduced calcium levels.

The use of wood-based mulch such as wood chips and bark may be valuable on excessively drained soils

3. Permanent Sod

Permanent sod, often including an under-tree herbicide strip, is the orchard floor management system most commonly used. A permanent sod offers many important benefits. It reduces soil erosion; gives support (especially important when soils are wet) for heavy equipment needed for brush removal, pesticide application, and mowing; reduces dust and dust deposits on fruit; reduces tree rack or wobble during wind events; insulates against cold penetration in winter; increases movement of key nutrients including calcium into the tree root zone; and may provide winter refuge for a beneficial mite species.

A permanent sod also allows soil organic matter levels to increase over time, a condition which when coupled with proper soil pH management, eliminates the need to apply phosphorous throughout the life of the orchard.

The key to success with this system is establishment (preferably prior to planting) of a permanent sod floor. Combinations of slow-growing grass types such as low-growing hard fescues and perennial ryegrasses are preferable.

The process of establishing an orchard floor should include elimination of perennial weeds and grasses through use of an herbicide such as glyphosate (Roundup). In addition, correction of soil drainage deficiencies, soil pH and nutrient adjustment based on soil test recommendations, and preparation of a smooth, stone-free soil surface for seeding are all key elements for success. A 2-year soil preparation process that includes a full summer of cover cropping with a vigorous cover crop such as Sudan grass or Japanese millet is ideal. Seeding of a new orchard floor is best done in late summer or early autumn. In older plantings, the permanent sod is often a ‘wild’ mix of more vigorous grasses and herbaceous plants, a mix that requires extensive management including several mowings annually. In addition, the orchard floor is often rough and rutted from years of equipment traffic and dotted with rock outcroppings, adding to the management cost.

Some drawbacks are associated with permanent ground cover. Certain plant species such as alfalfa can promote pest populations (e.g., tarnished plant bug). Ground cover also provides competition for water and nutrients, especially to young trees. If not properly managed, it also provides habitat for voles. These drawbacks can be minimized with appropriate management of the orchard floor.

Mowing is the most important orchard floor management tool. Establishment of an orchard floor composed of slow growing grass species can reduce mowing requirements significantly. With an orchard floor composed of vigorous ‘wild’ species, several timely mowings will be required to prevent undue competition for trees and reduce vole populations by limiting their preferred habitat. A final mowing in late autumn (using a flail type mower) can reduce the potential apple scab infection risk the following spring.

Herbicides are generally used to manage groundcover around tree trunks and in that portion of the under-tree area that is difficult to mow. For mature trees on seedling or semi-dwarf rootstock, this herbicide strip may extend up to 6 feet or more out from tree trunks. With dwarf rootstock trees, the herbicide strip generally extends 2 feet or less out from the trunks. Maintaining herbicide strips as narrow as practical is important in reducing the risk of soil erosion and tree rack as well as cold penetration into the root zone of trees. Research has shown that if orchards are irrigated the herbicide strip can be more narrow. In addition, narrow strips may facilitate movement of mite predators from the orchard floor into trees in summer. Less total herbicide is used per acre when these strips are narrow, reducing risk for environmental problems including herbicide leaching and runoff.

It is important to use herbicides judiciously for maintenance of these strips. Ideally, the use of herbicides will leave a living groundcover and root system or a mat of killed ground cover to protect soil from erosion and cold penetration. The overuse of herbicides, even in narrow strip systems, will lead to a barren soil strip and a high risk of erosion, tree rack, and cold temperature injury to tree root systems, and storm-water runoff

Herbicide timing should be chosen so as to assure that live groundcover, or a matting of killed groundcover will be present when soil erosion is likely, especially during the dormant season, and when thunderstorms are likely. Practices that promote extensive moss growth have not been identified, but it is evident that some herbicides inhibit moss establishment and others do not.

Maintaining or increasing soil organic matter (humus) should be an objective of sustainable orchard groundcover management in New England. Soil organic matter is much more than the dead leaves, stems, and roots produced by the groundcover and orchard trees. As plant tissues decay, through the activity of soil microorganisms (bacteria, actinomycetes, fungi, algae, protozoa, and nematodes) they produce **humus**, a complex mixture of organic compounds that gives topsoil its characteristically dark brown color. The soil microbes themselves die, contributing to the total pool of biomass that forms humus. In sod-covered soils, humus typically constitutes the bulk of soil organic matter. But humus is not permanent. Its constituents undergo a slow, but continuing process of decay. If soil is kept bare, the major food source for soil microorganisms is eliminated, and humus can then be expected to disappear faster than it is formed.

Humus is a major source of nitrogen, phosphorous, and sulfur. These three essential elements are abundant in biological tissue, the source of humus. Humus also has a controlling influence on the availability of essential micro-nutrients, not because its parent biological tissues were high in micro-nutrients, but because humus can form "chelates" with copper, zinc, manganese, etc. that are released from soil minerals. Chelated micronutrients are held against leaching from the soil, and under the right conditions, are available to plant roots.

Another value of humus derives from its electrostatic attraction for oppositely charged nutrient elements, protecting them against leaching. This property, called cation exchange capacity, is also exhibited by clay particles. Cation exchange capacity, together with chelation, allows soils to hold nutrients until picked up by plant roots. Soils in which these properties are at a low level, as in soils with little clay or organic content, are naturally low in agricultural productivity, because they cannot supply as much mineral nutrition as the crops are capable of using.

Additional benefits of soil organic matter are:

- It increases moisture-retention in sandy soils. Organic matter can hold up to 20 times its weight in water.
- It acts as "glue" to hold very small soil mineral particles together in units called aggregates. Aggregation permits a loose, open, granular condition that aids penetration by water, air, and roots, and resists erosion.
- It has the ability to absorb many organic pesticides, holding them near the soil surface, where they are more likely to be degraded by biological activity and sunlight, rather than leach to groundwater.

8.3 Herbicides and Their Use

If you use herbicides, you are responsible for their safe and proper use. The label is the law. Be aware of the potential for contamination of waterbodies, groundwater, and food.

8.3.1 Types of Herbicides

Herbicides can be separated into two broad categories: those applied to the soil before weeds have emerged (pre-emergence or 'residual' herbicides) and those applied directly to visible weeds (post-emergence or 'contact' herbicides). A few pre-emergence herbicides also have some activity against emerged weeds.

Residual herbicides have a lasting effect on the soil. How long weed growth is prevented by an application of residual herbicide depends on how quickly it is broken down on the soil by sunlight, microbial activity, or soil chemistry, and whether the herbicide is volatilized or leached below the upper inch or so of soil. Non-residual herbicides have little or no effect except on weeds that are present at the time of application.

Finally, some herbicides are effective only on grasses; some only on broadleaf weeds, and others show degrees of activity against both types of vegetation. No herbicide is effective against all species in all categories of weeds. Some herbicides are effective on certain weed species outside of the indicated category. For a list of specific weeds controlled, see product labels. The use of residual herbicides in particular should be limited to specific needs. The routine use of residual herbicides may increase the chance of creating a bare soil environment around trees (with an increased risk of soil erosion, tree rack, and cold temperature injury to tree roots). And it may facilitate the development of weed populations that are difficult to control with currently available herbicide options.

8.3.2 Manage to Prevent Resistance

Repeated use of a single herbicide, or herbicides with a shared specific mode of action without rotation or the use of alternative tactics such as cultivation or weed suppressing cover crops, may lead to herbicide-resistant weed populations. The build up of weed species that are not

affected by the specific herbicide, creates a new complex of weeds species under the trees.

Herbicides for which the risk of resistance is greatest include: diuron (Karmex), oryzalin (Surflan), oxyfluorfen (Goal), paraquat (Gramoxone), simazine and terbacil (Sinbar).

Combining pre-emergence herbicides with different modes of action is one technique that reduces the risk of weeds developing herbicide tolerance. The use of post-emergence herbicides such as glyphosate (Roundup) also helps, as do non-herbicide practices such as close-mowing and cultivation. Weed scouting before herbicide application is useful to identify which species are present. Scouting after herbicide application can reveal weed escapes or species shifts.

8.3.3 Herbicide Selection

No herbicide product is completely effective against weeds *and* always harmless to the trees. Good management requires choosing the proper product, or combination of products, to fit the situation. Give special attention to age of the trees and soil factors.

Age of the trees. Young trees have tender, green bark that can be damaged or penetrated by contact herbicides, both systemic and non-systemic. Damage to a high value perennial crop, like apples, can have major and prolonged financial impact. Pay close attention to the development of corky, dead outer bark on the portion of the trunk that will be contacted by a contact herbicide. Properly applied trunk paint or vole guards will help if they completely block the spray from contacting the green bark. However, the most important consideration is the careful application of herbicides, using shielded sprayers or wipe-on applicators where appropriate to minimize the risk of herbicide contacting the bark.

The most common and serious damage occurs on young fruit trees when unprotected bark is contacted by concentrated doses of herbicides that have both contact and systemic activity (e.g. glyphosate, paraquat, glufosinate-ammonium, and 2,4-D). These products can be used in young orchards, but their use requires precautions to prevent significant exposure of the trees.

Non-systemic products can also damage young trees, usually by burning a dead area into the trunk within about a foot of the soil surface. This can occur if the product is overly concentrated in the spray solution, and/or mixed with higher rates of liquid nitrogen fertilizers.

Young trees have shallow root systems, and most of their roots are within the herbicide treated area. Young tree roots may be highly exposed to root active herbicides that leach into the upper foot of soil. Simazine, diuron, terbacil (and to a lesser extent norflurazon and dichlobenil) all have the potential to damage trees in young or dwarf orchards, particularly on light sandy soils. Use caution and low rates when using these herbicides.

Soil Factors. Organic matter and increased binding sites that come with finer soil texture are important soil qualities that hold potentially mobile herbicides in the upper 2–4 inches of soil where they act to control weeds rather than affect fruit tree roots. If the product label suggests that you take these factors into consideration, do so. Orchards often have bands of lighter, shallower or gravelly soils running through them. Identify and record these poor soil areas. Use products and rates that are safe on the weakest soils, not the average.

8.3.4 Herbicides Can Damage Trees

To avoid tree injury, know the potential for injury, and follow label instructions carefully. Injury can be local (affecting only tissue directly hit by spray), or it may be systemic. Systemic injury can produce symptoms some distance from the site of contact, due to the ability of some herbicides to translocate within the plant.

Note the potential for tree damage by these herbicides:

- **glyphosate**: Is absorbed by foliage, root suckers, young-green bark and fresh pruning wounds, resulting in systemic injury. Do not apply after mid summer (July 15). Avoid contact with bark, foliage, and rootsuckers.
- **diuron, oxyfluorfen, terbacil:** Are absorbed by foliage and young bark, resulting in local injury. Shield bark of first- and second-leaf trees to prevent damage.
- **paraquat, glufosinate-ammonium:** Are absorbed by foliage, and bark, resulting in local injury
- **2,4-D:** Is absorbed by foliage, bark, and roots, resulting in systemic injury. **Do not use 2,4-D near or in grapes!!!**
- **dichlobenil, diuron, simazine, terbacil, and 2,4-D** can, under some conditions, be taken up by roots, resulting in injury or other symptoms. Root uptake is most likely in soils containing very little clay or organic matter. In the case of 2,4-D, the chemical is highly water-soluble, so movement to roots is possible where groundcover is insufficient to absorb (trap) the 2,4-D.
- The presence of burr knots may increase the risk of herbicide uptake by trees if herbicide comes in contact with bark tissue.

Other listed herbicides may produce injury to trees if not used at appropriate label rates and timings, taking into account tree age, soil texture, and soil organic matter.

8.3.5 Leaching and Runoff Potential

Leaching (downward herbicide movement through soil) is influenced by characteristics of the soil (texture,

compaction, organic content, pH, wetness, temperature). In addition, certain soil microorganisms and living weeds can sometimes metabolize absorbed herbicides, rapidly or gradually altering them to non-phytotoxic forms that may have different leaching characteristics. Leaching potential is also affected by certain characteristics of the herbicide, including water solubility, electrostatic properties, vapor pressure, and photodecomposition.

Because numerous complex interactions can occur between herbicides and the soil environment, it is impossible to accurately generalize leaching behavior for a wide range of possible soil situations.

Downward movement is most likely with chemicals that do not degrade quickly and do not adsorb strongly to clay or organic matter. The potential for tree damage or groundwater contamination is greatest with such chemicals when heavy rain comes soon after application, or where spills occur. Special attention should be given to the mixing and loading operation, as spills can quickly overload detoxifying processes of soil and sunlight.

Runoff (surface loss of herbicides from treated areas) can be avoided by the same means used to avoid soil erosion. Sloping ground and absence of groundcover increase surface runoff. Living sod or other dense groundcover and organic mulches inhibit runoff. Where problems persist, grass strips and berms can be used to separate treated areas from sensitive borderlands. Practices that prevent concentration of rain water into narrow channels will help. Wheel ruts often become stream-beds during heavy rainfall, as do channels from previous rainfalls. Travel lanes should run across rather than with the slope. Maintain and operate equipment with caution to prevent spills.

8.3.6 Need for Rain or Irrigation

Herbicides used for pre-emergence weed control generally require 0.5–1 inch of rain or irrigation, or shallow cultivation to initiate herbicidal action. The need for prompt incorporation varies.

Warm bright days speed surface breakdown and evaporation of certain herbicides. Some herbicides must be incorporated within 24 hours after application, while other materials can be stable for 3–4 weeks or more. Specific information is provided on product labels if rapid incorporation is necessary.

8.3.7 Persistent Weeds

Perennial and biennial species that persist where pre-emergence herbicides have been used can often be killed by one or more treatments with glyphosate, 2,4-D, or a combination of these two. Such species include bindweed, brambles, Canada thistle, dandelion, dock, evening primrose, goldenrod, horsenettle, plantain, poison ivy, and vetch. Yellow nutsedge can be killed with glyphosate, glufosinate, or paraquat, properly timed. Mid-June to mid-July is the best time for paraquat and glufosinate, while August and September are best for glyphosate. These late summer applications also carry the greatest risk of damage to the crop if foliage or green tissue is contacted by improper application. Note that preharvest interval requirements may influence choice of timing. In apple and stone fruit crops, clopyralid (Stinger) is also an option but it has a very specific weed spectrum. Weed identification is important in selecting this herbicide for perennial weed control. Pyraflufen-ethyl (Venue) has been shown to work well on Canada thistle (with Stinger), horsenettle (with paraquat), and bindweed (when mixed with another contact herbicide usch as paraquat or Rely).

8.3.8 Application Method

Regardless of which herbicides are chosen, proper application is essential to insure safety and efficacy. Take the time to set up and check the mechanics of the weed sprayer. This is too often neglected. Every time an herbicide sprayer is brought out for use, it needs to be checked, both for level application across the boom and rate per sprayed acre. There are many ways to calibrate orchard herbicide sprayers: use the one you are most comfortable with. If you do not already have a good method, try the procedure outlined at the beginning of this section.

Most orchards are sprayed with a single sided boom sprayer, with two, three, or four flat fan nozzles placed about a foot apart, starting at the distant tip of the boom. The boom is adjusted so that the spray from each nozzle over-laps about 1/3 of the pattern from the adjacent nozzles on either side at the level of the target. The “target” can be either weed growth if you are spraying contact herbicides, or the soil surface, if you are applying soil residual products.

Some growers use single “flood-jet” style nozzles to apply contact materials on both sides of a tree row with a single pass by the sprayer. This is somewhat effective, but not without problems, including injury to tree trunks. Most single nozzle band applications wider than a foot or two distribute herbicide unevenly. Single nozzle band application should not be used with most soil residual materials, or for products that may injure the young tree if applied to the trunk.

The use of anti-drift agent(s) is recommended, particularly for contact and systemic herbicides. With some herbicides and target weeds, addition of a surfactant, spreader-sticker, and or crop oil concentrate is also recommended. See label for details

8.3.9 Rate of Herbicide

For many pre-emergence herbicides, the lower recommended rate is the best choice for coarse texture orchard soils (sandy loam or loamy sand), provided

moisture conditions are suitable. Some preemergence herbicides are strongly adsorbed onto soil organic matter and/or clay particles. Therefore, on relatively high organic soils (above 3.5 percent by Walkley-Black method) and on clay loam soils, the higher label rate may be needed for pre-emergence control.

Soil texture and organic matter content can be determined by soil testing laboratories. Several different methods are used to estimate soil organic matter. For the same soil, different methods can give much different results. To properly interpret label recommendations regarding soil organic matter, ask your soil testing laboratory to indicate its estimate of organic matter as though it had been done by the Walkley-Black method.

Surface litter (non-decomposed organic tissues) can bond some herbicides, resulting in failure of the chemical to reach the soil where germinating seeds can be killed. Herbicides that are so affected will include a label recommendation for removal of surface litter, or clean cultivation prior to application of the herbicide.

Rates for post-emergence herbicides vary according to weed species and growth stage. Drought conditions that slow weed growth may make weeds more tolerant of post-emergence herbicides applied during that time.

Unless product labels suggest addition of surfactants or other adjuvants, their use is not likely to improve herbicide activity. Post-emergence herbicides should be used with enough water to avoid missing any plants or plant parts, while avoiding runoff, although systemic herbicides such as Roundup can be effective at low water volumes and incomplete plant contact.

8.3.10 Timing Herbicide Applications

Product labels limit timing of some herbicides to certain months, weed growth stage, temperatures, crop growth stage, or days to harvest. Detailed information is included on the product labels.

8.3.11 Tank Mixes

- If no statement concerning tank mixing of two or more herbicides is given on product labels, mixing is legal, though a test for compatibility will be necessary.
- Do a small-scale jar test as follows: Place one pint of water in a quart jar. Add each pesticide or a pre-mix of pesticide in water, one at a time, and shake well with each addition. Use each product in about the same proportion to water as it will be in the field mixture. One half of a measuring teaspoon of herbicide in a pint of water is approximately equivalent to one pint or one pound of herbicide in 25 gallons water. Unless labels indicate otherwise, add pesticides in this order: wettable powders, followed by flowables, emulsifiable concentrates, water solubles, and recommended adjuvants. However, when compatibility enhancers are used (tank mix adjuvants or spreader/stickers) these should be added first to the water. Invert the jar 10 times, then inspect the mixture immediately and again after 30 minutes. If a uniform mix cannot be made or if non-dispersable oil, sludge, or clumps of solids form, the mixture is incompatible and should not be used. Minor separation after 30 minutes (without sludge or clumps) that remixes readily with 10 jar inversions, is tolerable if spray tank agitation is good.
- When you tank mix in volume, put 2/3 of the water in the tank first. Then add pesticides one by one, with wettable powders first. Agitate for thorough mixing after each addition, before pouring in the next. Finish filling the tank with water.
- Maintain continuous agitation until the tank is empty.

8.3.12 Established Orchard Herbicide Program

A late spring and late fall application of herbicides to herbicide strips of established orchards is recommended. Specifically:

- Late fall herbicide application should include a translocated contact herbicide (2,4-D, or glyphosate if perennial weeds are present and trees can be shielded or missed) AND a residual herbicide (Kerb, Solicam, Surflan, Prowl, Chateau, Casoron, Matrix, Alion).
- Late spring herbicide application should include a different residual herbicide (Karmex, Sinbar, Solicam, Surflan, Prowl, Chateau, Matrix, Alion) and a contact herbicide if perennial weeds are present or annual weeds have emerged.

These two applications may give effective season-long control, improve consistency of treatment, decrease risk of crop injury, and decrease competition by weeds in early spring.

('Groundcover Management and Herbicides' adapted from original New England Apple Pest Management Guide by William Lord, University of New Hampshire. Adapted and edited for most recent version by George Hamilton, UNH Cooperative Extension, and Jon Clements, UMass Extension. Also from Cornell Pest Management Guidelines for Commercial Tree Fruit Production, Robin Bellinder and Deborah Breth.)

8.4 Herbicides for Tree Fruits

2,4-D is marketed in various formulations. Weedar 64 and 2,4-D Amine are registered for use in APPLE, PEAR, and STONE FRUIT orchards at least 1yr old. Unison is a new formulation of 2,4-D acid for pome and stone fruit. 2,4-D is a selective herbicide that is effective on many annual and perennial broadleaf weeds when applied as a postemergence foliar spray. It is particularly effective in controlling dandelions on the orchard floor

when applied in late fall. These materials should not be applied during the bloom period of fruit trees, i.e., from the time flower buds begin to expand until 4 weeks after bloom. Combinations of 2,4-D plus glyphosate have been effective in controlling many difficult perennial broadleaf weeds. Do not apply to bare ground or light, sandy soil. Be careful with herbicide DRIFT! Grapes, many flowers, and vegetable are very sensitive to 2,4-D drift.

Carfentrazone-ethyl is registered as Aim 2EC and 1.9EW at 2 and 1.9 lb ai/gallon, respectively. It is a contact, post-emergent, desiccant herbicide for control of young broadleaf weeds only; it has no effect on grasses or sedges. Aim is most effective if used on weeds that are small (up to 4 inches high) in combination with glyphosate. Tank mix provides faster desiccation of weeds than glyphosate alone, but is not effective for long-term control of perennial weeds. Aim should always be mixed with crop oil concentrate or nonionic surfactant. Do not allow spray to contact green bark, fruit or foliage. Aim can be used for sucker control when tissue is soft and succulent.

Clethodim (Select 2EC/SelectMax 0.97EC, Valent USA) 0.125 to 0.25 lb. a.i./A. Apply 8.0 to 16.0 fl. oz./A of Select 2EC or 16.0 to 32.0 fl. oz./A of SelectMax 0.97EC to control most grass weed species, including certain hard to control grass weeds, such as small grain volunteers and cover crops, and perennials such as hard fescue, tall fescue, Bermudagrass, orchardgrass, quackgrass, Johnsongrass, and wirestem muhly. Use the lower rate to control annual grasses and the perennial grasses listed above. Repeat the application if regrowth occurs. Always add oil concentrate to be 1% of the spray solution, or a minimum of 1 pt./A, to Select 2EC or nonionic surfactant to be 0.25% of the spray solution to SelectMax 0.97EC. For newly planted (nonbearing) apples, peaches, pears, plums, and cherries.

Clopyralid is registered as Stinger, at 3 lb.ai/gallon. It is a selective, postemergence herbicide for control of some broadleaf weeds if applied while weeds are generally small and actively growing. Some of the weeds controlled include clover species, dandelion, nightshade, burdock, common groundsel, jimsonweed, horseweed, and many thistle species including Canada. Can be used in APPLE (supplemental label) and STONE FRUIT. Treat the sod middles as well as the tree rows. Stinger is highly leachable in light soils.

Dichlobenil is available in 4% granular and 1.4 lb./gal. CS formulations. Dichlobenil volatizes rapidly under warm, moist soil conditions and must be applied in late fall or very early spring before the soil temperature exceeds 45°F to minimize such loss. It is absorbed principally by the roots of established and germinating weeds and rapidly translocated to growing points. This material is effective against a wide range of annual and established perennial grasses and weeds including nutsedge and quackgrass. Applications of 100 lb of 4G/A are effective on many annual grasses and broadleaf weeds, whereas 150 lb/A are usually required for control of most established perennials. Dichlobenil is labeled for use on APPLE, PEAR, and CHERRIES.

Diuron is marketed in an 80% dry flowable formulation as Karmex or Diuron 80DF as well as Diuron 4L (4lb AI per gallon). Diuron is effective against germinating annual broadleaf weeds and some annual grasses. It is absorbed by roots and translocated to the leaves where it interferes with photosynthesis. For best results it must be present in the soil before weed seeds germinate. Diuron is best used in combination with materials that are more effective on grasses. It is not effective on established perennial grasses or broadleaf weeds. Diuron has been effective against triazine-resistant pigweeds. Rates must be determined in relation to soil texture and organic matter content. Use is limited to APPLES, PEARS, and PEACHES. Labels do not recommend treatment of trees on full dwarf rootstocks.

Fluazifop-P butyl is available in a 2 lb AI/gallon formulation as Fusilade DX. Fluazifop is a selective postemergence herbicide effective on both annual and perennial grasses. Its best use is for control of grasses in newly planted orchards. Two applications are usually necessary with perennial grasses such as quackgrass. Spot treatments are suggested unless a severe grass problem exists. Inclusion of a nonionic surfactant enhances uptake by grass leaves. Can be used in STONE FRUIT ORCHARDS of any age and in NON-BEARING APPLE and PEAR ORCHARDS.

Flumioxazin is a herbicide with pre-emergent and post-emergent activity, formulated as Chateau WDG and Chateau SW. It provides residual control and will also enhance the activity of the burndown program with glyphosate or paraquat. It is readily absorbed by leaves, and quickly causes bleaching and wilting of weeds. It is effective for post-emergence control of many broadleaf weeds while they are small, 2-6 inches high, depending on the weed species. It also provides effective pre-emergent control of many broadleaf weeds and grasses. The label gives a rate of 6 to 12 oz. per acre per application (24 oz. maximum per year). If the soil is sandy or gravelly (over 80% content), a maximum rate of 6 oz/acre should be applied in trees established less than 3 years. If applied to trees established less than 1 year, the tree trunks must be protected with non-porous tree wraps. Label restricts application to between final harvest and pink bud on apples and budbreak on stone fruit.

Fluroxypyr (Starane Ultra, 0.14 to 0.5 lb. a.i./acre.) Use 0.4 to 1.4 pts. Starane Ultra/A to control many annual and certain perennial broadleaf weeds in pome fruit only. Apply to the foliage of actively growing weeds.

Starane Ultra will not control certain common annual broadleaf weeds, including common lambsquarter and pigweed sp. Tank-mix with 2,4-D to improve the spectrum of annual broadleaf weeds controlled, or with a glyphosate product to control emerged annual grasses and broadleaf weeds, and with residual herbicides for season long annual weed control. Do not apply more than 1.4 pts. of Starane/year. Do not apply Starane Ultra more than one time/year, during bloom, or within 14 days of harvest. Do not treat trees less than 4 years old. For established apples and pears ONLY and registered in MAINE ONLY.

Glufosinate-ammonium is currently registered as Rely 280 formulated as a liquid with 2.34 lbs. AI per gallon. Rely 280 is a non-selective herbicide for application as a directed spray labeled for control of a broad spectrum of annual and perennial grass and broadleaf weeds, and some woody species in APPLES only. Rootsucker control in APPLES is not allowed on the Rely 280 label. It has no residual activity. Avoid all contact with foliage and green bark tissue since injury to the trees can result, especially in young trees. Supply of Rely has been very limited.

Glyphosate is distributed as an aqueous solution under various generic formulations and under the name Roundup Original or Roundup WeatherMax. Glyphosate is a nonselective broad-spectrum herbicide for controlling established annual and perennial grasses and weeds plus woody brush, vines, and trees. No residual soil activity is to be expected from this material. The best timing of applications varies with weed type but is usually after weeds have developed full foliage and/or have begun to flower. Greatest effectiveness against nutsedge is obtained after tuber formation begins. Inclusion of 2,4-D and/or a nonionic surfactant is suggested to increase effectiveness, particularly on perennial broadleaf weeds. Glyphosate is absorbed through foliage and bark and translocated throughout the plant. Glyphosate may be applied as a directed spray or by wiper in APPLE, PEAR, and CHERRY orchards. Do not allow contact with foliage or bark on trunks of young fruit trees. Root-suckers or low branches that might be contacted by glyphosate should be removed at least 10 days before the glyphosate application. In APRICOT, PEACH, NECTARINE, PLUM, or PRUNE plantings, use wiper applications only. PEACHES and PLUMS are EXTREMELY SENSITIVE to glyphosate, and ANY contact with leaves or small branches or trunks of young trees may result in severe damage or tree death. USE EXTREME CARE TO ENSURE THAT NO PART OF THE PEACH TREE IS CONTACTED WITH OVERSPRAY OR DRIFT OF GLYPHOSATE.

Halosulfuron-methyl (Sandea, Gowan Co.) has a supplemental label for APPLE only and has both pre- and post-emergent activity on broadleaf weeds and nutsedge. It is absorbed through weed roots, shoots, and foliage and is translocated within the plant. Do not apply to trees established less than 1 year. Best results require application with a broad-spectrum burndown herbicide. Nutsedge control is best at 3-5 leaf stage for first germination flush, then followup again for the second flush.

Indaziflam (Alion, Bayer Crop Science, EPA Reg. No. 264-1106) is a pre-emergent herbicide with both broadleaf and grass weed control. It is a GROUP 29 herbicide. It is labeled on pome and stone fruit, but not to be used unless trees have been established 3-years or more. (Established Pome and Stone Fruit orchards are defined as the majority of trees in the orchard/grove established a minimum of three years.) Alion provides preemergence, residual control of weeds. Moisture is needed for activation. Alion controls weeds by inhibiting cellulose biosynthesis in plants. Do not apply within 25 feet of ponds, lakes, rivers, streams, wetlands, and habitat containing aquatic and semi-aquatic plants. The Pre-Harvest Interval (PHI) for pome and stone fruit is 14 days.

Isoxaben (Gallery T&V, Dow AgroSciences, EPA Reg. No. 62719-145) is a pre-emergence herbicide for control of broadleaf weeds in NON-BEARING orchards. Do not apply Gallery to newly transplanted non- bearing fruit and nut trees or non-bearing vineyards until soil or potting media has been settled by packing and irrigation or rainfall and no cracks are present or plant injury may occur. GALLERY IS HIGHLY RECOMMENDED AS A POST-PLANT TREATMENT IN 1ST-LEAF ORCHARDS.

Norflurazon is formulated as a dry flowable in Solicam 80 DF. Norflurazon at rates recommended provides control of most annual grasses and many annual broadleaf weeds plus suppression of quackgrass and nutsedge. It is absorbed by roots and translocated to growing points where it inhibits pigment formation. The material must be applied and moved into the soil by rainfall or irrigation before seed germination. Rates of application depend on organic matter and clay contents of the soil and crop. Norflurazon is most frequently used in tank-mix combinations that will increase effectiveness of broadleaf weed control. Established perennial weeds are not effectively controlled by norflurazon. Registered for use in APPLE, PEAR, APRICOT, CHERRY, NECTARINE, PEACH, PLUM, and PRUNE, depending on tree age.

Oryzalin is available as an aqueous suspension (Surflan A.S. or Oryzalin 4A.S.) containing 4 lb AI per gallon. It provides effective control of most annual grasses and some annual broadleaf weeds. Oryzalin has controlled triazine-resistant pigweed, but has not been sufficiently effective on ragweed or Pennsylvania smartweed. It is not effective against established weeds or grasses.

Oryzalin is absorbed by roots of germinating seedlings and interferes with cell division. To be effective, it must be applied and moved into the soil by 1/2 - 1 inch of rainfall-before seed germination. Oryzalin can be used in newly planted orchards as soon as the soil settles around the roots and no open cracks are present. It can be used in all tree fruit crops.

Oxyfluorfen is available as a 2 lb AI per gallon formulation in Goal 2XL, Galigan 2E GoalTender, or Collide. Oxyfluorfen has preemergence and post-emergence activity as a contact herbicide. Uptake can be through leaves, stems, or roots, but very little translocation occurs in the plant. Destruction of membranes occurs when treated plant parts are exposed to light. Oxyfluorfen is primarily effective against seedling broadleaf weeds. It does not control established perennial weeds or grasses and is best used in tank-mix combinations with other appropriate herbicides. Applications of oxyfluorfen must be made while trees are dormant, before buds begin to swell, to avoid possible damage from vapors. Registered for use on all tree fruit crops of any age.

Paraquat, as the dichloride salt, is marketed as *Gramoxone Inteon, which is a 2 lb/gallon formulation that has been formulated to prevent acute toxicity and has replaced most *Gramoxone Max (3 lb/gallon formulation) on the market. The rate for *Gramoxone Inteon is 2.5-4.0 pts/acre. *Gramoxone Inteon is registered for use in all the same crops as *Gramoxone Max. There are 2 generic products now registered, *Firestorm and *Parazone 3SL, which are both 3 lb/gallon materials. Paraquat is a nonselective contact herbicide that is effective in killing emerged annual broadleaf weeds and grasses and top-kills and suppression of perennials. It is rapidly absorbed into foliage and green bark where it is effective in destroying cell membranes. Paraquat is strongly adsorbed onto soil colloids where it is degraded by microbial activity. Contact with foliage, branches, and green bark on trunks of young trees can result in damage to the trees. Observe all worker safety cautions specified on labels when mixing, handling, or applying paraquat. It is registered for use on all tree fruit crops.

Pelargoinic acid is sold as Scythe (Gowan) and is a contact herbicide with moderate burn-down action (depending on rate) on annual and perennial broadleaf weeds and grasses. Somewhat effective at burning leaves on rootsuckers, and only herbicide specifically labeled for rootsucker 'control.' Use higher rates for greatest effect, however, quite expensive at higher rates.

Pendimethalin, formulated as an emulsifiable concentrate containing 3.3 lb AI/gal, is sold as Prowl 3.3EC. Pendimethalin is effective in controlling most annual grasses and some annual broadleaf weeds when used in preemergence applications. Primary mode of action is through root uptake and subsequent inhibition of cell division. Pendimethalin can be used in newly planted orchards. Combination with a contact herbicide is necessary to control emerged or established weeds. Use of Prowl 3.3EC is limited to NONBEARING TREES, for all tree fruit crops. Prowl H2O is registered for use in BEARING pome and stone fruits. It should be applied at 2-4 qts/acre; it has a 24-hr REI and a 60-day PHI. The lower the rate, the shorter the weed control duration. It is effective for pre-emergent control of many grasses as well as some broadleaf weeds such as pigweed and lambsquarters.

Pronamide is available in water-soluble pouches as *Kerb 50WP and 3.3 lb./gal. SC. It is effective in controlling winter annual and perennial grasses and chickweed. It is absorbed by roots and translocated throughout the plant. Pronamide must be applied in late fall when temperature does not exceed 55 F. but before soil freeze-up, and moved into the soil by rain to be effective. The range of activity on broadleaf weeds is limited, requiring additional measures for their control. Rates of application are determined by the type of grass being controlled and by soil texture. Registered for use on APPLE, CHERRIES, NECTARINE, PEACH, PEAR, PLUM, APRICOT and PRUNE.

Pyraflufen ethyl (Venue, Nichino America) is a PPO inhibitor that is a nonselective contact herbicide for post-emergence control of broadleaf weeds in tree fruit crops. It is often tank mixed with other herbicides such as glyphosate, paraquat or glufosinate to speed up the burndown of weeds to cause rapid plant desiccation. The addition of a chemical with a different mode of action appears to improve weed kill and helps avoid development of weed resistance to herbicides. Venue is most effective when the weeds are small, 2-4 inches height. Venue is labeled for use on all POME and STONE fruits. A supplemental label allows use on rootsuckers, but otherwise avoid contact with green trunk bark (young trees).

Rimsulfuron is a sulfonylurea, dry flowable formulation, registered as Matrix for control of certain broadleaf weeds and grasses in stone and pome fruit established for at least 1 full growing season. Matrix is absorbed through roots and leaves inhibiting growth of susceptible leaves. Matrix is most effective if half an inch of rainfall or irrigation occurs within 2 weeks of application. Matrix is mainly a pre-emergent herbicide but can provide some post-emergent control if weeds are still in seedling stage; but Matrix applications should include a burndown herbicide such as glyphosate, paraquat, or glufosinate. Reduced weed control may result if applied to heavy weed residue, limiting even distribution of Matrix to the soil surface.

Saflufenacil (Treevix, BASF) is a Group 14 (WSSA)/Group E (HRAC) postemergence directed

broadleaf herbicide labeled for apple and pear only. It is a PPO inhibitor in dry flowable formulation registered as TreeVix for use in pome fruit. It is a post-emergent burndown for broadleaf weeds but must be tank mixed with a grass herbicide or broad-spectrum post-emergent herbicide such as glyphosate for improved control of marestail. Tank mixing with paraquat is not recommended; it may reduce the efficacy of TreeVix. It can be applied in pome fruit established for 12 months. TreeVix requires the use of MSO (methylated seed oil) as an adjuvant for best results.

Sethoxydim is marketed as Poast, which contains 1.5 lb AI/gal. Sethoxydim is a selective grass herbicide for use in controlling established annual and perennial grasses. It does not control broadleaf weeds or sedges. A crop-oil concentrate must be used with sethoxydim. Suggested rates depend on height of grasses being treated. Sethoxydim can be used in APPLE, PEAR, APRICOT, CHERRY, NECTARINE and PEACH orchards of any age and in NONBEARING PLUM and PRUNE ORCHARDS.

Simazine is available in several formulations including Princep 4L, Simazine 4L and 90DF, and Princep Caliber 90 for use in orchards. Simazine is effective in controlling a wide range of annual broadleaf weeds and grasses. It does not control established perennial weeds or grasses. Simazine is taken up by roots and translocated to the leaves where it interferes with photosynthesis. It must be applied and moved into the soil before weeds germinate to be most effective; therefore, late fall or very early spring applications are suggested. (Note that simazine has a 150 day PHI in pome fruit, which limits spring applicatiom.) Activity is reduced in soils of low pH. Resistant weeds such as pigweeds and lambsquarters have been found where simazine has been the principal herbicide used. Control of these weeds has been achieved by using tank-mix combinations with diuron, oryzalin, or pendimethalin. Rates of simazine application and crop tolerance depend on soil texture and organic-matter content as well as crop and tree age. Registered for use in APPLE, PEAR, TART CHERRY, SWEET CHERRY, PEACH, and PLUM established 1 year.

Terbacil is formulated as an 80% wettable powder under the name Sinbar. It is effective in controlling most annual grasses and broadleaf weeds and in providing partial control or suppression of such perennials as quackgrass, horsenettle, and nutsedge. Terbacil is absorbed by plant roots and is translocated to the leaves where it interferes with photosynthesis. Residual activity of terbacil in the soil is relatively long-lived. This material is frequently used in tank-mix combinations with diuron or simazine. Application rates and crop tolerance depend on soil texture and organic-matter content as well as crop and tree age. Use is limited to APPLES and PEACHES. Terbacil is also registered for newly-planted fruit trees after the soil has settled and young and non-bearing apple, peach, plum, apricot and cherry trees at very low rates, but these uses have not yet been fully tested.

Table 8.4.1. Minimum time between planting and herbicide use.

None = no time limit noted on label NB = Nonbearing trees only; —= not labeled for use on crop.

Sample Trade Names (*active ingredient*)	**Apple**	**Pear**	**Apricot**	**Tart Cherry**	**Sweet Cherry**	**Nectarine**	**Peach**	**Plum**	**Prune**
Aim 2EC, 1.9EW (*carfentrazone-ethyl*)	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]
Alion (*indaziflam*)	3 yr	3 yr	3 yr	3 yr	3 yr	3 yr	3 yr	3 yr	3 yr
Casoron 4G (*dichlobenil*)	4 wk	4 wk	—	4 wk	4wk	—	—	—	—
Casoron 1.4CS (*dichlobenil*)	1 year	1 year	—	1 year	1 year	—	—	—	—
Chateau WDG (*flumioxazin*)	1 yr[1]	1 yr[1]	1 yr[1]	1 yr[1]	1 yr[1]	1 yr[1]	1 yr[1]	1 yr[1]	1 yr[1]
Fusilade DX (*fluazifop*)	NB	NB	None	None	None	None	None	None	None
Gallery (*isoxaben*)	NB	NB	NB	NB	NB	NB	NB	NB	NB
Goal 2XL, Galigan 2E, Goaltender, Collide (*oxyfluorfen*)	None	None	None	None	None	None	None	None	None
*Gramoxone (*paraquat*)	None	None	None	None	None	None	None	None	None
Karmex 80DF, Diuron 4L, 80DF (*diuron*)	1 yr	1 yr	—	—	—	—	3 yr	—	—
*Kerb (*pronamide*)	½-1 yr	½-1 yr	½-1 yr	½-1 yr	½-1 yr	½-1 yr	½-1 yr	½-1 yr	½-1 yr
Matrix 25 DF (*rimsulfuron*)	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr
Poast (*sethoxydim*)	None	None	None	None	None	None	None	NB	NB

Table 8.4.1. Minimum time between planting and herbicide use.

None = no time limit noted on label NB = Nonbearing trees only; —= not labeled for use on crop.

Sample Trade Names (*active ingredient*)	Apple	Pear	Apricot	Tart Cherry	Sweet Cherry	Nectarine	Peach	Plum	Prune
Princep 4L, Simazine 4L, 90DF, Caliber 90 (*simazine*)	1 yr	1 yr	—	1 yr	1 yr	—	1 yr	1 yr	—
Prowl 3.3E (*pendimethalin*)	None	None	None	None	None	None	None	None	None
Prowl H_2O (*pendimethalin*)	None	None	None	None	None	None	None	None	None
Rely280 (*glufosinate-ammonium*)	1 yr[1]	—	—	—	—	—	—	—	—
Roundup, Touchdown (*glyphosate*)	None	None	None	None	None	None	None	None	None
Sandea (*halosulfuron-methyl*)	1 year	—	—	—	—	—	—	—	—
Scythe (*pelargonic acid*)	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]
Sinbar 80WP (*terbacil*)	3 yr/NB	NB	NB	NB	NB	NB	3yr/NB	NB	NB
Solicam DF (*norflurazon*)	None	1 yr	1 yr	18 mo	18 mo	6 mo	6 mo	1 yr	1 yr
Starane Ultra (fluroxypyr)	4 yr	4 yr	—	—	—	—	—	—	—
Stinger (*clopyralid*)	1 yr	—	None	None	None	None	None	None	None
Surflan AS (*oryzalin*)	None	None	None	None	None	None	None	None	None
Treevix (saflufenacil)	1 yr	1 yr	—	—	—	—	—	—	—
Unison (*2,4-D*)	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr
Venue (*pyraflufen-ethyl*)	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]	None[1]
Weedar 64, Amine 4, 2,4-D Amine (*2,4-D*)	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr

Sinbar + Karmex tank mix at lower rates - Apples and peaches established at least 2 yr.

* Restricted-use pesticide; may be purchased and used only by certified applicators or used under the supervision of a certified applicator.

[1] Kerb. Not less than 6 mo after fall transplanting nor less than 1 yr after spring transplanting of labeled crops.

[2] Low rate for newly planted and young, non-bearing fruit trees (except apple). Higher rate for apple and peach established 3-year.

[3] Can be applied to trees less than 1 year old if non-porous wraps, grow tubes, or waxed containers are used.

[1] Do not allow contact with green bark or foliage of newly planted trees.

Table 8.4.2. Effectiveness of herbicides in tree fruit crops.

Trade Name(s) (*active ingredient*)	AG	AB	PG	PB	WBV	YN	BW	HN	CT	SB	PW	RW
2,4-D (multiple trade names)	—	G	—	G	F	—	G	F	F	—	G	G
Aim EC, Aim EW (*carfentrazone-ethyl)*	—	G	—	P	—	—	P	—	—	—	G	G
Alion (indaziflam)	G	G	P	P	P	F	F	—	—	—	G	G
Casoron 4G (*dichlobenil*)	G	G	G	G	—	G	—	G	G	—	G	G
Chateau SW (*flumioxazin*)	G	G	P	P	P	P	P	P	P	P	G	G
Fusilade (*fluazifop*)	G	—	F	—	—	—	—	—	—	—	—	—
Gallery (isoxaben)	—	G	—	—	—	—	G	—	—	—	G	G
Goal, Collide (*oxyfluorfen*)	F	G	—	—	—	—	—	—	—	—	G	G
*Gramoxone Inteon (*paraquat*)	G	G	F	F	F	G[3]	F	F	F	—	G	F
Karmex (*diuron*)	G	G	F	—	—	—	—	—	—	—	G	G
*Kerb (*pronamide*)	G	—	G	—	—	—	—	—	—	—	—	—
Matrix (*rimsulfuron*)	G	G	P	P	P	F	P	P	F	P	G	F
Poast (*sethoxydim*)	G	—	F	—	—	—	—	—	—	—	—	—
Princep (*simazine*)	F	G	—	—	—	—	—	—	—	—	G[4]	—
Prowl, Prowl H20 (*pendimethalin*)	G	F	—	—	—	—	—	—	—	—	G	—
Rely 280	G	G	F	F	P	G	F	F	F	—	G	G

Table 8.4.2. Effectiveness of herbicides in tree fruit crops.

Trade Name(s) (*active ingredient*)	AG	AB	PG	PB	WBV	YN	BW	HN	CT	SB	PW	RW
Roundup, Touchdown (*glyphosate*)	G	G	G	G	G[1]	G[2]	G	G[1]	G[1]	F	G	G
Treevix *(saflufenacil)*	—	G	—	F	—	—	F	—	F	G	G	G
Sandea (halosulfuron-methyl)	—	G	—	—	—	G	F[6]	G	F[6]	—	G	G
Scythe (pelargonic acid)	G	G	F	F	P	—	F	F	F	F	F	F
Sinbar (*terbacil*)	G	G	F	F	—	F	—	F	—	—	F	G
Solicam (*norflurazon*)	G	F	F	—	—	F	—	—	—	—	F	—
Starane Ultra (fluroxypyr)	G	G	F	F	P	P	F	—	—	—	G	G
Stinger (*clopyralid*)	—	F[5]	—	F[5]	—	—	—	F	G	—	—	F
Surflan (*oryzalin*)	G	F	—	—	—	—	—	—	—	—	G	P
Treevix *(saflufenacil)*	—	G	—	P	P	—	F	—	—	—	G	G
Venue (*pyraflufen-ethyl*)	—	G	—	F-G[6]	—	—	G[6]	G[6]	G[6]	F	G	G

Key: G = good; **F** = fair; **P** = poor

***** Restricted-use pesticide; may be purchased and used only by certified applicators or used by someone under the supervision of a certified applicator.

[1] Combination with 2,4-D amine has improved effectiveness.
[2] Best results with late-summer (after August 1) applications.
[3] Best results with early mid-summer (before July 15) applications.
[4] Resistant types may require use of alternative materials.
[5] Not broad spectrum; see label for specific weed targets.
[6] Requires tank mix.

Abbreviations:
AG = Annual grasses; **PG** = Perennial grasses;
AB = Annual broadleaves; **PW** = Pigweeds;
BW = Bindweeds; **RW** = Ragweed;
CT = Canada thistle; **SB** = Smooth bedstraw;
HN = Horsenettle; **WBV** = Woody brush, vines;
PB = Perennial broadleaves; **YN** = Yellow nutsedge.

Table 8.4.3. Weed control guidelines for tree fruit.

Refer to back of book for key to abbreviations and footnotes.

Crop						*Tree Age*				
Apples	Pears	Cherries	Peaches	Apricots	Plum/Prune	Planting Year	1 year plus	2 years plus	3 years plus	**PRODUCT NAME** (*active ingredient, weight of active per unit of herbicide*) *Notes:*
X	X	X	X	X	X		X	X		**2,4-D AMINE, WEEDAR 64, or other labeled formulation** (*2,4-D, 3.8 lb/gal*) *Weeds Controlled:* broadleaves *Rate (per acre):* 3 pt. *AI per acre (lbs/acre):* 1.4 *Days to harvest:* Apples and pears: 14; apricots, cherries, peaches, and plums: 40 *REI (hours):* 48 *Comments:* Established perennials, woody brush and vines can also be controlled by using in tank mix with glyphosate. To control dandelions and other broadleaf weeds in sod cover under cherry trees, apply in the fall (best) or early spring BEFORE TREES OR DANDELIONS BEGIN TO BLOOM. Yearly application is needed to control dandelions. Avoid contact with fruit, foliage, stems, or limbs of trees. Not all products labeled for all crops. See labels.
X	X	X	X	X	X	X	X	X		**AIM EC** (*carfentrazone-ethyl, 2 lb/gal*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 1.9 oz *AI per acre (lbs/acre):* 0.03 *Days to harvest:* All tree fruits: 3 *REI (hours):* 12 *Comments:* Apply in tank mix with paraquat or glyphosate for broadleaf and grass control, but avoid contact with green bark and foliage in new to 2 year old trees.

Table 8.4.3. Weed control guidelines for tree fruit.

Refer to back of book for key to abbreviations and footnotes.

Crop						Tree Age				PRODUCT NAME (*active ingredient, weight of active per unit of herbicide*) *Notes:*
Apples	Pears	Cherries	Peaches	Apricots	Plum/Prune	Planting Year	1 year plus	2 years plus	3 years plus	
X	X	X	X	X	X				X	**ALION** (*indaziflam, 1.67 lb/gal*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 5.0-6.5 fl oz *Days to harvest:* 14 *REI (hours):* 12 *Comments:* Use lower rate on coarse-texture soils; use higher rate for longer weed control; do not apply more than total of 10.3 fl. oz. per acre per season; allow minimum of 30 days between application(s); do not use on soils with more than 40% gravel content. For trees established 3-years. Best control when applied to relatively bare ground.
X	X	X					X	X		**CASORON 1.4CS** (*dichlobenil, 1.4 lb/gal*) *Weeds Controlled:* annual grasses and broadleaves, perennial seedlings *Rate (per acre):* 1.4–2.8 gals. *AI per acre (lbs/acre):* 2.9-4.3 *Days to harvest:* None listed *REI (hours):* 12 *Comments:* Apply late fall or early spring. Controls many annual and perennial grasses and weeds in trees established 1 year or more..
X	X	X					X	X		**CASORON 4G** (*dichlobenil, 0.04 lb/lb*) *Weeds Controlled:* annual grasses and broadleaves, perennial seedlings *Rate (per acre):* 100-150 lb *AI per acre (lbs/acre):* 4.0-6.0 *Days to harvest:* none listed *REI (hours):* 12 *Comments:* November to March when soil temp is below 45˚. Controls many annual and perennial grasses and weeds in trees established 1year or more.
X	X	X	X	X	X	X	X	X		**CHATEAU 51 SW** (*flumioxazin, .51 lb/lb*) *Weeds Controlled:* annual grasses and broadleaf weeds *Rate (per acre):* 6-12 fl. oz. *AI per acre (lbs/acre):* 0.188-0.38 *Days to harvest:* Apples: by pink; apricots, cherries, peaches, pears, and plums: budbreak; or fall application post-harvest *REI (hours):* 12 *Comments:* 12 fl. oz is maximum rate for an application; with 24 fl. oz maximum for the season. If soil is covered with weeds at the time of application, apply with paraquat. Can only be applied prior to the 'pink bud' stage (apple) or bud break (pear and stone fruit) or in the fall after harvest. **DO NOT APPLY TO TREES ESTABLISHED LESS THAN 1 YEAR UNLESS PROTECTED FROM SPRAY CONTACT BY NON-POROUS TUBES OR WAX CONTAINERS. See label for further use restrictions and limitations.**
X	X	X	X	X	X	X	X	X	X	**COLLIDE** (*oxyfluorfen, 9.01 lb/gal*) *Weeds Controlled:* Annual grasses and broadleaf weeds *Rate (per acre):* 2- 8 pt *AI per acre (lbs/acre):* 2.25-9.01 *Days to harvest:* 0 *REI (hours):* 24

Table 8.4.3. Weed control guidelines for tree fruit.

Refer to back of book for key to abbreviations and footnotes.

Crop						Tree Age				PRODUCT NAME (*active ingredient, weight of active per unit of herbicide*) *Notes:*
Apples	Pears	Cherries	Peaches	Apricots	Plum/Prune	Planting Year	1 year plus	2 years plus	3 years plus	
										COLLIDE (*continued*) *Comments:* Apply as soon as soil has settled and no cracks are present. Oxyfluorfen applications limited to dormant trees (before buds on trees begin to grow).
X	X	X	X	X	X	X	X	X	X	**FUSILADE DX** (*fluazifop-p-butyl, 2 lb/gal*) *Weeds Controlled:* Annual and perennial grasses *Rate (per acre):* 1-1.5pts *AI per acre (lbs/acre):* 0.25-0.375 *Days to harvest:* Stone fruit 14; nonbearing apples and pears only *REI (hours):* 12 *Comments:* Grasses 2-8 in tall. Repeat before regrowth is 10 in tall. Use surfactant or crop oil according to label directions.
X	X	X	X	X	X	X	X	X		**GALIGAN 2E** (*oxyfluorfen, 2 lb/gal*) *Weeds Controlled:* annual grasses and broadleaf weeds *Rates (per acre):* Pre-emergence: 5-6 pts; Postemergence: 2-6 pts *AI per acre (lbs/acre):* Pre-emergence: 1.25-1.5; Postemergence: 0.5-1.5 *Days to harvest:* Do not apply between budswell and final harvest. *REI (hours):* 24 *Comments:* Apply as soon as soil has settled and no cracks are present. Oxyfluorfen applications limited to dormant trees (before buds on trees begin to grow).
										GALLERY (*isoxaben*) *Weeds Controlled:* pre-emergent broadleaf *Rates (per acre):* 0.66-1.33 lb *AI per acre (lbs/acre):* 0.5-1.0 *Days to harvest:* 365 *REI (hours):* 12 *Comments:* Do not apply more than a total of 4 lb of Gallery T&V 75 Dry Flowable per acre within a 12-month period
X	X	X	X	X	X	X	X	X		**GOAL 2XL,** (*oxyfluorfen, 2 lb/gal*) *Weeds Controlled:* annual grasses and broadleaf weeds *Rates (per acre):* 3.2-4 qt *AI per acre (lbs/acre):* 1.6-2.0 *Days to harvest:* Do not apply between budswell and final harvest *REI (hours):* 24 *Comments:* Apply as soon as soil has settled and no cracks are present. Oxyfluorfen applications limited to dormant trees (before buds on trees begin to grow).
X	X	X	X	X	X	X	X	X		**GOALTENDER,** (*oxyfluorfen, 4 lb/gal*) *Weeds Controlled:* annual grasses and broadleaf weeds *Rates (per acre):* Pre-emergence broadcast:2.5-3 pts; pre-emergence banded: 2.5-4 pts; postemergence broadcast: 1-3 pts; postemergence banded: 1-4 pts. *AI per acre (lbs/acre):* Pre-emergence broadcast:1.25- 1.5; pre-emergence banded: 1.25- 2; postemergence broadcast: .5-1.5; postemergence banded: .5-2. *Days to harvest:* Do not apply between budswell and final harvest *REI (hours):* 24

Table 8.4.3. Weed control guidelines for tree fruit.

Refer to back of book for key to abbreviations and footnotes.

Crop						Tree Age				PRODUCT NAME (*active ingredient, weight of active per unit of herbicide*) *Notes:*
Apples	Pears	Cherries	Peaches	Apricots	Plum/Prune	Planting Year	1 year plus	2 years plus	3 years plus	
										GOALTENDER, (*continued*) *Comments:* Apply as soon as soil has settled and no cracks are present. Oxyfluorfen applications limited to dormant trees (before buds on trees begin to grow).
X	X	X	X	X	X	X	X	X		***GRAMOXONE INTEON, SL, SL 2.0** (*paraquat, 2 lb/gal*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 2.5-4.0 pt. *AI per acre (lbs/acre):* 0.63-1.0 *Days to harvest:* Apples and pears: none listed; apricots, cherries, nectarines, and plums: 28; peaches: 14 *REI (hours):* 24 *Comments:* Apply to emerged weeds as needed. Avoid contact of paraquat with foliage or trunks of trees. SEE LABEL FOR WORKER SAFETY CAUTIONS.
X	X		X				X	X	X	**DuPont KARMEX 80DF, DIURON 80DF, other labeled formulations** (*diuron, 0.80lb/lb*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 1.25-2.5 lb, or 3-6 pt *AI per acre (lbs/acre):* 1.0-3.0 *Days to harvest:* Apple and pear: apply March through May or post-harvest; peaches: 20 or 90, see label *REI (hours):* 12 *Comments:* Apply early spring before weeds emerge. For apples and pears, do not apply to varieties grafted on full-dwarf rootstocks. For peach, only – apply to trees 3 full years old or older on some labels. See label for soil-texture and organic matter rate limitations. Add *paraquat to help control established weeds. Addition of oryzalin has improved late-season annual grass and broadleaf weed control. **NOTE:** Karmex may be applied in apple and pear plantings established for at least 1 year and peach plantings established at least 3 years.
X	X	X	X	X	X		X	X		***KERB 50W, SC** (*pronamide, 0.5 lb/lb, or 3.3 lb./gallon*) *Weeds Controlled:* Established perennial grasses *Rate (per acre):* 4.0-8.0 lb *AI per acre (lbs/acre):* 2.0-4.0 *Days to harvest:* post harvest in fall *REI (hours):* 24 *Comments:* Apply late fall before soil freezes. Spring-planted trees must be established at least 6 mo; fall-planted trees at least 1 yr. Use other materials for broadleaves and late-summer annual grasses.
X	X	X	X	X	X		X	X		**MATRIX 25DF** (*rimsulfuron, 0.25 lb/lb*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 4 oz. *AI per acre (lbs/acre):* 0.0625 *Days to harvest:* Apples and pears: 7; Apricots, cherries, peaches, and plums: 14 *REI (hours):* 4 *Comments:* Can be applied once a year as a single application or two times if a banded application of 50% is used. Rainfall or irrigation is necessary for activation.

Table 8.4.3. Weed control guidelines for tree fruit.

Refer to back of book for key to abbreviations and footnotes.

Crop						Tree Age				PRODUCT NAME (*active ingredient, weight of active per unit of herbicide*) *Notes:*
Apples	Pears	Cherries	Peaches	Apricots	Plum/Prune	Planting Year	1 year plus	2 years plus	3 years plus	
X	X	X	X	X	X	X	X	X		**POAST** (*sethoxydim,1.5 lb/gal*) *Weeds Controlled:* annual grasses *Rate (per acre):* 1.0-2.5 pt *AI per acre (lbs/acre):* 0.28-0.47 *Days to harvest:* Apples and pears: 14; apricots, cherries, and peaches: 25; plums/prune: 1 year (non-bearing application) *REI (hours):* 12 *Comments:* Apply to actively growing grass before tillering or seedhead formation. Use a crop-oil concentrate when applying to plum and prune (see label).
X	X	X	X		X		X	X	X	**PRINCEP 4L** (*simazine, 4 lb/gal*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 1-2 qt *AI per acre (lbs/acre):* 1.0-2.0 *Days to harvest:* Apples: 150; pears, tart cherries: not listed; peaches, plums, sweet cherries: applied late fall to early spring *REI (hours):* 12 *Comments:* Apply early spring before weeds emerge. See soil-texture rate limitations on label. Add paraquat to help control established weeds. Addition of napropamide, pendimethalin, or oryzalin have improved late-season annual grass and broadleaf control.
X	X	X	X	X	X	X	X	X		**PROWL 3.3 EC** (*pendimethalin, 3.3 lb/gal*) *Weeds Controlled:* annual grasses and broadleaf weeds *Rates (per acre):* 4.8 qts. *AI per acre (lbs/acre):* 4 *Days to harvest:* Non-bearing use only. *REI (hours):* 24 *Comments:* Prowl 3.3 EC use limited to NONBEARING TREES ONLY.
X	X	X	X	X	X	X	X	X		**PROWL H2O** (*pendimethalin, 3.8 lb/gal*) *Weeds Controlled:* annual grasses and broadleaf weeds *Rate (per acre):* 2-4 qts. *AI per acre (lbs/acre):* 1.9-3.8 *Days to harvest:* 60 (for all tree fruit) *REI (hours):* 24 *Comments:* Prowl H2O can be used in non-bearing and bearing trees. No more than 4.2 qts/acre/year of Prowl H2O may be applied.
X							X			**RELY 280** (*glufosinate-ammonium, 2.34 lb/gal*) *Weeds Controlled:* broadleaves and grasses *Rate (per acre):* Weeds less than 3": 48 fl oz; weeds less than 6" high pre-tiller grasses: 56 fl oz; weeds greater than 6" and/or grasses that have tillered: 56-82 fl oz *AI per acre (lbs/acre):* Weeds less than 3": .8775; weeds less than 6" high pre-tiller grasses:1.02; weeds greater than 6" and/or grasses that have tillered: 1.02-1.5 *Days to harvest:* 14 *REI (hours):* 12 *Comments:* Sucker control is not listed on Rely 280 label. Avoid contact with green bark (protect young tree trunks)

Table 8.4.3. Weed control guidelines for tree fruit.

Refer to back of book for key to abbreviations and footnotes.

Crop						*Tree Age*				**PRODUCT NAME** (*active ingredient, weight of active per unit of herbicide*) *Notes:*
Apples	**Pears**	**Cherries**	**Peaches**	**Apricots**	**Plum/Prune**	**Planting Year**	**1 year plus**	**2 years plus**	**3 years plus**	
X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**ROUNDUP, OTHER FORMULATIONS** (*glyphosate,4 lb/gal and 4.5 lb/gal*) *Weeds Controlled:* all *Rates (per acre):* 1-3 qts. *AI per acre (lbs/acre):* 1-3 *Days to harvest:* Apples and pears: 1; apricots, cherries, peaches, and plums: 17 *REI (hours):* 12 *Comments:* Timing varies with weed type. Apply to emerged weeds as needed. Avoid contact of glyphosate with foliage, branches, suckers or trunks of trees. When applying to peach, do not contact bark or foliage!
X	**X**	**X**	**X**	**X**	**X**					**SCYTHE** (*pelargonic acid*) *Weeds Controlled:* annual broadleaf and grasses mostly; rootsuckers *Rates (per acre):* 3-10% by volume *Days to harvest:* 0 *REI (hours):* 12 *Comments:* Can be used as a directed/shielded spray and/or rootsucker control. Avoid contact with green bark or desirable foliage. Use 5% for control of annual broadleaf weeds and grasses, 10% for maximum vegetation burndown.
X							**X**	**X**	**X**	**SANDEA** (*halosulfuron-methyl*) *Weeds Controlled:* broadleaf weeds and nustsedge *Rates (per acre):* 1/2 to 1 ounce *Days to harvest:* Apple: 14 *REI (hours):* 12 *Comments:* Apply uniformly with ground equipment in a minimum of 15 gals of water per acre. For best results use a NIS and broad-spectrum burndown herbicide with post-emergence applications. Avoid spry drift or contact with fruit and foliage. Avoid application when temperature above 85 F. Do not apply more than 2 ounces Sandea per acre per year.
X	**X**	**X**	**X**		**X**		**X**	**X**	**X**	**SIMAZINE 90DF, PRINCEP other labeled formulations** (*simazine, 0.9 lb/lb*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 1.1-2.2 lbs *AI per acre (lbs/acre):* 1.0-2.0 *Days to harvest:* Apples: 150 days; pears, sour cherries: depends on the product label; peaches, sweet cherries, plums: apply late fall to early spring. *REI (hours):* 12 *Comments:* Apply early spring before weeds emerge. See soil-texture rate limitations for simazine and norflurazon. Add paraquat to help control established weeds. Addition of napropamide, pendimethalin, or oryzalin have improved late-season annual grass and broadleaf control. **NOTE:** Tank mixes will alter the days to harvest. See product label for details.
X	**X**		**X**			**X**	**X**	**X**	**X**	**SINBAR 80 DF** (*terbacil, .8 lb/lb*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 0.5-1.0 lb. (High rate is 2 lb for 2+ year old peaches) *AI per acre (lbs/acre):* 0.4-0.8 *Days to harvest:* Apples and peaches: 60; All other tree fruit: non-bearing *REI (hours):* 12

Table 8.4.3. Weed control guidelines for tree fruit.

Refer to back of book for key to abbreviations and footnotes.

Crop						Tree Age				PRODUCT NAME (*active ingredient, weight of active per unit of herbicide*) *Notes:*
Apples	Pears	Cherries	Peaches	Apricots	Plum/Prune	Planting Year	1 year plus	2 years plus	3 years plus	
										SINBAR 80 DF (*continued*) *Comments:* For non-bearing, young, newly-planted trees, make the first application after a significant rainfall or irrigation that will settle the soil around the base of the tree. Rate varies with tank mix combination, age of tree, and soil texture/organic matter content.
X	X	X	X	X	X		X	X		**SOLICAM** (*norflurazon, 0.8 lb/lb*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 2.5-3.0 lb *AI per acre (lbs/acre):* 2.0-2.4 *Days to harvest:* All: 60 *REI (hours):* 12 *Comments:* Apply early spring before weeds emerge. See soil-texture rate limitations. Add paraquat to help control established weeds. Additions of napropamide, pendimethalin, or oryzalin have improved late-season annual grass and broadleaf weed control.
X	X								X	**STARANE ULTRA** (*fluoxypyr, 2.8 lb/gal*) *Weeds Controlled:* annual and perennial broadleaves *Rate (per acre):* 0.4-1.4 pt *AI per acre (lbs/acre):* 0.14-0.5 *Days to harvest:* 14 *REI (hours):* 24 *Comments:* Do not apply Starane Ultra more than one time/year or during bloom.
X		X	X	X	X	X	X	X	X	**STINGER** (*clopyralid, 3 lb/gal*) *Weeds Controlled:* Established perennial broadleaf weeds *Rate (per acre):* 1/3-2/3 pt *AI per acre (lbs/acre):* 0.12-0.24 *Days to harvest:* 30 *REI (hours):* 12 *Comments:* Apply for post-emergence control of specific problem weeds such as Canada thistle, clover, vetch, dandelion, in row and row middles. Not to exceed 2/3 pt/A/year. Apple trees established 1 year or more. Do not apply during apple bloom.
X	X	X	X	X	X	X	X	X		**SURFLAN AS** (*oryzalin, 4 lb/gal*) *Weeds Controlled:* annual grasses and broadleaf weeds *Rate (per acre):* 3-6 qts. *AI per acre (lbs/acre):* 3-6 *Days to harvest:* None listed *REI (hours):* 24 *Comments:* Additional measures may be needed to control later emerging weeds. Add paraquat to help control established perennial grasses and weeds.
X	X						X	X	X	**TREEVIX** (*saflufenacil, 0.7 lb a.i. per lb*) *Weeds Controlled:* Weeds Controlled: postemergence broadleaf *Rate (per acre):* 1 oz *AI per acre (lbs/acre):* *Days to harvest:* 0

Table 8.4.3. Weed control guidelines for tree fruit.

Refer to back of book for key to abbreviations and footnotes.

Crop						*Tree Age*				**PRODUCT NAME** (*active ingredient, weight of active per unit of herbicide*) *Notes:*
Apples	**Pears**	**Cherries**	**Peaches**	**Apricots**	**Plum/Prune**	**Planting Year**	**1 year plus**	**2 years plus**	**3 years plus**	
										TREEVIX (*continued*) *REI (hours):* 12 *Comments:* Do not apply more than 1 oz Treevix in a single application; do not apply more thant 3 oz Treevix in a single season; do not use in tree nurseries or year of planting; 2nd, 3rd leaf trees should have trunk shields or care taken to not spray trunks. Must be tank mixed with a grass herbicide or broad spectrum post-emergent herbicide such as glyphosate, requires the addition of MSO (methylated seed oil) as an adjuvant for best results.
X	**X**	**X**	**X**		**X**		**X**	**X**		**UNISON or other labeled formulation** (*2,4-D, 1.74 lb/gal*) *Weeds Controlled:* broadleaves *Rate (per acre):* 3 pt. *AI per acre (lbs/acre):* 0.6525 *Days to harvest:* Apples and pears: 14; cherries, peaches, plums: 40 *REI (hours):* 48 *Comments:* To control dandelions and other broadleaf weeds in sod cover under cherry trees, apply in the fall (best) or early spring BEFORE TREES OR DANDELIONS BEGIN TO BLOOM. Yearly application is needed to control dandelions. Avoid contact with fruit, foliage, stems, or limbs of trees.
X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**VENUE** (*pyraflufen-ethyl, 0.177 lb/gal*) *Weeds Controlled:* listed broadleaf weeds *Rate (per acre):* 1-4.0 fl. oz. *AI per acre (lbs/acre):* 0.17 to 0.68 oz. *Days to harvest:* 0 *REI (hours):* 12 *Comments:* Do not allow spray to contact green bark of trunk area. Can be applied postharvest, dormant, pre-bloom, and in season. Use 3-4 oz./acre for sucker management when suckers are young and not hardened off. Effective on Canada thistle (with Stinger), horsenettle (with paraquat), and bindweed (with another contact herbicide).

*Restricted-use pesticide.

9 Wildlife Damage Management

9.1 Deer and Rabbits

Several commercial repellents are available to reduce deer or rabbit browsing to orchards (Table 9.1.1). The effectiveness of repellents is extremely variable and is affected by factors such as deer or rabbit numbers, feeding habits, and environmental conditions. Repellents may be cost-effective for controlling wildlife damage when:

1. Light to moderate damage is evident,
2. Small acreages are damaged, and
3. Few applications will be needed for adequate control.

If these three conditions are not satisfied, it is best to look at the cost-benefit ratios for fencing and/or state permits for removing deer

With the use of repellents some damage must be tolerated, even if browsing pressure is low. None of the existing repellents provides reliable protection for more than 5 weeks when deer or rabbit densities are high. If browsing pressure is severe, a long-term damage management program should be implemented, including potential habitat modifications, reductions in animal numbers, and an evaluation of fencing alternatives.

A landowner can use a variety of non-chemical alternatives to reduce wildlife damage to fruit trees. These techniques fall into three primary categories: exclusion, habitat modification, and wildlife population reductions. Fencing is the most common exclusion technique used to prevent damage to crops. Helpful information can be found at: wildlifecontrol.info

Habitat modifications can reduce damage levels by making areas less suitable for problem wildlife species. Damage prevention with cultural manipulations should begin with site selection and plant establishment. Removal of brush, stone piles, and non-mowed wet areas in and near orchards, will reduce the attractiveness of sites to rodents and rabbits. Mowing in established plantings can reduce preferred foods of wildlife, remove protective cover, enhance predation, and expose animals to severe weather conditions. Sites adjacent to croplands should also be managed to reduce pest numbers, as nuisance wildlife may reinvade orchards from these habitats.

Wildlife population reductions may be necessary to reduce damage to tolerable levels. When trapping, care and experience are necessary to reduce captures of non-target species. Live-traps should be substituted for body-gripping traps in areas where pets or endangered wildlife may inadvertently be captured. In rural locations, shooting can be used to effectively remove problem animals. When practical, reductions in populations of game species (i.e., deer, rabbits, etc.) should occur during open hunting seasons. Check with your state department of wildlife management to help reduce deer or wildlife abundance and impacts on agricultural and forested lands.

Wildlife population reduction by lethal methods often fails to provide long-term relief from damage. Where habitat conditions are suitable, and exclusion is not attempted, most pests will repopulate the site soon after lethal control efforts have ceased. Habitat modification and exclusion methods usually require more initial effort and expense, but these techniques may provide longer-term damage prevention, especially when a few pest individuals can inflict substantial losses.

9.2 Meadow and Pine Voles

Two species of voles cause damage in New England orchards. Meadow voles are found throughout the region and probably inhabit every sod orchard. Pine voles are a problem in mostly southern New England orchards, especially in southeast Massachusetts, Connecticut, and Rhode Island. Several orchards in these states have both species present, and may experience considerable damage to trees during severe weather, or when other food sources become unavailable.

The contrasting living habits of meadow and pine voles have important implications for their detection and control. Meadow voles live primarily above the ground surface in dense sod or vegetation. Pine voles live primarily below ground and damage the root systems of trees. When feasible, hand placement of baits in tunnels or under roofing shingles, slabs of wood, or similar protected bait stations, is the preferred method for baiting pine voles. The optimum times to apply baits are in the early spring and after the fall harvest.

For orchards with meadow vole problems, an annual post-harvest baiting program using a *zinc phosphide- or *chlorophacinone-treated bait is strongly recommended. Both grain-based and pelletized baits are available from commercial sources (Table 9.1.1). Do not apply baits (particularly grain-based products) to areas with bare ground, including vegetation-free herbicide strips under trees, as this may increase the chance of feeding and mortality of non-target song and game birds. Hand-place rodenticides under bait stations (i.e., shingles) instead of broadcast baiting orchards frequented by wild turkeys. Pelletized baits are preferred over *zinc phosphide-treated corn. Research indicates corn baits are less effective and more attractive to non-target wildlife. Always follow label directions for rates and observe all precautions. Because there is evidence that bait shyness may occur with repeated use of *zinc phosphide baits, a single, complete bait coverage of the orchard site during a period of fair weather is desirable. Ideally, this should closely follow a post-harvest mowing.

Because of their underground habits, pine voles are more difficult to control. In orchards with recurring pine vole problems, the placement of toxic baits beneath previously established baiting stations (1 or 2 per tree) is a reliable method. In addition, toxicants can be hand-placed directly in active underground burrows. Some rodenticides may also be hand-broadcast directly beneath the tree's drip-zone, directing the bait toward burrow entrances. Not all formulations are approved for broadcast application, so follow label directions. *Chlorophacinone may provide better control for pine voles because of their habit of caching food in underground burrows. (*Chlorophacinone may have a special use label in your state – check with your Extension specialist.) As with meadow voles, late fall is the best time for control efforts. Avoid using acute toxicants such as *zinc phosphide more than once every 6 months, preferably only once per year. However, heavy pine vole infestations, as indicated by numerous burrows and fresh dirt castings at several adjacent trees, may require a second application of bait about 2 weeks after the first.

The most important consideration in the timing of a control program is to achieve the greatest vole reduction just before onset of severe winter conditions. Voles that remain alive in the orchard will survive under the protection of snow cover and can inflict considerable tree damage during winter months. Monitoring orchards for signs of vole activity enables growers to detect vole population increases. Apple activity indices can provide a reliable measure of rodent numbers and the potential for damage.

Young orchards (trees ranging in age from 1-15 years) are most susceptible to pine vole damage. Also, young trees inter-planted in older orchards are extremely vulnerable and must be protected from pine voles. Persistent pine vole populations in older orchards (trees 30-60 years) should be hand-baited to limit potential vole damage in adjacent younger orchard blocks.

Although toxic baits offer reliable control and should be used where voles are abundant, cultural practices can reduce or even eliminate the need for toxic baits. Careful mowing and herbicide treatment will lower rodent numbers because voles require green, growing vegetation for survival and breeding. The meadow vole is especially vulnerable to close mowing of orchard driveways, and rotary mowers are much more effective than sickle-bar types for removing orchard ground cover and thatch.

The use of an herbicide strip beneath the trees and along the tree rows is a second cultural practice which can effectively eliminate meadow voles. Although close-mowing coupled with herbicide treatments can provide outstanding meadow vole control, recent evidence indicates these management practices will reduce but not eliminate pine voles.

Clean cultural practices, including removing dropped apples, winter prunings, and vegetation near the base of trees, all aid in reducing vole population buildups. Wire or nylon guards can be used for protecting younger trees from voles as well as rabbits, as long as they are both high enough and buried in the ground a couple inches. Still, good ground cover management = good vole management!

IMPORTANT NOTE: *Zinc phosphide and *chlorophacinone are restricted-use pesticides and may be purchased and used only by certified applicators or used by someone under the supervision of a certified applicator.

9.3 Woodchucks

Woodchucks are found in agricultural lands throughout much of eastern North America. Woodchucks may cause damage by digging burrows and building associated dirt mounds, which can damage farm machinery or tree root systems; and by tearing the bark on the trunk of trees during scent-marking activities.

Woodchucks causing damage may be taken in any manner by owners, lessees and members of their immediate families, or authorized employees, occupying or cultivating lands without a license or permit. Consult your state department of wildlife management if you have questions about a specific situation. Landowners have usually relied on lethal methods to reduce woodchuck damage. However, lethal controls are marginally successful for controlling woodchuck populations, as animals invade orchards from surrounding areas and reoccupy burrow systems.

Shooting and trapping can be used to remove problem woodchucks from fields. Shooting may be illegal or unsafe under some circumstances. Where legal, woodchucks can be captured using #2 leghold traps, #160 or #220 body-gripping traps, or live traps baited with apples and set near burrow entrances. Only live traps should be used where pets or livestock might be inadvertently captured. Woodchucks captured live cannot be legally transported off your property and should be humanely euthanized.

Electric fencing can be effective for reducing wood chuck damage. Electric, high-tensile deer fences may be modified to exclude woodchucks by adding additional wires at 5- to 6-inch intervals up to 18 inches high.

9.4 Beavers

Beavers will occasionally chew bark on fruit trees, and most damage often occurs within 300 feet of a permanent water source, such as a stream or pond. Removal of a problem beaver or destruction of a dam or lodge usually requires a permit issued by the appropriate state or local authority. Contact your state wildlife management agency to get more information about resolving beaver conflicts -- shooting or trapping beavers causing damage to agricultural crops may be authorized.

Removal of a problem beaver or family group may reduce tree damage for several years. (Check with local and state

officials regarding regulations on beaver dam and/or trapping.) However if damage persists, other management options may be needed to reduce economic losses. Beavers seldom stray far from water, and installing a 2-strand electric fence between the pond or stream and the orchard may eliminate beaver access and damage. Also, putting metal vole guards or cages around the base of each tree will protect them from rodent chewing including voles, rabbits, and beavers.

There are no EPA-registered toxicants or repellents for managing beaver damage. Mixing sand with latex paint, then coating the bottom of tree trunks, has shown some effectiveness in reducing rodent chewing. Growers will need to integrate exclusion techniques along with occasional beaver removal to reduce tree damage in orchards.

9.5 Birds

Contact Alan Eaton (Alan.Eaton@unh.edu) for the new publication 'Bird Damage Prevention for Northern New England Fruit Growers.' (Available on-line: https://extension.unh.edu/resources/files/Resource001797_Rep2514.pdf)

(Prepared by P. D. Curtis and M. E. Richmond, NYS Wildlife Damage Management Program, Department of Natural Resources; adapted for New England by Jon Clements, UMass Extension)

Table 9.1.1. Common and product names of commercial rodenticides, fumigants, and repellents used in orchards.

Common Name	Product Name	EPA Reg. No.	Use
*Zinc phosphide	Bonide Orchard Mouse Bait	4-152	Rodenticide
*Zinc phosphide	PROZAP® Zinc Phosphide Pellets	61282-49	Rodenticide
*Chlorophacinone	Rozol® VOLE BAIT (check state registration status)	7173-242	Voles
13.8% Ammonium Soap	Hinder [1]	5481-508	Repellent
37% Putrescent Egg Solids	Deeraway Big Game Repellent Liquid Spray Kit	50932-6-74794	Repellent
20% Thiram	Nott Chew-Not	358-105	Repellent
2.5% Capsaicin	Hot Sauce Animal Repellent	72-574	Repellent

* Restricted-use pesticide; may be purchased and used only by certified applicators or used by someone under the supervision of a certified applicator.

[1] Application to apples under hot, humid conditions may result in fruit-finish (spray-burn ring) problems.

10 Nutrient Management of Apple Orchards

10.1 Introduction

When developing mineral nutrient management programs for tree fruits, it is important to consider the nutrient demand-supply relationship throughout the season. Early season canopy development and fruit growth require large amounts of nitrogen (N), while fruit quality development and the acquisition of adequate cold hardiness by the tree later in the season require only a minimum supply of N. Thus, an ideal seasonal pattern of tree nitrogen status should be to start the season with relatively high nitrogen status to promote rapid leaf development and early fruit growth. As the season progresses, nitrogen status should decline gradually to guarantee fruit quality development and wood maturity before the onset of winter. There are three sources of nitrogen supply tree fruits can use. First is reserve nitrogen that has accumulated in the tree from the previous growing season. This source of nitrogen is readily available for initial growth during the spring. In fact, spur leaf development and early fruit growth is mainly supported by the reserve N. The second source is the natural N supply from the soil mineralization process. This process provides substantial amounts of nitrogen for trees growing on soils with high organic matter. The third is nitrogen fertilizers applied to the soil or to the foliage. To determine the amount of fertilizer nitrogen needed, we need to know the total tree demand and the amounts the other two nitrogen sources can provide. However, there is not enough information currently available on this demand-supply relationship to make this approach practical. Instead, soil and leaf analyses have been developed over the years to help growers diagnose tree nutrient status and soil nutrient availability and make adjustments on their fertilization programs accordingly.

10.2 Soil Analysis

Soil analysis is very useful for determining lime requirement and mineral availability in the soil before orchard establishment. For existing orchards, it provides information necessary for interpreting leaf analysis results and modifying fertilization programs.

A soil nutrient analysis should be performed before planting a new orchard and every 2 to 3 years after orchard establishment. The soil sample taken should be representative of the soil type and conditions within the orchard. Generally, the area included in any one-sample collection should not exceed 10 acres. Scrape away the surface 1-inch of soil, then collect samples from the 1 to 8 inch depth, and separate samples from 8 to 16 inches. In a 10 acre orchard, a minimum of 10 to 20 subsamples is suggested. Thoroughly mix the 1-8 inch subsamples together to provide a representative sample for the topsoil, and treat the 8 to 16 inch subsamples similarly to get a representative sample for subsoil. Soil samples can be sent to **The Connecticut Agricultural Experiment Station Slate Laboratory**, P.O. Box 1106, New Haven, CT 06504 (203-974-8521); **University of Connecticut Soil Nutrient Analysis Laboratory**, 6 Sherman Place, U-102, Storrs, CT 06269-5102 (860-486-4274); **University of Maine Soil Testing Service Analytical Laboratory**, 5722 Deering Hall, Orono, ME 04469-5722 (207-581-3591); **University of Massachusetts Soil & Plant Tissue Testing Laboratory**, West Experiment Station, Amherst, 01003 (413-545-2311); **University of New Hampshire Cooperative Extension Soil Testing Program**, Spaulding Life Science Center, Room G28A, 38 College Road, Durham, New Hampshire 03824 (603-862-3200); or **University of Vermont Agricultural & Environmental Testing Laboratory**, 262 Jeffords Hall, Burlington, VT 05405 (802-656-3030).

10.3 Preplant Soil Preparation

Table 10.3.1. Soil management groups.

Soil Group	Texture
I	Clayey soils, fine-textured soils.
II	Silty loam soils with medium to moderately fine texture.
III	Silty loam soils with moderately coarse texture.
IV	Loamy soils, coarse- to medium-textured soils.
V	Sandy soils, very coarse-textured soils.

10.3.1. Liming

The pH values of orchard soils should be maintained in the range of 6.0 to 6.5 throughout the soil profile to optimize plant growth and nutrient availability. For preplant soil preparation, we recommend the pH of topsoil (0–8 inch depth) be adjusted to 7.0 and that of subsoil to 6.5. Most soils in New York and New England have pH values lower than optimum and need liming to raise the pH prior to planting a new orchard. This also ensures adequate calcium and magnesium supplies in the soil.

The amount of lime required to adjust topsoil pH to 7.0 and subsoil pH to 6.5 is determined by the current pH values of the topsoil and subsoil (determined from a soil analysis) and the buffering capacity of the soil, i.e. exchange acidity or the acid portion of the cation exchange capacity (CEC), of topsoil and subsoil (also determined from a soil analysis). Using these values, the lime requirement can be determined from Table 10.3.2 for topsoil and from Table 10.3.3 for subsoil. The amount of lime to be added is the sum of topsoil plus subsoil requirement. When complete soil tests are not available, Table 10.3.4 may be used to estimate lime requirement.

Exchange acidity (used in Tables 10.3.2 and 10.3.3) may be reported on the soil test, but if not, it can be calculated easily from the percent base saturation and the cation exchange capacity. First, add the percent base saturation of K, Mg, and Ca. Next, subtract that total from 100% to obtain the percent acidity. Finally, multiply the cation exchange capacity by the percent acidity to get the exchange acidity.

Example
Topsoil

1. Soil test: pH 6.0, cation exchange capacity of 10.6 me/100gc, base saturation of 2.4 % K, 6.4% Mg, and 16.2% Ca
2. Calculate total percent base saturation: 2.4% + 6.4% + 16.2% = 25.0%
3. Calculate the percent acidity: 100% - 25.0% = 75%
4. Calculate the exchange acidity: 0.75 x 10.6 = 8.0 me/100gc
5. Determine 100% ENV lime requirement from Table 10.3.2: 2.5 tons/acre

Subsoil

1. Soil test: pH 5.2, cation exchange capacity of 5.7 me/100gc, base saturation of 1.1% K, 3.4% Mg, and 8.0% Ca
2. Calculate total percent base saturation: 1.1% + 3.4% + 8.0% = 12.5%Calculate the percent acidity: 100% - 12.5% = 87.5%
3. Calculate the exchange acidity: 0.875 x 5.7 = 5.0 me/100gc
4. Determine 100% ENV lime requirement from Table 10.3.3: 2.0 tons/acre

Total lime to be applied to the topsoil and subsoil: 4.5 tons 100% ENV lime/acre

The lime recommendations in Tables 10.3.2, 10.3.3, and 10.3.4 are for 100% effective neutralizing value (ENV). The actual lime rate to be applied is calculated by dividing the recommended 100% ENV rate by the ENV of the lime to be used.

The desired levels of soil calcium and magnesium are listed in Table 10.3.5 for different soil management groups. If soil magnesium levels are below the desired level, then high-Mag lime should be used for liming.

Table 10.3.2. Tons of 100% ENV lime per acre required to increase pH to 7.0 for topsoil (0 to 8 inches).

	Exchange Acidity (me/100g soil)																				
Soil pH	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***	***21***	***22***	***23***	***24***	***25***
4.4 - 4.5	2.7	3.2	3.7	4.3	4.8	5.3	5.9	6.4	6.9	7.4	8.0	8.5	9.0	9.6	10.1	10.6	11.2	11.7	12.2	12.8	13.3
4.6 – 4.7	2.6	3.2	3.7	4.2	4.7	5.3	5.8	6.3	6.9	7.4	7.9	8.4	9.0	9.5	10.0	10.5	11.1	11.6	12.1	12.7	13.2
4.8 - 4.9	2.6	3.1	3.7	4.2	4.7	5.2	5.7	6.3	6.8	7.3	7.8	8.3	8.9	9.4	9.9	10.4	11.0	11.5	12.0	12.5	13.0
5.0 - 5.1	2.6	3.1	3.6	4.1	4.6	5.1	5.6	6.1	6.6	7.2	7.7	8.2	8.7	9.2	9.7	10.2	10.7	11.2	11.8	12.3	12.8
5.2 - 5.3	2.4	2.9	3.4	3.9	4.3	4.7	5.3	5.7	6.3	6.8	7.2	7.7	8.2	8.6	9.2	9.6	10.2	10.6	11.1	11.6	12.0
5.4 - 5.5	2.1	2.6	3.0	3.4	3.8	4.2	4.7	5.1	5.5	5.9	6.3	6.7	7.2	7.6	8.1	8.5	8.8	9.3	9.7	10.2	10.6
5.6 - 5.7	2.0	2.3	2.7	3.1	3.5	3.9	4.2	4.6	5.0	5.4	5.8	6.2	6.5	6.9	7.3	7.7	8.1	8.5	8.8	9.2	9.6
5.8 - 5.9	1.8	2.1	2.4	2.8	3.1	3.5	3.8	4.2	4.5	4.9	5.2	5.5	5.9	6.2	6.7	6.9	7.2	7.6	7.9	8.3	8.6
6.0 - 6.1	1.6	1.9	2.2	2.5	2.8	3.2	3.5	3.8	4.1	4.4	4.7	5.0	5.4	5.7	6.0	6.3	6.6	6.9	7.2	7.6	7.9

Table 10.3.3. Tons of 100% ENV lime per acre required to increase pH to 6.5 for subsoil (8 to 16 inches).

	Exchange Acidity (me/100g soil)																				
Soil pH	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***	***21***	***22***	***23***	***24***	***25***
4.4 - 4.5	2.4	2.8	3.3	3.8	4.2	4.7	5.2	5.7	6.1	6.6	7.1	7.6	8.0	8.5	9.0	9.4	9.9	10.4	10.9	11.3	11.8
4.6 - 4.7	2.3	2.8	3.3	3.7	4.2	4.7	5.1	5.6	6.0	6.5	7.0	7.4	7.9	8.4	8.8	9.3	9.8	10.2	10.7	11.2	11.6
4.8 - 4.9	2.3	2.7	3.2	3.7	4.1	4.6	5.0	5.5	5.9	6.4	6.9	7.3	7.8	8.2	8.7	9.1	9.6	10.0	10.5	10.9	11.4
5.0 - 5.1	2.2	2.7	3.1	3.5	4.0	4.4	4.9	5.3	5.7	6.2	6.6	7.0	7.5	7.9	8.3	8.7	9.2	9.6	10.1	1.05	11.0
5.2 - 5.3	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.0	8.4	8.8	9.2	9.6	10.0
5.4 - 5.5	1.6	1.9	2.2	2.6	2.8	3.1	3.5	3.8	4.1	4.4	4.7	5.0	5.4	5.6	6.0	6.3	6.6	6.9	7.2	7.6	7.9
5.6 - 5.7	1.3	1.6	1.8	2.1	2.4	2.6	2.8	2.9	3.4	3.6	3.9	4.1	4.4	4.6	4.9	5.1	5.4	5.6	5.9	6.2	6.4
5.8 - 5.9	1.0	1.21	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0
6.0 - 6.1	0.8	0.9	1.1	1.3	1.4	1.6	1.7	1.9	2.0	2.2	2.4	2.5	2.7	2.8	3.0	3.1	3.3	3.5	3.6	3.8	3.9

Table 10.3.4. General lime recommendations for a depth of 16 inches (tons of 100% ENV lime per acre).

Soil pH	Sands	Sandy Loams	Loams & Silt Loams	Silty Clay Loams
4.5	4.5	10.0	16	22
4.6 - 4.7	4.5	10.0	15.5	21.5
4.8 - 4.9	4.5	9.5	14.5	20.5
5.0 - 5.1	3.5	8.5	13.0	18.0
5.2 - 5.3	2.5	7.0	11.0	14.5
5.4 - 5.5	1.7	5.0	7.0	10.2
5.6 - 5.7	1.7	3.5	5.0	7.7
5.8 - 5.9	1.2	2.5	4.5	6.0
6.0 - 6.1	1.0	2.5	3.5	5.0
6.2 - 6.3	0.7	1.7	2.5	3.5
6.4 - 6.5	0.5	1.2	1.7	2.5
6.6 - 6.7	0.4	0.9	1.2	1.7

Lime should be thoroughly harrowed into the surface soil, then plowed to work it as deeply as possible into the soil. If large amounts of lime are required (more than 3 tons per acre), split application is recommended, working one-half or two thirds of the total amount of lime into the soil as indicated above, plus thoroughly harrowing the remainder into the topsoil after plowing.

10.3.2. Other Preplant Nutrients

Potassium: The desired levels of soil potassium are listed in Table 10.3.5 for the different soil management groups. The difference between the desired level and the soil test result in both the topsoil and the subsoil is the amount to be added to the soil. [(Desired Level topsoil – actual level topsoil) + (Desired Level subsoil – actual level subsoil) = lb./acre K2O per 16-inch depth.

Phosphorus: Incorporation of appropriate rates of phosphorus during preplant soil preparation is the best means of providing adequate phosphorus for the life time of the orchard. The recommended amounts of preplant phosphorus for various soil test levels are listed in Table 10.3.6. The amount of phosphorus to be added is the sum of topsoil plus subsoil requirement.

Nitrogen: During preplant soil preparation, an application of nitrogen at 40 lb./acre is suggested for cover crop establishment. An additional 40 lb./acre is suggested when the cover crop is plowed down or when seeding the permanent grass sod.

Boron: Typical boron levels for different soil textures are given in Table 10.3.7. If soil test shows boron levels are in the low to medium range, then 2 to 3 lb. of boron is recommended for preplant soil preparation.

Table 10.3.5. Approximate levels of Calcium, Magnesium, and Potassium for topsoil (0 to 8 inches) and subsoil (8 to 16 inches) of different soil management groups

Soil Group	CEC (me/100g)		Ca (lb./acre)		Mg (lb./acre)		K2O (lb./acre)	
	Topsoil	*Subsoil*	*Topsoil*	*Subsoil*	*Topsoil*	*Subsoil*	*Topsoil*	*Subsoil*
I	25	17	7800	4600	950	550	520	300
II	20	13	6200	3700	750	450	450	260
III	18	12	5600	3300	700	400	430	250
IV	16	11	5000	2900	600	350	400	240
V	12	8	3700	2200	450	250	330	200

Table 10.3.6. Soil test phosphorus values and rates of phosphate (P_2O_5) application for orchards

Soil Test P Results		Amount of P_2O_5 to Apply (lbs/acre)	
ppm	*lbs/acre*	*Pre-planting*	*Established orchards**
<0.5	<1	120	60
0.5-1.5	1-3	100	60
2-4	4-8	60	30
>4.5	>9	40	0

* Do not apply phosphate to established orchards unless leaf analysis also indicates a need.

Table 10.3.7. Boron soil test levels for soils with different textures

Relative Soil Test Levels	Loamy Sand	Sandy Loam	Loam & Silt	Rate of Boron (lbs/a)
Very High	>0.60 ppm (>1.2 lbs/a)	>0.90 ppm (>1.8 lbs/a)	>1.20 ppm (>2.4 lbs/a)	0
High	0.36-0.60 ppm (0.7-1.2 lbs/a)	0.61-0.90 ppm (1.2-1.80 lbs/a)	0.81-1.20 ppm (1.6-2.4 lbs/a)	1
Medium	0.20-0.35 ppm (0.4-0.7 lbs/a)	0.30-0.60 ppm (0.6-1.2 lbs/a)	0.40-0.80 ppm (0.8-1.6 lbs/a)	2
Low	<0.20 ppm (<0.4 lbs/a)	<0.30 ppm (<0.6 lbs/a)	<0.40 ppm (<0.8 lbs/a)	3

Note: Soil test results for boron should be judged in relation to leaf analysis results. Leaf analysis is considered to be a better indicator of boron status.

10.4 Fertilization Program for Young Trees

When new trees are planted in the spring, immediate supply of adequate water is essential to settle the soil around the roots, but application of nitrogen fertilizer is not recommended. This is because the initial tree growth is mainly supported by the nutrient reserves within the tree and the uptake of nutrients from the soil is often delayed due to the damaged root system. In addition, applying large amounts of dry fertilizers at planting may cause damage to the roots. The first application of nitrogen fertilizer should be made at budbreak at a rate of 0.6 to 1.0 ounce of actual nitrogen per tree. Liquid nitrogen fertilizers are preferred. If dry fertilizers have to be used, make sure to avoid any contact with the trunk. A second application at the same rate should be made 4 weeks after budbreak. To improve early season tree growth, 2 to 3 sprays of 6 lbs of urea per 100-gal water is recommended at 10 to 14-day intervals beginning at 3 weeks after budbreak. In early October, 2 sprays of foliar urea at 25 lbs per 100 gal are also suggested.

In the second year, when new shoots begin their rapid growth (early to mid-May), apply 0.1 to 0.2 pounds of actual nitrogen per tree and a similar N spray program as in year 1. If trees have a substantial crop and the variety is susceptible to bitter pit, a foliar calcium program is recommended.

10.5 Fertilization Program for Established Orchards

10.5.1 Using Leaf Analysis

Leaf analysis indicates the concentration of nutrients that are present in the foliage. If leaf samples are taken correctly and the results are interpreted properly, it provides a good tool for developing an effective fertilization program. Leaf analysis standard for fruit trees are listed in Table 10.4.1.

Leaf samples should be collected between 60 to 70 days after petal fall, which generally corresponds to late July and early August. Mid-shoot leaves should be sampled from current season terminal shoots on the periphery of the tree. Sample trees should represent the general conditions of the orchard in terms of vigor, crop load, etc. Each sample should consist of about 100 leaves collected from several trees in the area being sampled. Do not mix leaves from different varieties, soil conditions, tree vigor, or crop load. Record observations on terminal shoot length, thickness, crop load, and fruit size. Leaf samples can be sent to: **Maine Agricultural and Forest Experiment Station Analytical Laboratory**, 5722 Deering Hall, University of Maine, Orono, ME 04469-5722 (207-581-3591); **UMass Soil & Plant Tissue Testing Laboratory**, West Experiment Station, University of Massachusetts, Amherst, 01003 (413-545-2311); **University of New Hampshire Cooperative Extension Soil Testing Program**, Spaulding Life Science Center, Room G28A, 38 College Road, Durham, New Hampshire 03824 (603-862-3200); or **University of Vermont Agricultural & Environmental Testing Laboratory**, 209 Hills Building, University of Vermont, Burlington, VT 05405 (802-656-3030).

Please note that the desired levels in Table 10.4.1 are given as general references. Individual state plant-tissue testing laboratories may use somewhat different optima. If given, follow the nutrient recommendations of the laboratory conducting the analyses and your local fruit specialist.

It should be recognized that leaf analysis has its limitations. First, leaf samples are taken relatively late in the growing season. Even if you can get the leaf analysis results back immediately, you may not have enough time left during the season to correct mineral deficiencies if there are any. Secondly, routine leaf analysis cannot detect the transient nutrient demand by certain physiological processes early in the season. For example, trees have a large transient demand for boron at bloom. Finally, even if leaf analysis shows no mineral nutrient deficiency, you still need to have a maintenance program in place to make up the amount of nutrients that is lost in harvested fruit and fallen leaves every year. Therefore, two fertilization programs are suggested here for established trees. One is a maintenance program. The other is a corrective program for trees with nutrient deficiency.

Table 10.5.1. Leaf analysis standards for tree fruits (dry weight basis).

Element	Crop	Desired Level
Nitrogen	Young nonbearing apples and pears	2.4-2.6%
	Young bearing apples and pears	2.2-2.4%
	Mature soft apples and pears	1.8-2.2%
	Mature hard apples and processing	2.2-2.4%
	Cherries, plums, prunes	2.4-3.4%
	Peaches	3.0-4.0%
Phosphorus	All crop	0.13-0.33%
Potassium	All crops	1.35-1.85%
Calcium	All crops	1.3-2.0%
Magnesium	Apples and pears	0.35-0.50%
	Stone fruits	0.40-0.60%
Boron	Apples and pears	35-50 ppm
	Stone fruits	30-40 ppm
Zinc	All crops	30-50 ppm
Copper	All crops	7-12 ppm
Manganese	All crops	50-150 ppm
Iron	All crops	50+ ppm

10.5.1.1. Maintenance Program

This program is suggested when leaf analysis shows no nutrient deficiency or no deficiency symptoms are observed.

Timing	Foliar Sprays	Ground Applications
Green tip	One spray of 2 to 4 lbs of a fixed copper product per 100 gal (C-O-C-S or Kocide).	
Tight cluster to pink	One spray of tank mixed 3 lbs of urea and 1 lb Solubor/100 gal	Apply 20 to 40 lbs of actual nitrogen/acre to soil.
Petal fall to early cover sprays	One spray of Zn-EDTA at label rate at second cover. **Plus** One spray of 3 to 4 lb of calcium chloride/100 gal at third cover. **Plus** Two sprays of 15 lb of Epsom salt/100 gal at petal fall, and second cover.	Apply 40 to 60 lbs of potassium/ acre to soil at petal fall.
End of shoot growth to harvest	Three to four sprays of 3 to 4 lbs of calcium chloride/100 gal at 14-day intervals for bitter pit susceptible varieties.	
After harvest		Apply 40 to 60 lb of potassium/ acre to soil. **Plus** Every 2 to 3 years, apply appropriate amount of lime determined from soil analysis.

10.5.1.2. Corrective Program

This program is suggested when leaf analysis shows nutrient deficiency, or deficiency symptoms are observed. Match fertilizer applications to specific nutrient deficiency. (See table on next page.)

Timing	Foliar Sprays	Ground Applications
Green tip	One spray of 2 to 4 lbs of a fixed copper product per 100 gal (C-O-C-S or Kocide)	
Prebloom period	Two sprays of tank-mixed 1 lb of Solubor, 3 lbs of urea, and Zn-EDTA at label rate per 100 gallon, one at 1/2" green and the other at tight cluster to pink	Apply 40 to 60 lbs of actual nitrogen/acre to soil.

Timing	Foliar Sprays	Ground Applications
Petal fall to early cover sprays	Two foliar sprays of 5 lbs of urea/100 gal at petal fall and first cover. **Plus** Two sprays of Zn-EDTA at label rate at petal fall and second cover. **Plus** Two foliar sprays of 1 lb of Solubor/100 gal at first and third cover. **Plus** Three sprays of 15 lbs of Epsom salt/100 gal applied at petal fall, first and second covers. **Plus** One foliar spray of 3 to 4 lbs of calcium chloride per 100 gal at third cover.	Apply 60 to 150 lbs of Potassium/acre to soil at petal fall.
End of shoot growth to harvest	Five to six sprays of 3 to 4 lbs of calcium chloride/100 gal at 14-day intervals.	Apply 60 to 150 lbs of potassium to soil at the end of shoot growth.
After harvest	Two sprays of 25 lbs of urea/100 gal at 7 to 10-day intervals. P**lus** One spray of 1 lb of actual copper/acre as copper sulfate.	Soil application of 60 to 150 lbs of potassium/acre as sulfate of potash-magnesia. **Plus** Soil application of dolomitic lime to increase calcium and magnesium supply based on soil and leaf analyses.

10.5.2 Special Considerations in Foliar Application of Nutrients

To minimize the number of sprays applied in the orchard, it is frequently desirable to combine various nutrient materials or to add them in tank mixes with pesticides. Before doing so, however, one needs to make sure they are compatible.

Generally, urea, Solubor, Zn-EDTA, and Epsom salts are compatible. Urea, Solubor, and Zn-EDTA have been used together safely in prebloom sprays on apples and pears. A tank mix of urea and Epsom salts has sometimes injured young apple foliage; if both are required, they should be applied separately. Epsom salts and some of the boron products listed in Table 10.4.5 may increase the pH of the tank mix, and if used with pH-sensitive pesticides, pH of the tank mix should be tested and adjusted by using a suitable acidifying agent. Solubor and presumably other forms of boron should not be tank-mixed with any pesticide contained in water-soluble plastic packages because it inhibits the dissolution of the plastic. Foliar nutrients, in general, and Solubor, in particular, should not be tank-mixed with oil.

Although Epsom salts, Solubor and Zn-EDTA are compatible for use in postbloom sprays, many orchardists prefer not to add all three to one tank. A petal fall spray may then contain Epsom salts alone or with Solubor; the first cover spray a combination of Epsom salts and Solubor; the second cover spray a combination of Epsom salts and Zn-EDTA; and the third cover spray a combination of Solubor and Zn-EDTA.

Calcium chloride may be physically incompatible with Epsom salts, resulting in plugging of sprayer nozzles. Calcium chloride cannot be tank-mixed with Zn-EDTA because some of the dissolved calcium may displace Zn, causing phytotoxicity.

It should be pointed out that some Zn-chelate products contain a large percentage of unchelated Zn, which may cause injury to foliage and fruit. Therefore, before using a new Zn product in your orchard, test the product by spraying a few trees at the label rate to see if any phytotoxicity occurs.

More detailed information concerning nutrient management for orchards can be found in Cornell Cooperative Extension Information Bulletin 219, *Orchard Nutrition Management* by Warren Stiles and Shaw Reid. See the section on “Tree Fruit Reference Materials” at the end of this publication for ordering information.

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10.6 Characteristics of Commonly Available Fertilizers

Table 10.6.1. Nitrogen fertilizers

Common Name	N (%)	Pounds of Formulated Product per pound of N	Acidity or Basicity (lb $CaCO_3$/lb	
			Acidity	*Basicity*
Ammonia, anhydrous	82	1.22	1.8	—
Ammonia, aqua	20	5.00	1.8	—
Ammonium nitrate	33.5	2.98	1.8	—
Ammonium polyphosphate	12	8.33	4.1	—
Ammonium sulfate	20.5	4.88	5.4	—
Calcium nitrate	15.5	6.45	—	1.3
Diammonium phosphate	16-18	5.56	4.1	—
Monoammonium phosphate	11	9.09	5.3	—
Nitrate of soda-potash	15.5	6.45	—	1.3
Potassium nitrate	13	7.69	—	2.0
Sodium nitrate	16	6.25	—	1.8
Urea	45	2.22	1.6	—
Nitrogen solutions	variable[1]	—	—	—

[1]Nitrogen solutions may consist of mixtures of urea plus ammonium nitrate, aqua ammonia, or anhydrous ammonia plus urea or ammonium nitrate or both of these materials. Consult supplier for analysis.

Table 10.6.2. Phosphorus fertilizers

Common Name	P_2O_5 (%)	Pounds of Formulated Product per Pound of P_2O_5	N (%)
Ordinary superphosphate	20	5	0
Concentrated superphosphate	46	2.27-2.17	0
Ammoniated superphosphate	40*	2.5*	5*
Monoammonium phosphate	52*	1.92*	13*
Diammonium phosphate	46*	2.17*	18*
Urea-ammonium phosphate	28	3.57	28

*Values may vary depending on fertilizer source.

Table 10.6.3. Potassium fertilizers

Common Name	Chemical Formula	K_2O (%)	Pounds of Formulated Product per Pound of K_2O
Muriate of Potash	KCl	60	1.67
Sulfate of Potash	K_2SO_4	53	1.89
Sulfate of Potash Magnesia	K_2SO_4•2$MgSO_4$	22	4.54
Potassium polyphosphate	KPO_3	40	2.50
Potassium carbonate	K_2CO_3	67	1.50
Potassium nitrate	KNO_3	44	2.27

Table 10.6.4. Boron fertilizers[1]

Product Name	B (%)	Form of B*	Increase in Spray Water pH	Cost per Pound of B
B-17	17.0	BA	none	low
Mor-Bor 17	17.3	BA	none	low
Spray-Bor	16.5	NaB	moderate	low
Solubor	20.5	NaB	high	very low
Solubor DF	17.4	NaB	high	n/a
Albion Liquid B	5.0	NaB	high	high
Liquibor	2.5	BA, NaB	high	high
Borosol 10	10.0	BA	very high	moderate
N-Boron	5.4	BA	very high	n/a

*Form of boron indicates boron compound used in formulating the product: **BA:** boric acid; **NaB:** sodium polyborates.
[1]From Dr. Frank Peryea, Washington State University.

Table 10.5.6. Miscellaneous fertilizers

Name	Mineral Element	Content (%)	Name	Mineral Element	Content (%)
Gypsum	Ca	24	Kieserite	Mg	17.3
Superphosphate	Ca	20	Magnesium oxide	Mg	49-56
Concentrated superphosphate	Ca	14	Magnesium sulfate	Mg	16
Calcium nitrate	Ca	24	Zinc chelate	Zn	variable
Calcium chloride (77-80%)	Ca	27.8	Zinc sulfate	Zn	36%
Calcium chloride (35% liquid)	Ca	12.6	Basic zinc sulfate	Zn	50-52
Calcium chelates	Ca	variable	Copper chelate	Cu	variable
Epsom salts	Mg	10	Copper sulfate	Cu	25%


FIGURE 11.1.1
GROWTH STAGES IN
APPLE
1 Dormant
2 Silver tip
3 Green tip
4 Half-inch green
5 Tight Cluster
6 Pink
7 Bloom
8 Petal Fall
9 Fruit set

11 Apples

11.1 Insecticides and Fungicides for Apples

See Sections 11.2, 11.3, 11.4, and 11.5 for comments related to this table.

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Silver Tip							
Crown rot	33	Aliette WDG	2.5-5 lb/A 0.5-1 pt/100 gal	14	12		
	4	Ridomil Gold SL	2 qts/A 0.5 pt/100 gal		48		[7.2]
European fruit lecanium		oil	2-3 gal/100 gal			High	[20.2]
European red mite		oil	2-3 gal/100 gal			High	[20.11]
Green Tip							
Apple scab	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24	High	[2.1,2.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24	High	[2.1,2.2]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24	High	[2.1,2.2]
	M3	Dithane 75DF or M45 /Manzate ProStik /Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77 (A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77 (A)	24	High	[1.3,2.2]
	M7	Syllit FL *plus*	2.0 pts/A	7	48	High	[2.15]
	M4	Captan *or*	see rates above	0	24		[2.1,2.2]
	M3	Manzate, Penncozeb or Polyram	see rates above	BL, 77 (A)	24		[1.3,2.2]
	9	Scala	7.0-10.0 fl.oz./A	72	12	High	
	9	Vangard WG	3.0-5.0 oz/A	0	12	High	
European red mite		oil	1-2 gal/100 gal			High	[20.3,20.4]
Fire blight	M1	Bordeaux mixture, 8-10-10 *plus* oil (may also use with any copper below)	8.0 lb/100 gal 1.0 qt/100 gal				[8.4]
	M1	Champ Formula-2 4.6F	5.33-10.5 pts/A	HIG	24		
	M1	C-O-C-S WDG	8.0-11.7 lb/A	GT	24		
	M1	Cuprofix Ultra Disperss 40DF	5.0-7.5 lb/A	HIG	48		
	M1	Kocide 3000	3.5-7.0 lb/A 1.11-2.3 lb/100 gal	HIG	48		
Rosy apple aphid	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[28.2,28.2a]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Green Tip (continued)							
Rosy apple aphid (*continued*)	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	Moderate	[28.2,28.2a]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
Half-Inch Green							
Apple scab	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24	High	[2.1,2.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24	High	[2.1,2.2]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24	High	[2.1,2.2]
	M3	Dithane 75DF or M45 /Manzate ProStik /Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77(A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77(A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77(A)	24	High	[1.3,2.2]
	M7	Syllit FL *plus*	2.0 pts/A	7	48		[2.15]
	M4	Captan *or*	see rates above	0	24		[2.1,2.2]
	M3	Dithane, Manzate, Penncozeb or Polyram	see rates above	BL, 77(A)	24		[1.3,2.2,2.4]
	9	Scala	7.0-10.0 fl.oz./A	72	12		
	9	Vangard WG	3.0-5.0 oz/A	0	12		
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
European red mite		oil	1-2 gal/100 gal			High	[20.3,20.4]
Redbanded leafroller	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[27.1]
Rosy apple aphid	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	Moderate	[28.2,28.2a]
	7C	Esteem 35WP	3-5 oz/A	45	12	High	[28.2,28.2b]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
San Jose scale		oil	2 gal/100 gal			High	[29.3]
	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[29.3]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[29.3]
	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	High	[29.3]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Half-Inch Green (continued)							
	7C	Esteem 35WP *plus* oil	4-5 oz/A 2 gal/100 gal	45	12	High	[29.3]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[29.3,29.4]
Tight Cluster							
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
Apple scab	M3	Dithane 75DF or M45 /Manzate ProStik /Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77 (A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77 (A)	24	High	[1.3,2.2]
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.1,2.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.1,2.2]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.1,2.2]
	M7	Syllit FL *plus*	2.0 pts/A	7	48		[2.15]
	M4	Captan *or*	see rates above	0	24		[2.2]
	M3	Dithane, Manzate, Penncozeb or Polyram	see rates above	BL, 77 (A)	24		[2.1,2.2]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal		14	24	
	3	Vintage SC	6-12 fl.oz/A 3-4 fl.oz/100 gal	30	24		
	3	Topguard	13 fl.oz./A	14	12		
	7	Fontelis 1.67 SC	16-20 fl.oz./A 5.3-6.7 fl oz/100 gal	28	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.4,2.14]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.4,2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.4,2.14]
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,9	Luna Sensation 500SC	4-5.8 fl oz/A 3.3-1.9 fl oz/100 gal	14	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]

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Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Tight Cluster (continued)							
European red mite		oil	1-2 gal/100 gal			High	[20.3,20.4]
	10A	Apollo 4SC	4-8 fl.oz./A	45	12	High	[20.5,20.5a,20.6, 20.11,20.11a]
	10A	Onager 1 EC	12-24 fl.oz./A	28	12	High	[20.5,20.5b,20.11, 20.11a]
	10A	Savey 50DF	3 oz/A	28	12	High	[20.5,20.5b,20.6, 20.11,20.11a]
	10B	Zeal	2-3 oz/A	14	12	High	[20.5,20.5b,20.9, 20.11]
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		
		Vintage SC	3.0 fl.oz./100 gal	30	24		
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Rosy apple aphid	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	Moderate	[28.2,28.2a]
	7C	Esteem 35WP	3-5 oz/A	45	12	High	[28.2,28.2b]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
San Jose scale		oil	2 gal/100 gal			High	[29.3]
	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[29.3]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[29.3]
	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	High	[29.3]
	7C	Esteem 35WP *plus* Oil	4-5 oz/A 2 gal/100 gal	45	12	High	[29.3]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[29.3,29.4]
Tarnished plant bug	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[33.1,33.1a,33.1b]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[33.1,33.1a,33.1b]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Tight Cluster (continued)							
Tarnished plant bug (*continued*)	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[33.1,33.1a,33.1b]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[33.1,33.1a,33.1b]
	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	9C	Beleaf 50SG	2-2.8 oz/A	21	12	High	[33.1,33.1a,33.1d]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[33.1,33.1a,33.1c]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,33.1,33.1a, 33.1b]
Pink							
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
Apple scab	M3	Dithane 75DF or M45/ Manzate ProStik/ Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77 (A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77 (A)	24	High	[1.3,2.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.6,2.7]
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.6,2.7]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.6,2.7]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal	14	24		
	3	Vintage SC	6-12 fl.oz/A 3-4 fl.oz/100 gal	30	24		
	3	Topguard	13 fl.oz./A	14	12		
	7	Fontelis	16-20 fl.oz./A	28	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.4,2.14]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.4,2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.4,2.14]
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Black Rot & White Rot	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	8.0 lb/A 1.2-2.0 lb/100 gal	0	24		
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14]

Table 11.5.1 Pesticide Spray Table – Apples.

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Pink (continued)							
Blister Spot	33	Aliette WDG	2.5-5.0 lb/A 0.5-1.0 lb/100 gal	14	12		[5.1]
Cedar Apple Rust	M3	Ferbam Granuflo	3.5 lb/A 0.88 lb/100 gal	7	24		
	M3	Manzate ProStik	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Penncozeb 75DF	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Polyram 80DF	3.0 lb/A	BL, 77 (A)	24		[2.2]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-8.0 oz/A 1.6-2.0 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
	3	Topguard	12 fl.oz./A	14	12		
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
European red mite	1A	Vydate 2L	2-4 pts/A 1-2 pts/100 gal	14	48	Moderate	[20.7a]
	10A	Apollo 4SC	4-8 fl.oz./A	45	12	High	[20.5,20.5a,20.6, 20.11,20.11a]
	10A	Onager 1 EC	12-24 fl.oz./A	28	12	High	[20.5,20.5b,20.11, 20.11a]
	10A	Savey 50DF	3 oz/A	28	12	High	[20.5,20.5b,20.6, 20.11,20.11a]
	10B	Zeal	2-3 oz/A	14	12	High	[20.5,20.5b,20.9, 20.11]
Mullein plant bug	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[23.3]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[23.3]
	4A	Actara 25WDG	4.5 oz/A	14/35 (A)	12	High	[23.3,23.3a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[23.3,23.3c]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[23.3,23.3b]
Obliquebanded leafroller	11A	Agree 3.8WS	1-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
Oriental fruit moth		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate OFM-F 24.6S	1.32-2.93 fl.oz./A		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/A		0	High	[14.2]
		Isomate OFM TT	100 ties/A		0	High	[14.2]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Pink (continued)							
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		[9.3,9.4]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Rosy apple aphid	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,28.2]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,28.2]
	1A	Vydate 2L	2-8 pts/A 1-2 pts/100 gal	14	48	Moderate	[28.2,28.3a]
	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	Moderate	[28.2,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	Moderate	[28.2,35.1b]
	4A	Actara 25WDG	4.5 oz/A	14/35 (A)	12	High	[15.4,28.2,28.3b]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[28.2,28.3c]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[28.2,28.4a]
	7C	Esteem 35WP	3-5 oz/A	45	12	High	[28.2,28.2b]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
Spotted tentiform leafminer, Apple blotch leafminer	1A	Vydate 2L	2-4 pts/A 1 pt/100 gal	14	48	High	[30.1,30.2, 30.2a,30.3,30.3a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[30.1,30.1a,30.2, 30.3]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[30.1,30.1a,30.2]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[30.1,30.1a,30.1b, 30.2,30.3]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[30.1,30.1a,30.2, 30.3]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Pink (continued)							
Spotted tentiform leafminer, Apple blotch leafminer (*continued*)	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[30.1,30.1a,30.1b, 30.2,30.2a,30.2b, 30.3]
	3A	Pyrenone 6L	12 fl.oz./A		12	Moderate	[30.1]
	4A	Actara 25WDG	4.5 oz/A	14/35 (A)	12	High	[15.4,30.1, 30.1d,30.2,30.2a, 30.2c,30.3]
	4A	Assail 30SG	2.5 oz/A	7	12	High	[30.1,30.2,30.2a, 30.3]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[30.1,30.2, 30.2a,30.2c,30.3]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[30.1,30.1e,30.2, 30.2a,30.3]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[30.1,30.2,30.3]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[30.1,30.1d,30.2, 30.2a,30.2c,30.3]
	28	Altacor 35WDG	2.5-4 oz/A	5	4	High	[30.1,30.2, 30.2d,30.3]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[30.1,30.2,30.2d, 30.3]
	UN	Aza-Direct 1.2L	11.5-42 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	UN	Azatin XL 0.27EC	10-16 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,30.1,30.1a, 30.2,30.3]
Tarnished plant bug	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[33.1,33.1a,33.1b]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[33.1,33.1a,33.1b]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[33.1,33.1a,33.1b]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[33.1,33.1a,33.1b]
	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	9C	Beleaf 50SG	2-2.8 oz/A	21	12	High	[33.1,33.1a,33.1d]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[33.1,33.1a,33.1c]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,33.1,33.1a, 33.1b]
Bloom							
Apple scab	M3	Dithane 75DF or M45 /Manzate ProStik /Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77 (A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77 (A)	24	High	[1.3,2.2]
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.6,2.7]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.6,2.7]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.6,2.7]

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Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Bloom (continued)							
Apple scab (*continued*)	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal	14	24		
	3	Topguard	13 fl.oz./A	14	12		
	7	Fontelis	16-20 fl.oz./A	28	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.4,2.14]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.4,2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.4,2.14]
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Black Rot & White Rot	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	8.0 lb/A 1.2-2.0 lb/100 gal	0	24		
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[10.3,10.4]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14]
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Blister Spot	33	Aliette WDG	2.5-5.0 lb/A 0.5-1.0 lb/100 gal	14	12		[5.1]
Blossom End Rot	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[6.2]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[6.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[6.2]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[6.2]
Cedar Apple Rust	M3	Ferbam Granuflo	3.5 lb/A 0.88 lb/100 gal	7	24		
	M3	Manzate ProStik	3.0 lb/A 1.0 lb/100 gal	BL, 77(A)	24		[1.3,2.2]
	M3	Penncozeb 75DF	3.0 lb/A 1.0 lb/100 gal	BL, 77(A)	24		[1.3,2.2]
	M3	Polyram 80DF	3.0 lb/A	BL, 77(A)	24		[2.2]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-8.0 oz/A 1.6-2.0 oz/100 gal	14	24		
	3	Topguard	12 fl.oz./A	14	12		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Bloom (continued)							
Codling moth		Checkmate CM-F 14.3S	2.4-4.8 fl.oz./A		4	Moderate	[14.2]
		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
Fire blight		Agri-mycin	24.0 oz/A 8.0 oz/100 gal	50	12		[8.3,8.10]
		Apogee 27.5%	4.5-9.0 oz/100 gal	45	12		[8.6]
		Bloomtime Biological FD	0.33 lb/A	PF	4		[8.8]
		Fireline	12.0 oz/100 gal		12		
		Firewall	24.0 oz/A 8.0 oz/100 gal	50	12		[8.3,8.10]
		Mycoshield 17WP	1.0 lb/100 gal	60	12		[8.9]
		Serenade ASO	2.0-6.0 qt/A	0	4		[8.7]
		Streptrol 17WP	24.0 oz/A 8.0 oz/100 gal	50	4		[8.3,8.10]
Lesser appleworm		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
Mullein plant bug	4A	Assail 30SG	4-8 oz/A	7	12	High	[23.3,23.3c]
Obliquebanded leafroller	11A	Agree 3.8WS	1-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,24.2,24.3, 24.3a]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	18	Intrepid 2F	8-16 oz/A	14	4	High	[24.2,24.3, 24.3b]
Oriental fruit moth		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate OFM-F 24.6S	1.32-2.93 fl.oz./A		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
		Isomate OFM TT	100 ties/A		0	High	[14.2]
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		[9.3,9.4]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Bloom (continued)							
Powdery Mildew (*continued*)	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Petal Fall							
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
Apple rust mite	21A	Nexter 75WS	5.2-10.7 oz/A	25	12	Moderate	[13.2]
	21A	Portal 0.4EC	2 pts/A	14	12	High	[13.2]
Apple scab	M3	Manzate ProStik	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[2.7]
	M3	Penncozeb 75DF	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[2.7]
	M3	Polyram 80DF	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.7,2.6]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.7,2.6]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.7,2.6]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal	14	24		
	3	Topguard	13 fl.oz./A	14	12		
	7	Fontelis	16-20 fl.oz./A	28	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.14,2.4]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.14,2.4]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14,2.4]
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Black Rot & White Rot	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	8.0 lb/A 1.2-2.0 lb/100 gal	0	24		
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[10.3,10.4]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14]
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Blossom End Rot	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[6.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[6.2]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[6.2]
Cedar Apple Rust	M3	Ferbam Granuflo	3.5 lb/A 0.88 lb/100 gal	7	24		
	M3	Manzate ProStik	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Penncozeb 75DF	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Polyram 80DF	3.0 lb/A	BL, 77 (A)	24		[2.2]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-8.0 oz/A 1.6-2.0 oz/100 gal	14	24		
	3	Topguard	12 fl.oz./A	14	12		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
Codling moth		Cyd-X 0.06SC	1-6 fl.oz./A	0	4	Moderate	[14.1,14.3,14.3f]
		Carpovirusine 0.99SC	0.25-0.4 qt/A 0.5-1 pt/100 gal	0	4	Moderate	[14.1,14.3,14.3f]
		Checkmate CM-F 14.3S	2.4-4.8 fl.oz./A		4	Moderate	[14.2]
		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate Puffer CM-OFM	1-2 units/ acre		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[14.1,14.3,14.3g]
	1A	Lannate LV 2.4L	1.5-3 pts/A 1.5 pts/100 gal	14	72	High	[14.1,14.3,14.3g]
	1A	Sevin 80 Solupak	1.25-3.75 lb/A	3	12	Moderate	[14.1,14.3,14.3j]
	1A	Sevin XLR Plus 4EC	1-3 qt/A	3	12	Moderate	[14.1,14.3,14.3j]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[14.1,14.3,14.3e]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1,14.3]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1,14.3,14.3a, 14.3c]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[14.1,14.3,14.3e]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1,14.3]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	Moderate	[14.1,14.3]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	Moderate	[14.1,14.3]

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Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Codling moth (*continued*)	6	Proclaim 5SG	4.8 oz/A 1.2 oz/100 gal	14	12	Moderate	[14.1,14.3,14.3h]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[14.1,14.3]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[14.1,14.3,14.3e]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.1,14.3,14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1,14.3,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1,14.3,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1,14.3,14.3a, 14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1,14.3]
	UN	Neemix	7-16 fl.oz./A	0	12	Moderate	[14.1,14.3]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1,14.3, 14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1,14.3]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1,14.3, 14.3k]
Comstock mealybug	4A	Assail 30SG	4-8 oz/A	7	12	High	[15.2a,15.3a,15.3b]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[15.2a,15.3a,15.3b]
	21A	Portal 0.4EC	2 pts/A	14	12	High	[15.2a,15.3a,15.3b]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[15.2a,15.3a,15.2b, 15.3b]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,15.2a,15.3b, 15.4]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal		12	High	[1.0,15.2a,15.3a, 15.3b,15.4]
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
European apple sawfly	1A	Lannate LV 2.4L	1.5-3 pts/A 1.5 pts/100 gal	14	72	Low	[18.1,18.1a]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[18.1]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[18.1]
	4A	Actara 25WDG	4.5-5.5 oz/A	14/35 (A)	12	High	[15.4,18.1,18.2a]
	4A	Assail 30SG	5-8 oz/A	7	12	Moderate	[18.1]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[18.1,18.2a]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[18.1,18.2a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[18.1,18.2a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,18.1]

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
European apple sawfly (*continued*)	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,15.4,18.1]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,15.4,18.1]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,18.1]
European red mite	6	*Agri-Mek 8SC	2.25-4.25 fl.oz./A 0.5-1 fl.oz./100 gal	28	12	High	[20.8,20.9]
	10A	Apollo 4SC	4-8 fl.oz./A	45	12	High	[20.5,20.5a,20.6, 20.11,20.11a]
	10A	Onager 1 EC	12-24 fl.oz./A	28	12	High	[20.5,20.5b,20.11, 20.11a]
	10A	Savey 50DF	3 oz/A	28	12	High	[20.5,20.5b,20.6, 20.11,20.11a]
	10B	Zeal	2-3 oz/A	14	12	High	[20.5,20.5b,20.9, 20.11]
	12B	Vendex 50WP	1-2 lb/A 4-8 oz/100 gal	14	48	Low	[20.11,20.11c]
	20B	Kanemite 15SC	31 fl.oz./A	14	12	High	[20.9,20.9b,20.11, 20.11c]
	21A	Nexter 75WS	4.4-5.2 oz/A	25	12	High	[20.9,20.9a, 20.11]
	21A	Portal 0.4EC	2 pt/A	14	12	High	[20.9,20.9a,20.11]
	UN	Acramite 50WS	0.75-1 lb/A	7	12	High	[20.9,20.9a,20.11]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,20.8,20.9]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12 12	High	[1.0,20.8,20.9]
Fire blight		Agri-mycin	24.0 oz/A 8.0 oz/100 gal	50	12		[8.3,8.10]
		Apogee 27.5%	4.5-9.0 oz/100 gal	45	12		[8.6]
		Firewall	24.0 oz/A 8.0 oz/100 gal	50	12		[8.3,8.10]
		Streptrol 17WP	24.0 oz/A 8.0 oz/100 gal	50	4		[8.3,8.10]
Green fruitworms	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[21.1,21.1a]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[21.1,21.1a]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	High	[21.1,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[21.1,35.1b]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[21.1,21.1b]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[21.1,21.1b]
	3A	Baythroid XL 1EC	1.4-2 fl.oz./A	7	12	High	[21.1,21.1b]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	High	[21.1,21.1b]

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Green fruitworms (*continued*)	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	High	[21.1,21.1b]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[21.1]
	28	Altacor 35WDG	2.5-4 oz/A	5	4	High	[21.1]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[21.1]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,21.1]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,21.1,21.1d]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,21.1,21.1d]
Lesser appleworm		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[14.1a]
	1A	Lannate LV 2.4L	1.5-3 pts/A 1.5 pts/100 gal	14	72	High	[14.1a]
	1A	Sevin 80 Solupak	1.25-3.75 lb/A	3	12	Moderate	[14.1a,14.3j]
	1A	Sevin XLR Plus 4EC	1-3 qt/A	3	12	Moderate	[14.1a,14.3j]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1a,14.3a,14.3c]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1a]
	6	Proclaim 5SG	4.8 oz/A 1.2 oz/100 gal	14	12	Moderate	[14.1a]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[14.1a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.1a,14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1a,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1a,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1a,14.3a,14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1a]
	UN	Neemix	7-16 fl.oz./A	0	12	Moderate	[14.1a]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0, 14.1a,14.3k]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1a,14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1a]
Mullein plant bug	4A	Assail 30SG	4-8 oz/A	7	12	High	[23.3,23.3c]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[23.3,23.3b]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,23.3]
Obliquebanded leafroller	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	Moderate	[24.2,24.2a,24.2c]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	Moderate	[24.2,24.2a,24.2c]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[24.2,24.3,24.3b, 24.3c]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	Moderate	[24.2]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	Moderate	[24.2,24.3,24.3b, 24.3c,24.3d]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[24.2,24.3,24.3c]

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Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Obliquebanded leafroller (*continued*)	3A	Danitol 2.4EC	16 fl.oz./A	14	24	Moderate	[24.2,24.2d,24.3, 24.3b,24.3c]
	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	Moderate	[24.2]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[24.2,24.3,24.3b]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	High	[24.2,24.3,24.3b]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	High	[24.2,24.3,24.3b]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[24.2,24.2e,24.3, 24.3b]
	11A	Agree 3.8WS	1-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,24.2,24.3, 24.3a]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i,24.2,24.3]
	18	Intrepid 2F	8-16 oz/A	14	4	High	[24.2,24.3, 24.3b]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[24.2,24.3, 24.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[24.2,24.3,24.3b]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,24.2,24.3, 24.3b,24.3c]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,24.2,24.3, 24.3b,24.3c,24.4]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,24.2,24.3, 24.3b,24.4]
Oriental fruit moth		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate OFM-F 24.6S	1.32-2.93 fl.oz./A		0	Moderate	[14.2]
		Checkmate Puffer CM-OFM	1-2 units/ acre		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
		Isomate OFM TT	100 ties/A		0	High	[14.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[14.1a]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1a,14.3,14.3a, 14.3c]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[14.1a]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1a]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	Moderate	[14.1a]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	Moderate	[14.1a]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Oriental fruit moth (*continued*)	6	Proclaim 5SG	4.8 oz/A 1.2 oz/100 gal	14	12	Moderate	[14.1a]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[14.1a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[14.1a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1a, 14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1a,14.3a,]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1,14.3,14.3a, 14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1a]
	UN	Neemix	7-16 fl.oz./A	0	12	Moderate	[14.1a]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1a,14.3k]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1a,14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1a]
Oystershell scale	1A	Sevin 4F	1.5-3 qt/A	3	12	High	[25.1]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	High	[25.1]
	1A	Sevin XLR Plus 4EC	1.5-3 qt/A	3	12	High	[25.1]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	
Plum curculio		Surround 95WP	25-50 lb/A	0	4	Moderate	[12.2,26.2]
	1A	Sevin 4F	1.5-3 qt/A	3	12	Moderate	[26.2,26.4c]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	Moderate	[26.2,26.4c]
	1A	Sevin XLR Plus 4EC	1.5-3 qt/A	3	12	Moderate	[26.2,26.4c]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[26.2,26.4a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[26.2]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[26.2]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	Moderate	[26.2]
	4A	Actara 25WDG	4.5-5.5 oz/A	14/35 (A)	12	High	[26.2,26.4a,26.4b]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[26.2,26.4a]
	22	Avaunt 30WDG	5-6 oz/A	14	12	High	[26.2,26.4a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,26.2]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,26.2,26.4b]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal		12	High	[1.0,26.2,26.4b]
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		[9.3,9.4]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Powdery Mildew (*continued*)	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Redbanded leafroller	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,27.2]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,27.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[27.1]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	High	[27.2]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[27.2]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[27.2]
	11A	Agree 3.8WS	1-2 lb/A	0	4	High	[24.1,27.2]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	High	[24.1,27.2]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,27.2]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	High	[24.1,27.2]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[27.2]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[27.2]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,27.2]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,27.2]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,27.2]
Rosy apple aphid	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,28.2]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,28.2]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	Moderate	[28.2,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	Moderate	[28.2,35.1b]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[28.2]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[28.2,28.3c]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[28.2,28.4a]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
	23	Movento 240SC	6-9 fl.oz./A	7	24	Moderate	[28.4b]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,28.2]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,15.4]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
San Jose scale	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[29.4,29.4b]
Spotted tentiform leafminer, Apple blotch leafminer	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,30.2,30.2a, 30.2b,30.3]
	1A	Lannate LV 2.4L	1.5-3 pts/A 0.75 pt/100 gal	14	72	High	[12.1d,30.2,30.2a, 30.3]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[30.1,30.1a,30.2, 30.3]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[30.1,30.1a,30.2]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[30.1,30.1a,30.1b, 30.2,30.3]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[30.1,30.1a,30.2, 30.3]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[30.1,30.1a,30.1b, 30.2,30.2a,30.2b, 30.3]
	4A	Actara 25WDG	4.5 oz/A	14/35(A)	12	High	[15.4,30.1, 30.1d,30.2,30.2a, 30.2c,30.3]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[30.2,30.2a,30.3]
	4A	Assail 30SG	2.5 oz/A	7	12	High	[30.1,30.2,30.2a, 30.3]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[30.1,30.2, 30.2a,30.2c,30.3]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[30.1,30.1e,30.2, 30.2a,30.3]
	5	Entrust 2SC	6-10 fl.oz./A		4	High	[30.2,30.3]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	High	[30.2,30.3]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[30.1,30.2,30.3]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i,30.2]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[30.1,30.1d,30.2, 30.2a,30.2c,30.3]
	28	Altacor 35WDG	2.5-4 oz/A	5	4	High	[30.1,30.2, 30.2d,30.3]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[30.1,30.2,30.2d, 30.3]
	UN	Aza-Direct 1.2L	11.5-42 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	UN	Azatin XL 0.27EC	10-16 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,30.1,30.1a, 30.2,30.3]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,15.4,30.2, 30.3]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,15.4,30.2, 30.3]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,30.2]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Tarnished plant bug	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[33.1,33.1a,33.1b]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[33.1,33.1a,33.1b]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[33.1,33.1a,33.1b]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[33.1,33.1a,33.1b]
	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	9C	Beleaf 50SG	2-2.8 oz/A	21	12	High	[33.1,33.1a,33.1d]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[33.1,33.1a,33.1c]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,33.1,33.1a, 33.1b]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,15.4,33.1]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,33.1]
White apple leafhopper, Potato leafhopper	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,35.1]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,35.1]
	1A	Sevin 4F	0.5-1.5 qt/A	3	12	High	[35.1,35.1a]
	1A	Sevin 80 Solupak	0.63-1.88 lb/A	3	12	High	[35.1,35.1a]
	1A	Sevin XLR Plus 4EC	0.5-1.5 qt/A	3	12	High	[35.1,35.1a]
	1A	Vydate 2L	2-4 pt/A 1-2 pt/100 gal	14	48	High	[35.1,35.1a]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	High	[35.1,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[35.1,35.1b]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[35.1]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[35.1]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[35.1]
	3A	Baythroid XL 1EC	1.4-2 fl.oz./A	7	12	High	[35.1]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[35.1]
	4A	Actara 25WDG	2-2.75 oz/A	14/35(A)	12	High	[15.4,35.1,35.1c]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[35.1]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[35.1]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[35.1,35.1c]
	6	*Agri-Mek 8SC	2.25-4.25 fl.oz./A 0.5-1 fl.oz./100 gal	28	12	High	[35.1]
	16	Centaur 0.7WDG	9-12 oz/A	14	12	Moderate	[35.1]
	21A	Portal 0.4EC	2 pt/A	14	12	High	[35.1]
	22	Avaunt 30WDG	5-6 oz/A	14	12	High	[35.1,35.1c]
	UN	Aza-Direct 1.2L	12.5-42 fl.oz./A	0	4	Moderate	[35.1]
	UN	Neemix	7-16 fl.oz./A	0	4	Moderate	[35.1]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,35.1]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,15.4,35.1]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
White apple leafhopper, Potato leafhopper (*continued*)	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,15.4,35.1]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,35.1]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,35.1]
Additional Summer Sprays							
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
Apple aphid, Spirea aphid		M-Pede 49L	2 gal/100 gal		12	Moderate	[11.1]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[11.1]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[11.1]
	1A	Vydate 2L	2-8 pt/A 1-2 pt/100 gal	14	48	High	[11.1,11.1e]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	High	[11.1,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[11.1,35.1b]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[11.1]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[11.1]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	High	[11.1,11.1c]
	3A	Pyrenone 6L	12 fl.oz./A		12	Moderate	[11.1]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A see label	7	12	High	[11.1]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[11.1]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[11.1]
	9C	Beleaf 50SG	2-2.8 oz/A	21	12	High	[11.1]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[11.1,11.1d]
	UN	Aza-Direct 1.2L	12.5-42 fl.oz./A	0	4	Moderate	[11.1]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,11.1]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,11.1]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,11.1,11.1a]
Apple maggot		Surround 95WP	25-50 lb/A	0	4	Moderate	[12.2,12.1]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	Moderate	[12.1,12.1c,12.1d]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[12.1,12.1a]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	High	[12.1,12.1a]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Apple maggot (*continued*)	3A	Danitol 2.4EC	16 fl.oz./A	14	24	High	[12.1,12.1a,12.1b]
	4A	Assail 30SG	8 oz/A	7	12	High	[12.1,12.1a]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[12.1,12.1a]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[12.1,12.1a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,12.1,12.1a, 15.4]
Apple rust mite	21A	Nexter 75WS	5.2-10.7 oz/A	25	12	Moderate	[13.2]
	21A	Portal 0.4EC	2 pts/A	14	12	High	[13.2]
Apple scab	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.6,2.7]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.6,2.7]
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.6,2.7]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal	14	24		
	3	Topguard	13 fl.oz./A	14	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.4,2.14]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.4,2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.4,2.14]
	7	Fontelis	16-20 fl.oz./A	28	12		
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Bitter Rot	M4	Captan 80WDG	2.5-5.0 lb/A 0.625 lb/100 gal	0	24		
	M4	Captec 4L	1.0 pt/100 gal	0	24		
	M4	Captan 50WP	4.0 lb/A 1.0 lb/100 gal	0	24		
Black Rot & White Rot	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	8.0 lb/A 1.2-2.0 lb/100 gal	0	24		
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		
	11	Flint	1.5 oz/A 0.5 oz/100 gal	14	12		[2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14]
	7,11	Pristine 38WDG	14.5-18.5 fl.oz./A	0	12		
Blister Spot	33	Aliette WDG	2.5-5.0 lb/A 0.5-1.0 lb/100 gal	14	12		[5.1]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Cedar Apple Rust	3	Topguard	12 fl.oz./A	14	12		
Climbing cutworms: Darksided, Dingy, Mottled, Spotted, Variegated	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[16.2,16.2a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[16.2]
Codling moth		Carpovirusine 0.99SC	0.25-0.4 qt/A 0.5-1 pt/100 gal	0	4	Moderate	[14.1,14.3,14.3f]
		Checkmate CM-F 14.3S	2.4-4.8 fl.oz./A		4	Moderate	[14.2]
		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate Puffer CM-OFM	1-2 units/ acre		0	Moderate	[14.2]
		Cyd-X 0.06SC	1-6 fl.oz./A	0	4	Moderate	[14.1,14.3,14.3f]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
		Surround 95WP	25-50 lb/A	0	4	Moderate	[14.1,14.3,12.2]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[14.1,14.3,14.3g]
	1A	Lannate LV 2.4L	1.5-3 pts/A 1.5 pts/100 gal	14	72	High	[14.1,14.3,14.3g]
	1A	Sevin 80 Solupak	1.25-3.75 lb/A	3	12	Moderate	[14.1,14.3,14.3j]
	1A	Sevin XLR Plus 4EC	1-3 qt/A	3	12	Moderate	[14.1,14.3,14.3j]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[14.1,14.3,14.3e]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1,14.3]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1,14.3,14.3a, 14.3c]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[14.1,14.3,14.3e]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1,14.3]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	Moderate	[14.1,14.3]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	Moderate	[14.1,14.3]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[14.1,14.3]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[14.1,14.3,14.3e]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.1,14.3,14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1,14.3,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1,14.3,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1,14.3,14.3a, 14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1,14.3]
	UN	Neemix	7-16 fl.oz./A	0	4	Moderate	[14.1,14.3]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Codling moth (*continued*)	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1,14.3, 14.3k]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1,14.3, 14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1,14.3]
Comstock mealybug	4A	Assail 30SG	4-8 oz/A	7	12	High	[15.2a,15.3a,15.3b]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[15.2a,15.3a,15.3b]
	21A	Portal 0.4EC	2 pts/A	14	12	High	[15.2a,15.3a,15.3b]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[15.2a,15.2b,15.3a, 15.3b]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.2a,15.3a, 15.3b,15.4]
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
European corn borer	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[19.2]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[19.2]
European red mite	6	*Agri-Mek 8SC	2.25-4.25 fl.oz./A 0.5-1 fl.oz./100 gal	28	12	High	[20.8,20.9]
	10A	Apollo 4SC	4-8 fl.oz./A	45	12	High	[20.5,20.5a,20.6, 20.11,20.11a]
	10A	Onager 1 EC	12-24 fl.oz./A	28	12	High	[20.5,20.5b,20.11, 20.11a]
	10A	Savey 50DF	3 oz/A	28	12	High	[20.5,20.5b,20.6, 20.11,20.11a]
	10B	Zeal	2-3 oz/A	14	12	High	[20.5,20.5b,20.9, 20.11]
	12B	Vendex 50WP	1-2 lb/A 4-8 oz/100 gal	14	48	Low	[20.11,20.11c]
	20B	Kanemite 15SC	31 fl.oz./A	14	12	High	[20.9,20.9b,20.11, 20.11c]
	21A	Nexter 75WS	4.4-5.2 oz/A	25	12	High	[20.9,20.9a, 20.11]
	21A	Portal 0.4EC	2 pt/A	14	12	High	[20.9,20.9a,20.11]
	UN	Acramite 50WS	0.75-1 lb/A	7	12	High	[20.9,20.9a,20.11]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,20.8,20.9]
Fire blight		Apogee 27.5%	4.5-9.0 oz/100 gal	45	12		[8.6]
		Firewall	24.0 oz/A 8.0 oz/100 gal	50	12		[8.5]
Japanese beetle	1A	Sevin 4F	1.5-3 qt/A	3	12	High	[22.2]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	High	[22.2]
	1A	Sevin XLR Plus 4EC	1-5-3 qt/A	3	12	High	[22.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[22.2]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Japanese beetle (*continued*)	4A	Assail 30SG	5-8 oz/A	7	12	High	[22.2]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[22.2]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,22.2]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,22.2]
Lesser appleworm		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate Puffer CM-OFM	1-2 units/ acre		0	High	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[14.1a]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1a,14.3a,14.3c]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.1a,14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1a,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1a,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1a,14.3a,14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,14.1a]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1a,14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1a]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1a,14.3k]
Obliquebanded leafroller	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	Moderate	[24.2,24.2a,24.2c]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	Moderate	[24.2,24.2a,24.2c]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[24.2,24.3,24.3b, 24.3c]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	Moderate	[24.2,24.3,24.3b, 24.3c,24.3d]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[24.2,24.3,24.3c]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	Moderate	[24.2,24.2d,24.3, 24.3b,24.3c]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[24.2,24.3,24.3b]
	5	Entrust 2SC	6-10 fl.oz./A		4	High	[24.2,24.3,24.3b]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	High	[24.2,24.3,24.3b]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[24.2,24.2e,24.3, 24.3b]
	11A	Agree 3.8WS	1-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]

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Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Obliquebanded leafroller (*continued*)	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,24.2,24.3, 24.3a]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i,24.2,24.3]
	18	Intrepid 2F	8-16 oz/A	14	4	High	[24.2,24.3, 24.3b]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[24.2,24.3,24.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[24.2,24.3,24.3b]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,24.2,24.3, 24.3b,24.3c]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,24.2,24.3, 24.3b,24.3c,24.4]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,24.2,24.3, 24.3b,24.4]
Oriental fruit moth		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate OFM-F 24.6S	1.32-2.93 fl.oz./A		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
		Isomate OFM TT	100 ties/A		0	High	[14.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[14.1a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[14.1a]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[14.1a]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1a,14.3,14.3a, 14.3c]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[14.1a]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1a]
	5	Entrust 2SC	6-10 fl.oz./A		4	Moderate	[14.1a]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	Moderate	[14.1a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1a,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1a,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1,14.3,14.3a, 14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,14.1a]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1a,14.3k,]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1a]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1a,14.3k]
Oystershell scale	1A	Sevin 4F	1.5-3 qt/A	3	12	High	[25.1]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	High	[25.1]

Table 11.5.1 Pesticide Spray Table – Apples.

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Oystershell scale (*continued*)	1A	Sevin XLR Plus 4EC	1.5-3 qt/A	3	12	High	[25.1]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	
Plum curculio		Surround 95WP	25-50 lb/A	0	4	Moderate	[12.2,26.2]
	1A	Sevin 4F	1.5-3 qt/A	3	12	Moderate	[26.2,26.4c]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	Moderate	[26.2,26.4c]
	1A	Sevin XLR Plus 4EC	1.5-3 qt/A	3	12	Moderate	[26.2,26.4c]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[26.2,26.4a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[26.2]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[26.2]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	Moderate	[26.2]
	4A	Actara 25WDG	4.5-5.5 oz/A	14/35 (A)	12	High	[26.2,26.4a,26.4b]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[26.2,26.4a]
	22	Avaunt 30WDG	5-6 oz/A	14	12	High	[26.2,26.4a]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,26.2,26.4b]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,26.2,26.4b]
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		[9.3,9.4]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Redbanded leafroller	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,27.2]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,27.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[27.1]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	High	[27.2]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[27.2]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[27.2]
	11A	Agree 3.8WS	1-2 lb/A	0	4	High	[24.1,27.2]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Redbanded leafroller (*continued*)	11A	Deliver 18WG	0.5-2 lb/A	0	4	High	[24.1,27.2]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,27.2]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	High	[24.1,27.2]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[27.2]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[27.2]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,27.2]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,27.2]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,27.2]
San Jose scale	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	Moderate	[29.4]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	Moderate	[29.4]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[29.4,29.4a]
	7C	Esteem 35WP	4-5 oz/A	45	12	High	[29.4]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[29.3,29.4]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[29.4,29.4b]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,15.4,29.4]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	Moderate	[1.0,29.4]
Sooty Blotch & Flyspeck	M3	Indar 2F	6.0-8.0 fl oz/A	14	12		
	M3	Inspire Super	8.5-12.0 fl oz/A	14	12		
	M3	Ziram 76DF, 76 WDG	1.0 lb/100 gal	14	48		
	M4	Captan 80WDG	2.5 lb/A 0.625 lb/100 gal	0	24		
	M4	Captec 4L	4 qt/A 0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	4.0 lb/A 1.0 lb/100 gal	0	24		
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		
	1	Topsin M 70WP	3.2-4.0 oz/100 gal	1	48		[10.1,10.2]
	1	Topsin M WSB	3.2-4.0 oz/100 gal	1	48		[10.1,10.2]
	1	Topsin M 70WP, WDG	0.75-1 lb/A 4-6 oz/100 gal	1	48	1	[10.1]
	1	or Thiophanate-methyl 85WDG *plus:*	.6-.8 lb/A .2-.3 lb/100 gal	1	48		[10.2]
	M4	Captan 50WP	4 lb/A 1 lb/100 gal	0	24		
	M4	or Captan 80WDG	2.5 lb/A 5/8 lb/100 gal	0	24		
	M4	or Captan 4L	1 pt/100 gal	0	24		
	M3	or Manzate/ Penncozeb 75DF or 80WP	3 lb/A 1 lb/100 gal	77	24		[2.8]
	M3	or Manzate/Dithane/ Penncozeb Flowable	2.4 qt/A see label	77	24		
	M3	or Polyram 80DF	3 lb/A 1 lb/100 gal	77	24		

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Sooty Blotch & Flyspeck (*continued*)	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		
	7,11	Pristine 38WDG	14.5-18.5 oz/A	0	12		
Spotted tentiform leafminer, Apple blotch leafminer	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,30.2,30.2a, 30.2b,30.3]
	1A	Lannate LV 2.4L	1.5-3 pts/A 0.75 pt/100 gal	14	72	High	[12.1d,30.2,30.2a, 30.3]
	1A	Vydate 2L	2-4 pts/A 1 pt/100 gal	14	48	High	[30.1,30.2, 30.2a,30.3,30.3a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[30.1,30.1a,30.2, 30.3]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[30.1,30.1a,30.1b, 30.2,30.3]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[30.1,30.1a,30.2, 30.3]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[30.1,30.1a,30.1b, 30.2,30.2a,30.2b, 30.3]
	4A	Actara 25WDG	4.5 oz/A	14/35 (A)	12	High	[15.4,30.1, 30.1d,30.2,30.2a, 30.2c,30.3]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[30.2,30.2a,30.3]
	4A	Assail 30SG	2.5 oz/A	7	12	High	[30.1,30.2,30.2a, 30.3]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[30.1,30.2, 30.2a,30.2c,30.3]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[30.1,30.1e,30.2, 30.2a,30.3]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	High	[30.2,30.3]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	High	[30.2,30.3]
	6	*Agri-Mek 8SC	2.25-4.25 fl.oz./A 0.5-1 fl.oz./100 gal	28	12	High	[30.3]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[30.1,30.2,30.3]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i,30.2]
	28	Altacor 35WDG	2.5-4 oz/A	5	4	High	[30.1,30.2, 30.2d,30.3]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[30.1,30.2,30.2d, 30.3]
	UN	Aza-Direct 1.2L	11.5-42 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	UN	Azatin XL 0.27EC	10-16 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,30.1,30.1a, 30.2,30.3]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Spotted tentiform leafminer, Apple blotch leafminer (*continued*)	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,15.4,30.2, 30.3]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,30.2,30.3]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,15.4,30.2, 30.3]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,30.2]
Spotted wing Drosophila	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	Moderate	[31.2]
	5	Delegate 25WG	4.5-7 oz/A	7	4	Moderate	[31.2,31.2a]
	5	Entrust 2SC	6-10 fl.oz./A		4	High	[31.2,31.2b]
	5	Entrust 80WP	1.5-3 oz/A	7	4	High	[31.2,31.2b]
Stink bugs, incl. Brown marmorated stink bug		Surround 95WP	25-50 lb/A	0	4	Moderate	[12.2,32.2a]
	1A	Lannate 90SP	0.75 lb/A	14	72	High	[32.2a,32.2b]
	1A	Lannate LV 2.4L	2.25 pt/A	14	72	High	[32.2a,32.2b]
	1A	Vydate 2L	1.5-3 pt/A	14	48	Moderate	[32.2a,32.2b]
	2A	Thionex 3EC	2.67 qt/A 0.5 qt/100 gal	21	7 days	High	[32.2a,32.2b,32.2c]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[32.2a,32.2b,32.2c]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[32.2a]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	Moderate	[32.2a]
	3A	Baythroid XL 1EC	2.0-2.4 fl.oz./A	7	12	Moderate	[32.2a]
	3A	Danitol 2.4EC	10.7-21.3 fl.oz./A	14	24	Moderate	[32.2a,32.2b]
	4A	Actara 25WDG	4.5-5.5 oz/A	14/35 (A)	12	Moderate	[15.4,32.2a,32.2b]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,32.2a]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0, 15.4,32.2a]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	Moderate	[1.0,32.2a]
	4A/28	Voliam Flexi WDG	6.0-7.0 oz/A	35	12	Moderate	[1.0,15.4,32.2a]
Twospotted spider mite	10B	Zeal	2-3 oz/A	14	12	High	
	12B	Vendex 50WP	1-2 lb/A 4-8 oz/100 gal	14	48	Moderate	
	20B	Kanemite 15SC	31 fl.oz./A	14	12	High	
	21A	Nexter 75WS	8.8-10.7 oz/A	25	12	Moderate	
	21A	Portal 0.4EC	2 pt/A	14	12	High	
	UN	Acramite 50WS	0.75-1 lb/A	7	12	High	
Variegated leafroller, Sparganothis fruitworm	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,34.1]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,34.1]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[24.1,34.1,34.1a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[24.1,34.1,34.1a]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	Moderate	[24.1,34.1,34.1a]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Variegated leafroller, Sparganothis fruitworm (*continued*)	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,34.1]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,34.1,34.1a]
White apple leafhopper, Potato leafhopper	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,35.1]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,35.1]
	1A	Sevin 4F	0.5-1.5 qt/A	3	12	High	[35.1,35.1a]
	1A	Sevin 80 Solupak	0.63-1.88 lb/A	3	12	High	[35.1,35.1a]
	1A	Sevin XLR Plus 4EC	0.5-1.5 qt/A	3	12	High	[35.1,35.1a]
	1A	Vydate 2L	2-4 pt/A 1-2 pt/100 gal	14	48	High	[35.1,35.1a]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	High	[35.1,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[35.1,35.1b]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[35.1]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[35.1]
	3A	Baythroid XL 1EC	1.4-2 fl.oz./A	7	12	High	[35.1]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[35.1]
	4A	Actara 25WDG	2-2.75 oz/A	14/35 (A)	12	High	[15.4,35.1,35.1c]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[35.1]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[35.1]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[35.1,35.1c]
	16	Centaur 0.7WDG	9-12 oz/A	14	12	Moderate	[35.1]
	21A	Portal 0.4EC	2 pt/A	14	12	High	[35.1]
	22	Avaunt 30WDG	5-6 oz/A	14	12	High	[35.1,35.1c]
	UN	Aza-Direct 1.2L	12.5-42 fl.oz./A	0	4	Moderate	[35.1]
	UN	Neemix	7-16 fl.oz./A	0	4	Moderate	[35.1]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,15.4,35.1]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,35.1]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,15.4,35.1]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,35.1]
Woolly apple aphid	1B	Diazinon 50WP	1 lb/100 gal	21/PF (A)	96	High	[36.1,36.1b]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	Moderate	[35.1b,36.1]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	Moderate	[35.1b,36.1]
	4A	Admire Pro 4.6SC	7-10.5 fl.oz./A	7	12	Moderate	[36.2]
	4A	Assail 30SG	2.5-4 oz/A	7	12	Moderate	[36.1,36.1a]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Woolly apple aphid (*continued*)	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[36.1]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[29.4b,36.1]
Postharvest							
Crown rot	4	Ridomil Gold SL	2 qt/A 0.5 pt/100 gal		48		[7.2]
Control of Storage Disorders							
Apple scab	M3	Penncozeb 75DF	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77(A)	24		[2.7]
Control of Storage Disorders							
Storage rots	1	Mertect 340F *plus*	1 pt/100 gal				[37.1]
	M4	Captan 50WP *or*	2.5 lb/100 gal				
	M4	Captan 80WP *or*	1.6 lb/100 gal				
	M4	Captec 4L	1.25 qt/100 gal				
		Penbotec	16-32 fl oz/100 gal				[37.1]
	12	Scholar SC	10-16 fl oz/100 gal 16-32 fl oz/200,000 lb fruit				[37.1]
Storage scald		No Scald DPA-EC-283	2.5-5 pt/100 gal				[38.1]
Senescent break-down (McIntosh)		Dowflake Process Grade	25 lb/100 gal				[39.1]

11.2 Apple Disease Notes

11.2.1 Apple Rust Diseases

• Biology & Cultural

Varieties that are susceptible to cedar apple rust include: Arlet, Braeburn, Fuji, Gala, Ginger Gold, Goldrush, Golden Delicious, Idared, Jonathan, Lodi, Mutsu (Crispin), and Rome. All varieties are susceptible to quince rust under favorable weather conditions. See Table 6.2.3 for a precise listing of temperature and wetting periods necessary to cause cedar-apple rust infections. Maintain short intervals during periods of wet weather in orchards where quince rust fruit infections have been a problem. Quince rust infections are most likely to develop when long wetting periods (48 hours or more) occur between tight cluster and first cover and the average temperature is greater than
50°F.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

11.2.2 Apple Scab

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.3] The EBDC fungicides (mancozeb, maneb, Polyram) are labeled for use on apples in one of two different ways: (i) at a rate of 1.5-2 lb/100 gal (maximum 6 lb/A, no more than 24 lb/A per year), not to be applied after bloom; OR (ii) at a reduced rate of 3 lb/A (maximum 21 lb/A per year), which may be applied to within 77 days of harvest. The latter rate is adequate for control of rust diseases, and the extended timing is necessary to control rust infections on terminal leaves. It is illegal to combine or integrate the two treatment regimes.

[2.1] See discussion of inoculum reduction in the disease management section. Scab fungicide sprays beginning at green tip are absolutely essential in orchards with high carry-over inoculum or orchards where scab control with SI fungicides was less than satisfactory in previous years. If early season infections are allowed to become established, even the best fungicide programs will not prevent development of fruit scab in orchards where the scab fungus has developed resistance to all three of the fungicide groups (dodine, benzimidazoles, SI′s) that previously provided presymptom and postinfection activity against apple scab.

[2.2] Fungicide rates per acre should never be reduced below either (i) 50% of the per-acre rate listed on the label or (ii) 1.5 multiplied by the Amt/100 gal listed on the label. This applies even when spraying small trees. Although tree-row volume calculations may suggest that lower rates are appropriate, applying less than 50% of the

per-acre rate has frequently resulted in unsatisfactory scab control and/or more rapid development of fungicide resistance. In orchards with SI-resistant scab, a combination of a mancozeb fungicide at 3 lb/A plus a captan formulation that supplies 1.5 lb of active ingredient/A has provided excellent scab control when used in prebloom and bloom sprays. (A captan rate of 1.5 lb active ingredient/A translates to 3 lb/A of Captan 50W, 30 oz/A of 80W, or 1.5 qt/A for the 4L formulations.) This combination provides a better residual activity through heavy rains than would be available from either product used alone and it preserves the option of using mancozeb sprays after petal fall. The mancozeb-captan combination cannot be used close to prebloom oil sprays because of captan-oil incompatibilities. For reasons of economy and resistance management, it is recommended that SI and strobilurin fungicides not be used until pink, even when fungicidal protection is needed earlier; in such cases, make a single application of an alternative fungicide (captan, copper, EBDC) at green tip and half-inch green, then begin the SI/strobilurin program at pink. Do not apply captan or sulfur within 10 days of an oil spray. Do not apply liquid captan formulations with sulfur on sulfur-sensitive varieties. A further discussion of apple scab fungicide characteristics is presented in the section "Apple Scab Fungicides" and in Table 6.1.3.

[2.4] Sovran and Flint are excellent protectants, but they have only 48-72 hours of post-infection activity compared with 72-96 hr for the SI fungicides. Sovran and Flint also lack the presymptom activity that makes the SI fungicides so effective (in the absence of SI resistance) for arresting scab epidemics after primary scab lesions become visible in trees. Sovran and Flint have proven very effective against apple scab when applied at 7-9-day intervals to control primary scab, but they have not performed as well when used to control secondary scab in trees where scab lesions are already visible. Sovran and Flint control rust diseases fairly well when used as protectants, but they have little or no post-infection activity against rust diseases. CAUTION: Sovran has caused moderate to severe phytotoxicity (leaf burning) on several sweet cherry varieties when sprayed directly onto them at high labeled rates. The most sensitive varieties were: Somerset, Sweetheart, Valera, Van, and Vandalay; these varieties might also be injured by spray drift containing Sovran. Minor to moderate injury occurred on Cavalier, Coral Champagne, Emperor Francis, Royalton, Schmidt, Summit, and Viva; there is less danger of injury due to spray drift on these varieties. Many other sweet and sour cherry varieties (including Bing, Brooks, Cashmere, Gold, Hardy Giant, Hartland, Hedelfingen, Hudson, Kristin, Lapins, Lambert, Montmorency, Napoleon, Nelson Black Sweet, Rainier, Royal Ann, Sam, Stark Crimson, Stella, Sue, Tehranivee, Tulare, Ulster, Vega, Vic, Viscount, and Windsor) showed no injury when sprayed directly with high labeled rates. The Sovran manufacturer recommends: (i) Do not apply Sovran near or allow drift onto cherries in the highly sensitive group (Somerset, etc.); and (ii) thoroughly rinse spray equipment (tanks, hoses, nozzles) after spraying Sovran and before using this equipment on sensitive cherry varieties.

[2.6] Primary inoculum pressure is generally at a peak from pink through bloom—this is a critical time to maintain full coverage with proper fungicide rates.

[2.7] Serious losses from apple scab are usually the result of secondary spread to developing fruits. Therefore, it is important to carefully check blocks for the presence of primary scab lesions from petal fall through the early cover spray period. This is particularly important because fruit are most susceptible to infection during the first few weeks of their development. If scab is detected, the management strategy should be to (i) thoroughly protect the sensitive young fruitlets from fungal spores that are present, AND (ii) limit the number of new spores that can be produced. To protect fruitlets, use (a) the full rate of captan (e.g., 2 lb/100 gal of the 50WP formulation), or (b) the reduced rate of an EBDC fungicide (if allowable) supplemented with a half rate of captan, or (c) a strobilurin fungicide combined with a contact fungicide. To limit new spore production, use (a) an SI fungicide through 2nd cover (to prevent new leaf lesions), or (b) a registered strobilurin fungicide (to prevent new leaf lesions and suppress spore production from existing lesions). SI's should be used only in orchards where there is no resistance to these fungicides. With repeated use, these options will speed the development of resistance. Thus, they should be viewed as emergency "rescue" operations, and increased care should be taken in future seasons to avoid the development of primary scab that necessitated their use.

[2.8] It is illegal to use the 6 lb/A rate of the EBDC fungicides after bloom. It also is illegal to use the reduced rate (3 lb/A) after bloom if the rate for any of the sprays prior to petal fall exceeded 3 lb/A.

[2.9] The danger of primary scab is over after 1st cover except when drought conditions delay spore release. If primary scab has been well controlled, fungicide schedules and rates can be relaxed after the danger of primary infection is past. For best control of mildew, apply an SI or strobilurin fungicide through 2nd cover on bearing trees and through 4th cover on non-bearing trees.

[2.13] Sensitivity to the SI fungicides (Rally, Procure, Vintage, Indar, Topguard, Inspire Super) is declining among some populations of the apple scab and powdery mildew fungi. These materials still provide apple scab control in some orchards, but they are totally ineffective in other orchards. Declining efficacy usually appears in orchards with a history of regular SI use (3-5 applications for 10+ yr) under high disease pressure, whereas no decline is apparent in orchards where the materials have been used sparingly or in tight schedules with low levels of inoculum. In order to maintain the usefulness of these products, it is recommended that they be used: (a) at full rates with thorough spray coverage; (b) only in tank-mix combinations with another effective scab fungicide; and (c) no more than 2-3 times per season.

[2.14] Fungicide resistance to Sovran, Cabrio, and Flint is begining to develop in the Northeastern US. The primary strategies for reducing this risk of resistance are to rotate the strobilurins with unrelated fungicides, to limit the number of seasonal applications of strobilurin fungicides

(e.g., 3-4 per year), and to tank mix strobilurins with captan when treating trees with visible scab lesions.

[2.15] Fungicide resistance to dodine (Syllit) appears to be decreasing in prevalence, but because of previous resistance concerns, we still recommend that dodine be applied with either captan or a mancozeb fungicide. Syllit use should still be restricted to pre-bloom to mimize resistance concerns and maximize against the disease to which it works (i.e. apple scab). (CAUTION: Applications of dodine after bloom may cause russeting on russet-sensitive varieties). Recently, the pomace and some cultivar restrictions have been removed from the label

11.2.3 Black Rot & White Rot

• Biology & Cultural

Black rot inoculum is retained within trees in dead wood (e.g., old fire blight strikes) and fruitlet mummies; therefore, it is important to remove these sources to whatever extent possible. The critical periods for controlling black rot fruit infections are (a) from the 1st through 3d cover sprays, when fruitlets killed by thinning applications become infected (they become inoculum sources), and (b) during late summer, when maturing fruit are especially susceptible. Where black rot was not controlled well the previous year, protectant sprays may be needed at 2-3-week intervals until late August.

Black rot cankers cannot be controlled with fungicide sprays. Cankers develop primarily after wood has been weakened by other factors (e.g., drought, winter injury). However, the white rot fungus may establish superficial cankers on trees that receive only mancozeb and/or SI sprays during the primary scab period. Those superficial cankers can suddenly girdle limbs if trees become severely drought-stressed. Using a copper fungicide at green tip and/or including a fungicide with activity against black rot/white rot (e.g. Captan, Sovran, or Flint) in the prebloom scab control program should help to control superficial white rot cankers.

• Pesticide Application Notes

[2.8] It is illegal to use the 6 lb/A rate of the EBDC fungicides after bloom. It also is illegal to use the reduced rate (3 lb/A) after bloom if the rate for any of the sprays prior to petal fall exceeded 3 lb/A.

[2.14] Fungicide resistance to Sovran, Cabrio, and Flint is begining to develop in the Northeastern US. The primary strategies for reducing this risk of resistance are to rotate the strobilurins with unrelated fungicides, to limit the number of seasonal applications of strobilurin fungicides (e.g., 3-4 per year), and to tank mix strobilurins with captan when treating trees with visible scab lesions.

[10.3] Captan is relatively weak against sooty blotch and very weak against flyspeck; if using Captan for control of summer rot diseases, tank-mix with Topsin M, Prophyt, Flint or Sovran if sooty blotch and fly speck control are needed.

[10.4] For the best residual control of all summer diseases during the 30-50-day interval between the last spray and harvest, use Pristine or Captan combined Topsin M in the last application.

11.2.4 Blister Spot

• Pesticide Application Notes

[5.1] This is an economic problem primarily on the Mutsu cultivar, but Fuji occasionally shows symptoms when planted near Mutsu. Apply the 1st spray 10-14 days after petal fall. A delay in applying this spray will significantly reduce control in most years. Two additional sprays should be applied at weekly intervals if any rain occurs. Do not apply more than 3 sprays. The use of 2-4 lb Kocide /100 gal between green tip and 1/2-inch green in the spring may reduce overwintering inoculum and provide a small amount of additional control. Additionally, application of Aliette (or phosphorous acid or phosphite products) during pink, petal fall, and early cover sprays may also reduce infections.

11.2.5 Blossom End Rot

• Biology & Cultural

Blossom end rots can be caused by *Botrytis cinerea, Sclerotinia sclerotiorum,* and *Botryosphaeria obtusa*. It occurs sporadically and is most likely to become a problem if the weather is warm and wet between bloom and 1st cover and in orchards where only mancozeb, Polyram, or SI fungicides were applied during bloom and at petal fall. McIntosh, Delicious, Rome, and Paulared are most commonly affected.

• Pesticide Application Notes

[6.2] Where blossom end rot has occurred before, use captan, Sovran, Topsin M or Thiophanate-methyl in the bloom, petal fall, and 1st cover sprays if the weather conditions are favorable for infection.

11.2.6 Cedar Apple Rust

• Pesticide Application Notes

[1.3] The EBDC fungicides (mancozeb, maneb, Polyram) are labeled for use on apples in one of two different ways: (i) at a rate of 1.5-2 lb/100 gal (maximum 6 lb/A, no more than 24 lb/A per year), not to be applied after bloom; OR (ii) at a reduced rate of 3 lb/A (maximum 21 lb/A per year), which may be applied to within 77 days of harvest. The latter rate is adequate for control of rust diseases, and the extended timing is necessary to control rust infections on terminal leaves. It is illegal to combine or integrate the two treatment regimes.

[2.2] Fungicide rates per acre should never be reduced below either (i) 50% of the per-acre rate listed on the label or (ii) 1.5 multiplied by the Amt/100 gal listed on the label. This applies even when spraying small trees. Although tree-row volume calculations may suggest that lower rates are appropriate, applying less than 50% of the per-acre rate has frequently resulted in unsatisfactory scab control and/or more rapid development of fungicide resistance. In orchards with SI-resistant scab, a combination

of a mancozeb fungicide at 3 lb/A plus a captan formulation that supplies 1.5 lb of active ingredient/A has provided excellent scab control when used in prebloom and bloom sprays. (A captan rate of 1.5 lb active ingredient/A translates to 3 lb/A of Captan 50W, 30 oz/A of 80W, or 1.5 qt/A for the 4L formulations.) This combination provides a better residual activity through heavy rains than would be available from either product used alone and it preserves the option of using mancozeb sprays after petal fall. The mancozeb-captan combination cannot be used close to prebloom oil sprays because of captan-oil incompatibilities. For reasons of economy and resistance management, it is recommended that SI and strobilurin fungicides not be used until pink, even when fungicidal protection is needed earlier; in such cases, make a single application of an alternative fungicide (captan, copper, EBDC) at green tip and half-inch green, then begin the SI/strobilurin program at pink. Do not apply captan or sulfur within 10 days of an oil spray. Do not apply liquid captan formulations with sulfur on sulfur-sensitive varieties. A further discussion of apple scab fungicide characteristics is presented in the section "Apple Scab Fungicides" and in Table 6.1.3.

11.2.7 Crown Rot (Collar Rot)

• Biology & Cultural

Crown rot is primarily associated with trees on moderately to highly susceptible rootstocks (particularly MM.106 and young trees on M.26). It can also develop on moderately resistant rootstocks planted in poorly drained sites or in very wet years. Seedling and M.9 appear to be the least susceptible of the common rootstocks.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[7.2] Ridomil should be considered in sections of the orchard where crown rot has been a problem, or where the combination of marginal drainage and rootstock susceptibility indicates a potential problem. Make a solution containing .5 pts Ridomil Gold 4SL in 100 gal of water and apply this solution to the soil around the trunk at the following rate: Trunk diameter at 12 inches above soil line Quantity of Diluted Solution <1 inch 1 qt. 1-3inches 3 qts. >5 inches 4 qts. Apply just as growth begins in the spring and repeat immediately after harvest. Do not apply to newly planted trees. Ridomil is an effective protective fungicide, but is unlikely to cure trees in moderate to severe stages of decline.

11.2.8 Fire Blight

• Biology & Cultural

Fire blight is a potentially damaging disease on highly susceptible varieties such as Crispin (Mutsu), Fuji, Gala, Gingergold, Greening, Honeycrisp, Idared, Jonathan, Lady Apple, Monroe, Paulared, Rome, SweeTango, and Wayne. Most other varieties can become infected if warm, wet weather prevails during bloom. The potential for tree loss is especially high when susceptible varieties are grown on susceptible M.26 and M.9 rootstocks (or interstems), because fire blight can move from the scion or infected root suckers into the rootstock and kill the tree.

Pruning out infected shoots to limit the spread of shoot blight is of questionable benefit on large trees but is recommended on young or small trees, particularly those on M.9 or M.26 rootstocks or interstems. To effectively limit damage, strikes should be pruned out as soon as they appear throughout the terminal growth period. Pruning cuts should be made into healthy second year wood (if applicable) to minimize the abundance of fire blight spreading in asymptomatic tisse. Begin checking for symptoms about 90-100 degree days (base 55°F) after an expected infection event such as rain during bloom or summer hailstorm. Degree day information can be sourced from the NYS IPM NEWA network web site at newa.cornell.edu. Should fire blight develop, it is also important to maintain control of pear psylla and potato leafhopper because these insects can contribute to shoot blight infections. Recent research indicates that aphids and white apple leafhopper are less important in spread of fire blight.

• Monitoring & Forecasting

Fire blight outbreaks almost always originate with infections that occur during bloom. Therefore, preventing blossom blight is arguably the most critical component in blight control programs. Streptomycin (strep) is by far the most effective product for preventing blossom blight except in orchards where strep-resistant strains of the pathogen are present. There is no evidence that repeated use of strep sprays during bloom will contribute to development of strep resistance. However, repeated use of strep AFTER bloom has consistently resulted in strep resistance in all geographic areas where it has been tried. Therefore, routine use of strep after bloom must be avoided.

The need for streptomycin sprays during bloom depends upon a combination of both orchard risk factors and weather risk factors. Orchards are considered "at-risk" if any of the following apply, and risk is compounded where more than one of the following applies:

1. Trees are less than 6 years old
2. Trees are highly susceptible cultivars (see 8.1).
3. Fire blight was observed in the orchard in either of the previous two seasons.
4. Fire blight was observed in orchards within a half-mile of the orchard during the previous season.

Precise timing is critical for maximizing the effectiveness of strep sprays because bacterial populations build very rapidly in flowers during warm weather. A strep application will protect only those blossoms that are open when the application is made, and strep will not redistribute after sprays have dried. Thus, protection from strep sprays can be optimized by making applications just prior to wetting events so that all open blossoms are protected during the actual infection event.

Two different fire blight forecast models, MaryBlyt™ and Cougarblight 2010, can be used to predict

fire blight risk and assist in timing strep sprays. For Cougarblight predictions, consult the NEWA disease forecasting webpage (newa.nrcc.cornell.edu/newaModel/apple_disease). This disease forecast system provides disease prediction information updated on an hourly basis. The MaryBlyt™ model can be downloaded to any computer with the Windows operating system from the following website: www.caf.wvu.edu/Kearneysville/Maryblyt/. Attempting to time strep sprays without using one of these models will often result in control failures.

If one cannot access spray timing information from one of the blossom blight models, then at-risk orchards should be protected with streptomycin if weather has been relatively warm since full pink AND forecasts indicate the probability of rain or showers in the next 24 hr at temperatures greater than 60°F. A program to initiate spraying once 200 degree hours (base 65°F) have accumulated since full pink (first open blossom in the orchard) has proven effective in several locations and should serve as an approximate guideline. [Example: To calculate degree hours for a particular day, assume 6 hr at the low, and 12 hr at the average of the two. Thus, for a day with a high of 80°F, a low of 60°F, and the average of 70°F, the of accumulated degree hours can be calculated as: 6 hr x 15 degrees above 65 for the high + 6 hr x 0 degrees above 65 for the low + 12 hr x 5 degrees above 65 for the average, or 90 + 0 + 60 = 150 accumulated degree hours]. Thus, once 200 or more degree hours have accumulated, strep should be sprayed before the next forecasted rain, providing that temperatures are 60°F or higher.

The need for additional streptomycin treatments should be determined by continuing to monitor weather conditions carefully (i.e., model outputs or degree hour and heat unit accumulation following treatment) so long as any open blossoms remain on trees. On the NEWA Cougarblight model webpage it is possible to enter the streptomycin treatment date to re-set the model to calculate the need for additional treatment. This monitoring is particularly critical during hot weather at mid-bloom where flowers may open following streptomycin application and enough heat units are accumulated to put theses newly opened blossoms at risk for infection within a day or two of the previous strep spray. In these instances, streptomycin should be reapplied to protect newly opened blossoms before the next rain occurs. However, streptomycin can provide control if applied within 24 hr after a wetting event begins. Antibacterial activity depends upon absorption by the blossoms; therefore, streptomycin must dry on the trees to be effective. Thorough coverage is essential for control. Alternate row spraying is not recommended with streptomycin, but if it is used the rates applied per acre must be the same as for every-row applications. The application of streptomycin at concentrations greater than 6X has been associated with reduced levels of control and is therefore, not recommended. Refer also to [8.5] and [8.7].

For at-risk orchards, consider including streptomycin in the petal fall spray if trees still have any open flowers, or if no strep spray was applied within the previous 3-4 days and the degree hours over 65° either currently exceed or are expected to exceed 145 (= a MaryBlyt EIP of 75) within the next few days. The objective of including strep in the petal fall spray is to protect the lingering bloom that is especially prevalent in young high-density orchards. Alternatively, one could continue applying strep with timings suggested by the MaryBlyt or Cougarblight models to protect late flowers during the interval after 50-80% petal fall, and using these models to time strep sprays after petal fall can be especially important if flowers linger for more than a few days after petal fall and for newly planted trees that will tend to bloom later than established trees.

Streptomycin sprays at 4 oz/100 gal should never be made under any circumstances because field observations suggest that this low rate can lead to incomplete control in cases where some flowers receive less than optimum coverage due to imperfect spray distribution. Therefore, all applications of streptomycin should be at 8 oz/100 gal of dilute spray or at 1.5 lb/A for trees that require 300 gal/A for complete coverage. Where rates are calculated using tree-row volume, the minimum Amt/A for strep applied with an airblast sprayer is 12 oz/A even if tree-row volume calculations would suggest a lower rate.

Regulaid or other penetrating adjuvants that enhances uptake should no longer be applied with streptomycin regardless of whether or not there is quick drying conditions. Given the application paradigm of tankmixing bloom thinners, bactericides, fungicides, and insecticides from bloom to petal to 1st cover, the potential for overthinning and damage of young developing fruit is great to warrant the use of Regulaid with streptomycin. Applications of streptomycin plus Regulaid over a short time interval may result in excessive yellowing of young leaves and leaf margins.

Streptomycin should NEVER be applied when there are no flowers on the trees except when orchards with visible fire blight have been damaged by hail (see [8.5]).

• Pesticide Application Notes

[8.3] Fire blight outbreaks almost always originate with infections that occur during bloom. Therefore, preventing blossom blight is arguably the most critical component in blight control programs. Streptomycin (strep) is by far the most effective product for preventing blossom blight except in orchards where strep-resistant strains of the pathogen are present. There is no evidence that repeated use of strep sprays during bloom will contribute to development of strep resistance. However, repeated use of strep AFTER bloom has consistently resulted in strep resistance in all geographic areas where it has been tried. Therefore, routine use of strep after bloom must be avoided.

The need for streptomycin sprays during bloom depends upon a combination of both orchard risk factors and weather risk factors. Orchards are considered "at-risk" if any of the following apply, and risk is compounded where more than one of the following applies: 1. Trees are less than 6 years old 2. Trees are highly susceptible cultivars (see 8.1). 3. Fire blight was observed in the orchard in either of the previous two seasons. 4. Fire blight

was observed in orchards within a half-mile of the orchard during the previous season.

Precise timing is critical for maximizing the effectiveness of strep sprays because bacterial populations build very rapidly in flowers during warm weather. A strep application will protect only those blossoms that are open when the application is made, and strep will not redistribute after sprays have dried. Thus, protection from strep sprays can be optimized by making applications just prior to wetting events so that all open blossoms are protected during the actual infection event.

Two different fire blight forecast models, MaryBlytTM and Cougarblight 2010, can be used to predict fire blight risk and assist in timing strep sprays. For Cougarblight predictions, consult the NEWA disease forecasting webpage (newa.nrcc.cornell.edu/ newaModel/ apple_disease). This disease forecast system provides disease prediction information updated on an hourly basis. The MaryBlytTM model can be downloaded to any computer with the Windows operating system from the following website: www.caf.wvu.edu/Kearneysville/ Maryblyt/. Attempting to time strep sprays without using one of these models will often result in control failures.

If one cannot access spray timing information from one of the blossom blight models, then at-risk orchards should be protected with streptomycin if weather has been relatively warm since full pink AND forecasts indicate the probability of rain or showers in the next 24 hr at temperatures greater than 60°F. A program to initiate spraying once 200 degree hours (base 65°F) have accumulated since full pink (first open blossom in the orchard) has proven effective in several locations and should serve as an approximate guideline. [Example: To calculate degree hours for a particular day, assume 6 hr at the low, and 12 hr at the average of the two. Thus, for a day with a high of 80°F, a low of 60°F, and the average of 70°F, the of accumulated degree hours can be calculated as: 6 hr x 15 degrees above 65 for the high + 6 hr x 0 degrees above 65 for the low + 12 hr x 5 degrees above 65 for the average, or 90 + 0 + 60 = 150 accumulated degree hours]. Thus, once 200 or more degree hours have accumulated, strep should be sprayed before the next forecasted rain, providing that temperatures are 60°F or higher.

The need for additional streptomycin treatments should be determined by continuing to monitor weather conditions carefully (i.e., model outputs or degree hour and heat unit accumulation following treatment) so long as any open blossoms remain on trees. On the NEWA Cougarblight model webpage it is possible to enter the streptomycin treatment date to re-set the model to calculate the need for additional treatment. This monitoring is particularly critical during hot weather at mid-bloom where flowers may open following streptomycin application and enough heat units are accumulated to put theses newly opened blossoms at risk for infection within a day or two of the previous strep spray. In these instances, streptomycin should be reapplied to protect newly opened blossoms before the next rain occurs. However, streptomycin can provide control if applied within 24 hr after a wetting event begins. Antibacterial activity depends upon absorption by the blossoms; therefore, streptomycin must dry on the trees to be effective. Thorough coverage is essential for control. Alternate row spraying is not recommended with streptomycin, but if it is used the rates applied per acre must be the same as for every-row applications. The application of streptomycin at concentrations greater than 6X has been associated with reduced levels of control and is therefore, not recommended. Refer also to [8.5] and [8.7].

For at-risk orchards, consider including streptomycin in the petal fall spray if trees still have any open flowers, or if no strep spray was applied within the previous 3-4 days and the degree hours over 65° either currently exceed or are expected to exceed 145 (= a MaryBlyt EIP of 75) within the next few days. The objective of including strep in the petal fall spray is to protect the lingering bloom that is especially prevalent in young high-density orchards. Alternatively, one could continue applying strep with timings suggested by the MaryBlyt or Cougarblight models to protect late flowers during the interval after 50-80% petal fall, and using these models to time strep sprays after petal fall can be especially important if flowers linger for more than a few days after petal fall and for newly planted trees that will tend to bloom later than established trees.

We no longer recommend streptomycin sprays at 4 oz/100 gal under any circumstances because field observations suggest that this low rate can lead to incomplete control in cases where some flowers receive less than optimum coverage due to imperfect spray distribution. Therefore, all applications of streptomycin should be at 8 oz/100 gal of dilute spray or at 1.5 lb/A for trees that require 300 gal/A for complete coverage. Where rates are calculated using tree-row volume, the minimum Amt/A for strep applied with an airblast sprayer is 12 oz/A even if tree-row volume calculations would suggest a lower rate.

Regulaid at 1 pt/100 gal (or another adjuvant that enhances uptake) should be applied with streptomycin when sprays are applied under rapid drying conditions, but Regulaid should be omitted if sprays are applied under slow drying conditions or when strep is being applied for the second or third time prior to petal fall. Repeated use of streptomycin plus Regulaid over a short time interval may result in excessive yellowing of young leaves and leaf margins. Regulaid should always be included with streptomycin in the petal fall application so as to enhance uptake into clusters and young terminal shoots. Streptomycin should NEVER be applied when there are no blossoms on the trees except when orchards with visible fire blight have been damaged by hail (see [8.5]).

[8.4] Copper applied at green tip will not eliminate the need for streptomycin at bloom. However, it is effective in reducing the population of overwintering fire blight bacteria and is a useful component of an overall fire blight control program. Thorough coverage of the entire tree is necessary for maximum effectiveness, so dilute or high gallonage sprays are preferred. This is also an effective scab spray, but is likely to cause injury if applied beyond 1/4-inch to 1/2-inch green. The oil should be added at a rate of

1 qt per 100 gal of actual spray solution in the tank (i.e., do not concentrate the oil). Oil is added to increase efficiency of the copper, but will not control mites when applied at this time and rate. If using Bordeaux mix, prepare as described in the section "Fungicides." Add the oil after adding lime, but before making the mix up to final volume. Several other commercial copper formulations in addition to those listed are labeled for this use on apples. Although they have not been tested, research on other crops suggests that most copper formulations should give comparable rates of control at comparable rates of metallic copper.

[8.5] To reduce the chance of developing resistance, the routine use of streptomycin to control the spread of shoot infections is discouraged. However, an application of streptomycin is recommended following a hailstorm in fire blight-affected orchards, provided that such a spray can be applied without violating the preharvest interval. This application may be critical if even moderate amounts of blight were present before the storm. Sprays should be completed within 24 hr after the start of the hail.

[8.6] Apogee is a growth regulator that has given good control of fire blight infection of shoots, but is ineffective for control of blossom infections. Apogee should be applied in late bloom or early petal fall (when shoots are 1-3 inches long) at 6-12 oz/ 100 gal, with a second application 3-4 weeks later (Important: see recommendation and comments under "Growth Regulator Uses in Apples" section for more information about Apogee and water quality requirements). Because Apogee has no effect on preventing or slowing fire blight infections for at least 10 days after application, the need for application must be determined prior to the appearance of fire blight symptoms in the orchard. The need for application should be based upon the number of fire blight infection periods that occur during bloom and the severity of fire blight the previous season, as well as the susceptibility of the scion variety and rootstock. If Apogee is to be applied to trees less than 5 years old, the rate of application should be reduced to 3-6 oz/100 gal, and the grower must balance the benefit of shoot blight control against the drawback of reduced shoot growth. Apogee may affect thinning programs (see "Growth Regulator Uses in Apples").

[8.7] Serenade can be integrated into a fire blight control program, but it has been consistently less effective than streptomycin. Therefore, Serenade should be used only in rotational programs with streptomycin and not as the sole bactericide for fire blight management. Research at Geneva suggests that streptomycin should be the first product applied during bloom, particularly when conditions are very favorable for the development of fire blight. Serenade should be applied 24 hr after the infection event.

[8.8] Bloomtime Biological can be included in the fire blight control program for blossom blight. This biopesticide is consistently less effective than streptomycin, but may be a viable option in orchards with low levels of fire blight inoculum and during environmental conditions indicative of a low risk of infection. Research conducted in New England suggests that this product can provide up to 50% control when applied during bloom compared to streptomycin. In contrast to Serenade, (see above) this material should be applied prior to infection events.

[8.9] Mycoshield is registered for fire blight and can be included in the management program for blossom blight. This antibiotic is consistently less effective than streptomycin, but may be viable option as a resistance management tool when used in rotation with streptomycin. Use primarily in orchards with low levels of fire blight inoculum. Research conducted in New England suggests that this product may only provide up to 50% control when applied during bloom compared to streptomycin.

[8.10] The recommended action plan for fire blight management in New England is as follows: All fire blight cankers should be removed during winter pruning. Copper applications should be made at green tip. NEWA (newa.cornell.ecu) warnings of fire blight infection periods should be heeded, and recommended materials sprayed promptly. Prohexadione-Calcium (Apogee) sprays should be used at high rate, applied at 2-3 inches shoot growth. Fire blight strikes should be pruned out promptly and destroyed. If severe blossom blight occurs contact CCE for SR Ea testing. In all regions of New England the following action plan is recommended for newly planted orchards:

1. If possible, plant varieties grafted on fire blight-resistant rootstocks.
2. Trees should be carefully examined for fire blight infections before planting. Infected trees should be discarded. Samples should be submitted for strep-resistance testing.
3. Immediately after planting a copper spray should be applied. Wait until to the soil has settled to avoid phytoxicity issues.
4. Planting should be scouted at 7-day intervals for fire blight strikes until June 30. Infected tree should be removed. Plantings also need to be scouted 7-10 days after hail or severe summer storms and at the end of the season (mid-September). The NEWA/NRCC disease forecasting models for fire blight (newa.nrcc.cornell.edu/ newaModel/apple_disease) can assist by providing an estimate of symptom emergence following a storm or other trauma event.
5. If possible, remove flowers before they open. Since most new plantings have many blossoms the first year, and many orchards are high density (i.e. 1000-2000 trees per acre), blossom removal may not be possible. If practiced, the blossoms should be removed before there is a high risk of FB infection.
6. Apply copper, tank mix of streptomycin and oxytetracycline at the full label rate for each during any remaining bloom based on blossom blight predictions. The NEWA/NRCC disease forecasting models for fire blight (newa.nrcc.cornell.edu/ newaModel/apple_disease) will run nearly until August, and have an adjustable bloom date to account asynchronous or late bloom in new plantings.
7. Trees should receive a second copper spray at a stage equivalent to bloom. 48 hours REI before blossom removal.

8. Samples of any infections seen after planting should be submitted for streptomycin resistance testing.

11.2.9 Powdery Mildew

• Biology & Cultural

Powdery mildew survives the winter in vegetative or fruit buds that were infected the previous season. Winter temperatures below -11°F can kill the mycelium in the buds and temperatures below -24°F can kill many of the infected buds, thereby reducing overwintering infections and inoculum potential for the next growing season. Baldwin, Cortland, Crispin, Gala, Ginger Gold, Honeycrisp, Idared, Jonathan, Monroe, Paulared, and Rome are highly susceptible varieties. Other less-susceptible varieties may also become seriously diseased in certain years, particularly if planted near trees where mildew is not well controlled. Rain is not necessary for infection to occur; therefore, mildew sprays must be maintained even during prolonged dry spells when scab sprays aren't necessary. Mildew develops slowly at temperatures below 50°F so mildew sprays are relatively unimportant until temperatures regularly exceed this level. Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[2.12] Apple scab and powdery mildew resistance to Topsin M and Thiophanate-methyl may occur throughout New England. Once resistance develops it will persist indefinitely. Thus, these products should NOT be relied upon for apple scab or mildew control in orchards or regions with a long history of use.

[9.3] JMS Stylet Oil also provides mite control but has incompatibility problems with several other pesticides, including captan and sulfur. Refer to label for specific restrictions.

[9.4] Do not delay powdery mildew applications beyond pink.

11.2.10 Sooty Blotch and Fly Speck

• Biology & Cultural

Sooty blotch and fly speck develop gradually during periods of very high humidity; thus they are favored by frequent showers, prolonged cloudy weather, poor air circulation, dense tree canopies, and clustered fruit. These diseases are particularly damaging when rainy weather persists through summer and allows repeated cycles of secondary spread. Inoculum for sooty blotch and flyspeck often comes from alternate hosts in adjacent woods and hedgerows, such as trees, shrubs, vines, particularly wild brambles. Removal of these plants to whatever extent possible (e.g., bush-hogging fencerows or ditchbanks) will aid in disease control. Summer pruning, which increases air movement through the tree canopy, also aids in control of these diseases. After spores land on unprotected fruit, approximately 200 hr of accumulated wetting (as recorded on NEWA stations are required before flyspeck and sooty blotch will become evident on fruit. Note that older data suggested that 270 hr of accumulated wetting was required before disease became evident on fruit, but the 270 hr was for wetting periods recorded with string recorders. The electronic recorders used on NEWA stations are slightly less sensitive to dews and marginal wettings, so the appropriate thresholds for completion of the incubation period are 200 hr (electronic) or 270 hr (string) of accumulated wetting. Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[2.14] Fungicide resistance to Sovran, Cabrio, and Flint is begining to develop in the Northeastern US. The primary strategies for reducing this risk of resistance are to rotate the strobilurins with unrelated fungicides, to limit the number of seasonal applications of strobilurin fungicides (e.g., 3-4 per year), and to tank mix strobilurins with captan when treating trees with visible scab lesions.

[2.8] It is illegal to use the 6 lb/A rate of the EBDC fungicides after bloom. It also is illegal to use the reduced rate (3 lb/A) after bloom if the rate for any of the sprays prior to petal fall exceeded 3 lb/A.

[10.1] Sooty blotch and fly speck develop gradually during periods of very high humidity; thus they are favored by frequent showers, prolonged cloudy weather, poor air circulation, dense tree canopies, and clustered fruit. These diseases are particularly damaging when rainy weather persists through summer and allows repeated cycles of secondary spread. Inoculum for sooty blotch and flyspeck often comes from alternate hosts in adjacent woods and hedgerows, such as trees, shrubs, vines, particularly wild brambles. Removal of these plants to whatever extent possible (e.g., bush-hogging fencerows or ditchbanks) will aid in disease control. Summer pruning, which increases air movement through the tree canopy, also aids in control of these diseases. After spores land on unprotected fruit, 270 hr of accumulated wetting are required before flyspeck will become evident on fruit. Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

[10.2] Ascospores of the flyspeck fungus can be blown into orchards beginning near petal fall, but fungicides applied for scab control are usually adequate to control these early season infections. The real risk of flyspeck infection escalates when secondary spores become available in woodlots and hedgerows. This occurs after approximately 270 hours of accumulated wetting (rains and dew periods) counting from petal fall. Topsin M, Sovran, Flint, Inspire Super, and Pristine all arrest development of flyspeck infections on fruit if they are applied after infections have occurred, but the infections resume growing after fungicide residues are depleted. Applications of Topsin M, Sovran, Flint, Inspire Super, or Pristine should then be renewed at 14-21 day intervals. If all fungicide coverage is removed by heavy rains (> 3 inches after the last spray) during late August or early September, a late-

season spray may be needed to control disease on cultivars that will not be harvested within 25-30 days after fungicide coverage is depleted. Effectiveness of late-season sprays is largely dependent on spray coverage within the tree.

11.3 Apple Insect and Mite Notes

11.3.1 American Plum Borer

• Pesticide Application Notes

[17.1] One coarse spray of Lorsban to trunk burr knots between half-inch green and petal fall. Alternatively, if fresh borer activity is noted in early July, apply one spray of Lorsban in early July. Only 1 application of any chlorpyrifos material allowed per year in apples. PHI = 28 days.

[17.2] One coarse spray of Assail to trunk between pink and mid-June. If fresh borer activity is noted in early July, follow up with one additional spray of Assail before early August.

11.3.2 Apple Aphid, Spirea Aphid

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[11.1] Suggested action threshold: 30-40% of all terminals infested, OR 50% or more of the terminals with at least 1 aphid and less than 20% of the terminals with predators, OR 10% of fruit with honeydew or aphids.

[11.1a] Multiple applications of *Agri-Flex or Voliam Flexi in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. of thiamethoxam containing products per acre per growing season.

[11.1c] *Danitol will also provide suppression of European red mite.

[11.1d] Movento must be used with a spray adjuvant that has spreading and penetrating properties.

[11.1e] *Vydate applied in the summer against leafminer will also control apple aphid.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

11.3.3 Apple Maggot

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and Sampling Guide containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1] *Asana and *Warrior applied against other pests during this period will also control apple maggot. Suggested action threshold: capture of 1 fly on red sphere trap hung in block, or of 5 flies on red sphere baited with apple volatiles.

[12.1a] 2-4 sprays at 14-day intervals beginning late June to early July.

[12.1b] *Danitol will also provide suppression of European red mite.

[12.1c] Protective sprays at 7-day intervals beginning late June to early July.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[12.2] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

11.3.4 Apple Rust Mite

• Biology & Cultural

Occurs from late June to harvest, particularly on varieties with pubescent leaves; does not generally coincide with high red mite populations, as feeding tends to condition foliage to be less suitable for red mite development. Low numbers are valuable as prey for predator mites. Injury is a yellowish browning of leaves or white blotches on upper leaf surfaces.

• Pesticide Application Notes

[13.2] Use a maximum of 2 miticide applications per season; Suggested action threshold: >200 mites/leaf.

11.3.5 Climbing Cutworms: Darksided, Dingy, Mottled, Spotted, Variegated

• Pesticide Application Notes

[16.2] Apply spray when migrating larvae, or shoot or fruit injury, are first observed, usually in August. Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[16.2a] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

11.3.6 Codling Moth

• Biology & Cultural

Refer to the reference materials list at the end of this publication for Fact Sheets containing details on the biology and management of codling moth and oriental fruit moth.

• Monitoring & Forecasting

Control of 1st generation oriental fruit moth larvae generally coincides with the petal fall application window. Sprays against the summer generations of oriental fruit moth should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45°F) after the respective first sustained adult catches of the 2nd and 3rd broods, with follow-up applications on a 10–14-day interval. For orchards not receiving regular apple maggot sprays, or where codling moth is otherwise a significant problem, a developmental model predicts the appropriate larval treatment period for CM as 250-360 degree-days (base 50°F) after 1st adult catch for each generation, and approximately 150 DD after this same biofix date for insecticides with ovicidal activity. Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of these pests in your specific location.

• Biological & Non-chemical Control

Better control of target species is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Products directed against oriental fruit moth (Checkmate OFM-F, Isomate-M 100) are additionally active against lesser appleworm. Combination products (Checkmate CM-OFM Duel, Isomate-CM/OFM TT) are active against the above species as well as codling moth. The need for re-application depends on residual field life of specific formulations: Isomate-M 100, 90 days; Checkmate OFM-F and CM-F, 14-21 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.2] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth.

[14.1] For orchards not receiving regular apple maggot sprays, or where codling moth is otherwise a significant problem, a developmental model predicts the appropriate larval treatment period for CM as 250-360 degree-days (base 50°F) after 1st adult catch for each generation, and approximately 150 DD after this same biofix date for insecticides with ovicidal activity. Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of these pests in your specific location.

[14.2] Better control of target species is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Combination products (Checkmate CM-OFM Duel, Isomate-CM/OFM TT) are active against the above species as well as codling moth. The need for re-application depends on residual field life; for Checkmate OFM-F and CM-F, 14-21 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

[14.3] *Asana or *Warrior applied during this period will also provide control of these pests, as will a spray program as noted for apple maggot. Suggested action threshold: Avg. of >5 CM adults/week caught per pheromone trap once 150-360 DD (base 50°F) have accumulated since biofix; see [14.1].

[14.3a] Altacor, Avaunt and Assail applied at this time will also control European apple sawfly; Avaunt will control plum curculio.

[14.3b] Altacor and Intrepid provide only suppression of codling moth.

[14.3c] Use of a non-ionic surfactant is recommended with Assail.

[14.3e] Calypso, Dipel, and Imidan not registered for lesser appleworm.

[14.3f] §Carpovirusine and §Cyd-X labeled for use against codling moth only.

[14.3g] *Lannate not registered for oriental fruit moth.

[14.3h] *Proclaim used against codling moth should be applied at egg hatch and may be followed up with a second application in 7-14 days.

[14.3i] Rimon is limited to 1 application per season.

[14.3j] Use Sevin for codling moth and lesser appleworm; do not use within 30 days of full bloom unless fruit thinning is desired.

[14.3k] Do not exceed 0.172 lb a.i./A of thiamethoxam- containing products per acre per growing season.

11.3.7 Comstock Mealybug

• Biology & Cultural

This pest problem is apparently encouraged by excessive use of synthetic pyrethroids (more than 2 applications/season).

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[15.2a] One spray advised against newly emerged crawlers, usually in late May (petal fall period). In severe cases, sprays against the 2nd generation may also be elected.

[15.2b] Movento must be used with a spray adjuvant having spreading and penetrating properties.

[15.3a] Spray when crawlers 1st appear in summer, usually early Aug., and a 2nd spray 7-10 days later.

[15.3b] Actara applied against other pests at this time will provide control of Comstock mealybug.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

11.3.8 Dogwood Borer

• Biology & Cultural

Refer to the reference materials list at the end of this publication for Fact Sheets containing details on the biology and management of these pests. American plum borer can be a problem particularly in orchards adjacent to stone fruit plantings.

• Pesticide Application Notes

[17.1] One coarse spray of Lorsban to trunk burr knots between half-inch green and petal fall. Alternatively, if fresh borer activity is noted in early July, apply one spray of Lorsban in early July. Only 1 application of any chlorpyrifos material allowed per year in apples. PHI = 28 days.

[17.2] One coarse spray of Assail to trunk between pink and mid-June. If fresh borer activity is noted in early July, follow up with one additional spray of Assail before early August.

11.3.9 European Apple Sawfly

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[18.1] Particularly a problem in northern New England; 1 spray at petal fall. Suggested action threshold: Cumulative capture of 3 adults/trap by 90% petal fall if no insecticide was applied at pink, or of 6 adults if an insecticide was applied at pink (white sticky-board trap).

[18.1a] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[18.2a] Actara, Avaunt, Calypso and Lorsban will also control plum curculio when applied at this time.

11.3.10 European Corn Borer

• Biology & Cultural

Control of broadleaf weeds under trees is important.

• Pesticide Application Notes

[19.2] 1st generation spray: when migrating larvae, or shoot or fruit injury are first observed, usually in mid-June; 2nd generation: when larvae or injury to shoots or fruit is observed, usually in August. Be sure to note PHI limitations.

11.3.11 European Fruit Lecanium

• Pesticide Application Notes

[20.2] Oil is recommended at the 2-3 gal rate during the dormant period. This spray will also control European fruit lecanium.

11.3.12 European Red Mite

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and other resources containing details on the biology and management of this pest.

• Biological & Non-chemical Control

The predaceous mite, *Typhlodromus pyri*, which is native to apple production regions in western N.Y., can successfully control populations of European red mite in commercial apple orchards so that no applications of miticides are required for seasonal control when selective pesticide programs are followed. Refer to Tables 6.1.2 and 7.1.2 for ratings of pesticide effects on predatory mites, and to IPM Pub. No. 215 (*Achieving Biological Control of European Red Mite in Northeast Apples: An Implementation Guide for Growers*) for guidelines to implementing this approach.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[20.2] Oil is recommended at the 2-3 gal rate during the dormant period. This spray will also control European fruit lecanium.

[20.3] Good coverage is essential. Phytotoxicity from oil is more likely if sprays are concentrated more than 3X.

[20.4] Use 2 gal rate until tight cluster; reduce to 1 gal from tight cluster to pink. Good coverage is essential (300 gal/A recommended). San Jose scale, lecanium scale, and red bug are also controlled. See the "Acaricides" section of Fruit Crop Protectants for information on mixing and compatibility with fungicides. Suggested action threshold: 10% of spurs with eggs.

[20.5] One spray of Zeal, Apollo, Onager or Savey no later than pink bud stage (and at pink only if no spray was applied earlier) to control newly hatching larvae, in enough water to obtain adequate coverage; best efficacy is achieved when application is made as late as possible before bloom.

[20.5a] The rate of formulated Apollo in finish spray solution should be 4-8 oz per acre.

[20.5b] Zeal, Onager and Savey limited to 1 application per season.

[20.6] Tank mixing Apollo or Savey with oil at tight cluster can extend period of residual efficacy in the summer.

[20.7a] *Vydate may provide some mite suppression at pink; effective also on leafminer larvae and rosy apple aphid. Complete coverage of all leaf surfaces is required for best results.

[20.8] *Agri-Mek, *Agri-Flex, and *Gladiator can be used to control mites anytime from petal fall to about 4 weeks afterward, but is most effective when applied before foliage begins to harden off, generally within the first 2 weeks after petal fall. Must be applied in combination with a horticultural spray oil (not a dormant oil).

[20.9] Treatment generally not recommended at petal fall unless all previous sprays were either omitted or completely ineffective. Suggested action threshold: 1 mite/leaf or 30% of leaves with one or more mites. See Tables 6.1.2 and 7.1.2 for information about effects of pesticides on predatory mites.

[20.9a] Acramite, Zeal,Nexter, and Portal limited to 1 application per season.

[20.9b] Kanemite limited to a maximum of 2 applications per season.

[20.11] If oil is not to be used during the summer, 1 application of Acramite, Apollo, Kanemite, Nexter, Onager, Portal, Savey, Zeal or *Vendex at 1st to 2nd cover, as needed. Suggested action threshold: refer to Figs. 7.1.4-7.1.6 for appropriate (date-dependent) threshold and sampling procedure.

[20.11a] Apollo, Onager and Savey are primarily ovicides that will not directly reduce adult mite numbers.

[20.11c] For *Vendex, a 2nd application may be elected 10-14 days later (or, for Kanemite, 21 days later), as needed.

11.3.13 Green Fruitworms

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[21.1] Growers can usually wait until petal fall to assess the need for this treatment. Suggested action threshold: 3 larvae/tree on standard-size tree (27-40 trees/A); 1 larva/tree at density of 140 trees/A (semi-dwarf planting), lower for more closely spaced plantings.

[21.1a] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[21.1b] It is recommended that pyrethroids not be used more than 1-2 times/season in any orchard.

[21.1d] Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

11.3.14 Japanese Beetle

• Biology & Cultural

Adults emerge from the soil between early July and mid-August to feed on numerous trees and shrubs. In apple trees, beetles devour the tissue between the veins, leaving a lace-like skeleton. Severely injured leaves turn brown and often drop. Adults are most active during the warmest parts of the day and prefer to feed on plants that are fully exposed to the sun.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[22.2] Although pheromone traps are available and can be hung in the orchard in early July to detect the beetles' presence, they are generally NOT effective at trapping out the beetles. Fruit and foliage may be protected from damage by applying protective sprays; repeated applications may be required.

11.3.15 Lesser Appleworm

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are

present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[14.1a] Control of 1st generation oriental fruit moth larvae generally coincides with the petal fall application window. Sprays against the summer generations of oriental fruit moth should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45°F) after the respective first sustained adult catches of the 2nd and 3rd broods, with follow-up applications on a 10–14-day interval. Sprays against oriental fruit moth should generally also provide control of lesser appleworm.

[14.2] Better control of target species is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Products directed against oriental fruit moth (Checkmate OFM-F, Isomate OFM TT) are incidentally active against lesser appleworm. Combination products (Checkmate CM-OFM Duel, Isomate-CM/OFM TT) are active against the above species as well as codling moth. The need for re-application depends on residual field life; for Checkmate OFM-F and CM-F, 14-21 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

[14.3a] Altacor, Avaunt and Assail applied at this time will also control European apple sawfly; Avaunt will control plum curculio.

[14.3b] Altacor and Intrepid provide only suppression of codling moth

[14.3c] Use of a non-ionic surfactant is recommended with Assail.

[14.3i] Rimon is limited to 1 application per season.

[14.3j] Use Sevin for codling moth and lesser appleworm; do not use within 30 days of full bloom unless fruit thinning is desired.

[14.3k] Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

11.3.16 Mullein Plant Bug

• Biology & Cultural

Although predaceous on aphids and mites, nymphs occasionally damage fruit by feeding on flowers or young fruitlets. Damage appears as raised corky lesions and, in severe cases, fruit deformities. Most problematic in Red and Golden Delicious, Northern Spy, Empire and Spartan varieties.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Monitoring & Forecasting

During bloom, tap 2 yr-old flower-bearing shoots over a black beating tray, especially in problem spots and those in proximity to areas containing mullein and evening primrose. Suggested action threshold: 10 nymphs per 40 limbs (4 on each of 10 trees). High populations can also be predicted from pheromone trap catches the preceding fall (more than 6/trap/day any time after Sept. 1).

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[23.3] Susceptible to most insecticides applied at petal fall, but much damage has usually occurred by then. *Asana or Lorsban applied at pink against other pests will provide incidental control.

[23.3a] Actara will also control spotted tentiform leafminer, rosy apple aphid and tarnished plant bug when applied at this time; Multiple applications of Actara in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. of thiamethoxam containing products per acre per growing season.

[23.3b] Calypso will also control rosy apple aphid, spotted tentiform leafminer, 1st generation oriental fruit moth, and will suppress San Jose scale.

[23.3c] Assail will also control codling moth, European apple sawfly, rosy apple aphid, leafminers, and leafhoppers. Do not spray when bees are actively visiting the area.

11.3.17 Obliquebanded Leafroller

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and Sampling Guide containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[14.3i] Rimon is limited to 1 application per season.

[24.1] B.t. materials are most effective against smaller larvae.

[24.2] Spray at petal fall to control overwintered larvae. Suggested action threshold: 3% infested tips (clusters and terminals); refer to Fig. 7.1.2 for sampling procedure.

[24.2a] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[24.2c] *Lannate will also control white apple leafhopper.

[24.2d] *Danitol will also provide suppression of European red mite.

[24.2e] Addition of a penetrating surfactant will improve efficacy of *Proclaim; application at petal fall will also control spotted tentiform leafminer. *Proclaim use limited to 4.8 oz/A of formulated product per season.

[24.3] Suggested action threshold for summer brood larvae: 3% infested terminals, refer to Fig. 7.1.2 for sampling procedure.

[24.3a] For Bt products, greater efficacy against summer brood larvae has been shown with 2-4 sprays at the low rate on a 7-day interval, starting 10-12 days after first adult catch.

[24.3b] 2-3 sprays, 10-14 days apart, against larvae, starting 360 DD (base 43°F) after 1st adult trap catch.

[24.3c] It is recommended that pyrethroids not be applied more than 1-2 times/season in any orchard.

[24.3d] Use high rate of *Asana in problem orchards.

[24.4] Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

11.3.18 Oriental Fruit Moth

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[14.1] For orchards not receiving regular apple maggot sprays, or where codling moth is otherwise a significant problem, a developmental model predicts the appropriate larval treatment period for CM as 250-360 degree-days (base 50°F) after 1st adult catch for each generation, and approximately 150 DD after this same biofix date for insecticides with ovicidal activity. Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of these pests in your specific location.

[14.1a] Control of 1st generation oriental fruit moth larvae generally coincides with the petal fall application window. Sprays against the summer generations of oriental fruit moth should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45°F) after the respective first sustained adult catches of the 2nd and 3rd broods, with follow-up applications on a 10–14-day interval. Sprays against oriental fruit moth should generally also provide control of lesser appleworm.

[14.2] Better control of target species is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Products directed against oriental fruit moth (Checkmate OFM-F, Isomate OFM TT) are incidentally active against lesser appleworm. Combination products (Checkmate CM-OFM Duel, Isomate-CM/OFM TT) are active against the above species as well as codling moth. The need for re-application depends on residual field life; for Checkmate OFM-F and CM-F, 14-21 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

[14.3] *Asana or *Warrior applied during this period will also provide control of these pests, as will a spray program as noted for apple maggot. Suggested action threshold: Avg. of >5 CM adults/week caught per pheromone trap once 150-360 DD (base 50°F) have accumulated since biofix; see [14.1].

[14.3a] Altacor, Avaunt and Assail applied at this time will also control European apple sawfly; Avaunt will control plum curculio.

[14.3b] Altacor and Intrepid provide only suppression of codling moth.

[14.3c] Use of a non-ionic surfactant is recommended with Assail.

[14.3i] Rimon is limited to 1 application per season.

[14.3k] Do not exceed 0.172 lb a.i./A of thiamethoxam- containing products per acre per growing season.

11.3.19 Oystershell Scale

• Pesticide Application Notes

[25.1] Apply sprays at petal fall and 1st cover. Be aware of Sevin's fruit-thinning effects.

11.3.20 Plum Curculio

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring & Forecasting

Because the length of plum curculio's immigration and oviposition period is affected by weather patterns after petal fall, spray coverage should be maintained until 308 DD (base 50°F) from petal fall. Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of

active ingredients and modes of action contained in the product.

[12.2] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth.

[26.2] Petal fall and 1st cover sprays in Western New England; petal fall, 1st and 2nd cover sprays in Eastern New England and problem areas in Western New England.

[26.4a] Actara, Avaunt, Calypso, and Imidan will also control European apple sawfly when applied at this time;

[26.4b] Multiple applications of Actara, *Agri-Flex or Voliam Flexi in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. of thiamethoxam containing products per acre per growing season.

[26.4c] Do not use Sevin within 30 days of full bloom unless fruit thinning is desired.

11.3.21 Redbanded Leafroller

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[14.3i] Rimon is limited to 1 application per season.

[24.1] B.t. materials are most effective against smaller larvae.

[27.1] Sprays effective against adults during 1/2-inch green and larvae at petal fall and 1st cover. 3 applications advised in problem orchards not receiving summer applications of effective insecticides for other pests, starting in early June and at 12- to 14-day intervals to control second brood. Suggested action threshold: 2-3 larvae/tree.

[27.2] Control is obtained from sprays applied at petal fall and 1st cover. 3 applications advised in problem orchards not receiving summer applications of effective insecticides for other pests, starting in early June and at 12- to 14-day intervals to control second brood. Suggested action threshold: 2-3 larvae/tree.

11.3.22 Rosy Apple Aphid

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and Sampling Guide containing details on the biology and management of this pest.

• Monitoring & Forecasting

Examine fruit clusters at the pink stage for the presence of wingless adults and nymphs. Suggested action threshold: one infested cluster.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[28.2] Research indicates greater effectiveness if control applied no later than pink bud; difficult to control after pink, as most damage has already occurred by this time. Good coverage is required for adequate control. Pyrethroids will provide effective control at pink, but because of their toxicity to predatory mites, they are not recommended unless treatment is also required to control spotted tentiform leafminer and tarnished plant bug at this time. Suggested action threshold: 1 colony/100 fruit clusters.

[28.2a] One spray of Lorsban, even if mixing with oil, or of *Supracide, from green tip to tight cluster.

[28.2b] One spray of Esteem at half-inch green, or one spray of Beleaf from green tip to pink bud.

[28.3a] *Vydate may give some mite suppression when applied at pink. Do not exceed 4 pt *Vydate per acre.

[28.3b] Actara will also control spotted tentiform leafminer, mullein plant bug and tarnished plant bug when applied at pink.

[28.3c] Assail will also control mullein plant bug, spotted tentiform leafminer, 1st generation oriental fruit moth, and will suppress San Jose scale.

[28.4a] Calypso will also control plum curculio.

[28.4b] Movento must be used with a spray adjuvant having spreading and penetrating properties; Movento applied at petal fall to first cover will provide San Jose scale crawler control.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

11.3.23 San Jose Scale

• Biology & Cultural

Pruning to open up canopy is advised.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Monitoring & Forecasting

1st generation crawler emergence starts about 3 wk after petal fall (500 DD base 50°F from March 1, or 310 DD after 1st male catch); 2nd in late July-August (1451 DD from March 1, or 400 DD after 1st male catch of the 2nd generation).

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[29.3] Prebloom sprays more effective if applied dilute, at high volume; for severe infestations, follow up with summer applications of appropriate materials. Suggested action threshold: 3-6 encrusted areas/tree.

[29.4] 2 sprays against first and peak (7-10 days later) crawler activity in both generations. Suggested action threshold: 1-2 crawlers/trap (sticky tape around limb).

[29.4a] The addition of horticultural oil will improve performance of Assail.

[29.4b] Movento must be used with a spray adjuvant having spreading and penetrating properties; most effective when used at petal fall to first cover.

11.3.24 Spotted Tentiform Leafminer, Apple Blotch Leafminer

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and Sampling Guide containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[14.3i] Rimon is limited to 1 application per season.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[30.1] Suggested prebloom action threshold: 2 or more eggs/fruit cluster leaf; refer to Fig. 7.1.1 for sampling procedure.

[30.1a] Pyrethroids will also control rosy apple aphid and tarnished plant bug at pink.

[30.1b] Do not exceed 14.5 oz of *Asana per acre per treatment; *Asana and *Danitol not registered for apple blotch leafminer.

[30.1d] Actara and Avaunt will also control mullein plant bug and tarnished plant bug, and Actara will control rosy apple aphid, when applied at pink.

[30.1e] Improved activity of Delegate may be obtained by addition of an adjuvant such as horticultural mineral oil.

[30.2] Suggested action threshold: against sap-feeding larvae, if mines exceed 1/leaf, or if eggs exceeded 2/leaf at pink. (Refer to Fig. 7.1.3 for sampling procedure.)

[30.2a] Application at petal fall will also control white apple leafhopper.

[30.2b] *Danitol and *Lannate 90SP not labeled for apple blotch leafminer.

[30.2c] Actara, Avaunt and Calypso will also control plum curculio and European apple sawfly when applied at petal fall.

[30.2d] Altacor and Belt will also control codling moth, oriental fruit moth, and obliquebanded leafroller, and Altacor will additionally control European apple sawfly.

[30.3] Suggested action threshold: if 2nd brood sap-feeding mines exceed 2/leaf on mature terminal leaves. Before first tissue-feeding mines appear, examine 10 mature terminal leaves from each of 5 trees. (Refer to Fig. 7.1.7 for sampling procedure).

[30.3a] For 2nd brood: Do not apply *Vydate within 30 days of bloom.

11.3.25 Spotted Wing Drosophila

•Biology & Cultural

This is an exotic species of vinegar fruit fly, a group normally attracted to damaged and rotting fruit. But in contrast to endemic Drosophila fruit flies, it has a serrated ovipositor and will lay eggs in intact ripening fruit on the tree; it is also a pest of berry fruit crops. Originally known from Japan, it has now been found in NY, as well as in nearby states such as New England, PA, NJ, and MI. Refer to the reference materials list (17.4.2, Other References) at the end of this publication for fact sheets containing details on the biology and management of this species.

• Pesticide Application Notes

[31.2] Apply at first signs of adult activity. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations.

[31.2a] Delegate labeled for suppression only.

[31.2b] §Entrust use requires the user to have a copy of the appropriate 2(ee) recommendation in their possession at time of use.

11.3.26 Stink Bugs (including Brown Marmorated Stink Bug)

• Biology & Cultural

A number of native stink bug species can sometimes cause fruit damage in all tree fruits under conditions that are not fully understood. Adult feeding during bloom and shuck split can cause the fruit to abort, and feeding later in the summer can cause a deep catfacing injury such as that caused by tarnished plant bug, or depressed, dimpled, corky or water-soaked areas on the skin. All tree fruits are attacked, especially peaches and apples. Other species of stink bugs are predators. Elimination of alternate host broadleaf weeds, especially legumes, in the orchard will contribute to management efforts. If control is needed, insecticides should be timed to kill immigrating adults as they appear in the orchards to prevent feeding damage and subsequent mating and egglaying.

The brown marmorated stink bug is an invasive species from Asia that was first documented in Allentown, PA in 2001. This insect has spread across a number of eastern US States, and now extends to the west coast as well. It was first documented in NY in the Hudson Valley Region in 2008. Although it can be found throughout NY in and around structures and vehicles, extensive monitoring efforts in 2011 and 2012 have resulted in very few detections in agricultural crops; however, reports of sightings have been increasing. Refer to the reference materials list (17.4.2, Other References) at the end of this publication for fact sheets containing details on the biology and management of brown marmorated stink bug.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.2] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[32.2a] Apply at first signs of infestation; BMSB are very mobile pests, and may reinfest the treated area quickly. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations.

[32.2b] This is a FIFRA Section 2(ee) recommendation for BMSB control; the labeling must be in the possession of the user at the time of pesticide application.

[32.2c] Do not make more than 3 applications per year; do not exceed a maximum of 2.0 lbs active ingredient per year.

11.3.27 Tarnished Plant Bug

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[33.1] Suggested action threshold: 2-3 bleeding sites/10-terminal sample.

[33.1a] One spray advised at tight cluster to petal fall if an unusually high prebloom population is present.

[33.1b] A pyrethroid at pink will also control spotted tentiform leafminer and rosy apple aphid. It is recommended that pyrethroids not be used more than 1-2 times/season in any orchard.

[33.1c] Avaunt will also control mullein plant bug and spotted tentiform leafminer.

[33.1d] Actara and Beleaf will control rosy apple aphid, when applied at pink.

11.3.28 Variegated Leafroller, Sparganothis Fruitworm

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[24.1] B.t. materials are most effective against smaller larvae.

[34.1] Occasionally a problem in southern New England; in July if needed. Suggested action threshold: 3 larvae/tree on standard-size tree (27-40 trees/A); 1 larva/tree at density of 140 trees/A (semi-dwarf planting), lower for more closely-spaced plantings.

[34.1a] Bt products and *Leverage not registered for Sparganothis fruitworm.

11.3.29 White Apple Leafhopper, Potato Leafhopper

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[35.1] At petal fall or as nymphs appear later in summer. Will also control rose leafhopper. Suggested action threshold: average of 1 nymph/leaf.

[35.1a] Do not use Sevin or *Vydate before 2nd cover unless fruit thinning is desired. Sevin not labeled for potato leafhopper.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

[35.1c] Actara, Avaunt and Calypso will also control plum curculio and European apple sawfly when applied at petal fall.

11.3.30 Woolly Apple Aphid

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[29.4b] Movento must be used with a spray adjuvant having spreading and penetrating properties; most effective when used at petal fall to first cover.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

[36.1] In July when small colonies appear on periphery of canopy. Repeat applications may be necessary. Suggested action threshold: as nymphs migrate to terminals.

[36.1a] Use of a non-ionic surfactant or horticultural mineral oil is recommended with Assail.

[36.1b] Do not repeat *Diazinon applications closer than 14 days. Slight russeting may occur on some varieties, such as Golden delicious.

[36.2] Chemigation of Admire Pro into root-zone through low-pressure drip, trickle, micro-sprinkler or equivalent equipment.

11.4 Storage Disorders

11.4.1 Storage Rots

• Pesticide Application Notes

[37.1] Postharvest drench treatment of apples for control of storage rots is not recommend except when fruit must also be treated with diphenylamine (DPA) or calcium chloride. Holding tanks in postharvest drenching equipment must have good agitation to keep fungicides in suspension, and solutions must be replenished regularly as directed on the product labels.

Mertect 340F (thiabendazole) is no longer effective in many storages because strains of *Penicillium expansum* have developed resistance to the thiabendazole-plus-DPA combination. Storage operators who have noted decay problems in recent years should either switch to Penbotec or Scholar for their postharvest treatments, or they should use a mixture of Mertect 340F plus the full label rate of captan.

Penbotec and Scholar are fungicides with modes of action that are different from each other and from that of Mertect 340F. Both of these fungicides are very effective against both blue mold (*P. expansum*) and gray mold (*B. cinerea*). Both are compatible with DPA and calcium chloride. Both are recommended for use as the sole fungicide in postharvest drenches (i.e., they do not need to be combined with captan).

To slow selection of pathogens with resistance to Penbotec and Scholar, it is recommended that storage operators alternate use of these products from one year to the next. Much of the inoculum for *P. expansum* recycles from one year to the next on apple bins. By using Penbotec in one season and Scholar the next (or Scholar the first year and Penbotec the next year), spore populations on bins will not be subjected to selection pressure by the same fungicide in successive years.

Some countries that import apples from the US may not accept fruit treated with Penbotec, Scholar, or Captan. For the latest information on maximum residue levels (MRL's) that have been established in various countries, check the following website: mrldatabase.com.

None of the postharvest treatments will control pinpoint scab, latent bitter rot or black rot infections that are present at harvest, or postharvest decays caused by *Alternaria*.

Chlorinated water can also be used to disinfect fruit after harvest. Numerous commercial formulations of calcium hypochlorite and sodium hypochlorite are available with postharvest labels. However, chlorine only kills spores in the treatment solution and on the fruit surface at the time of treatment. It does not provide any residual protection. *Chlorine is **not** compatible with diphenylamine.* Thus, chlorination is most useful for disinfesting flume water on apple packing lines rather than as postharvest treatment prior to storage. Follow directions on the product label for maintaining appropriate levels of chlorine in treatment solutions.

11.4.2 Storage Scald

• Pesticide Application Notes

[38.1] Active ingredient may vary according to manufacturer: use label instructions to check rate required to obtain desired concentration. See Table 11.5.1 for varietal requirements.

Table 11.5.1 Recommended diphenylamine concentrations for varieties in New England subject to scald.

Variety	Diphenylamine (ppm)	Variety	Diphenylamine (ppm)
Baldwin	1000-1500	Idared	1000
Braeburn	1000	Jonagold	1000
Cortland	2000	McIntosh	1000
Delicious	1000-1500	Mutsu	2000
Empire	1000	Rome	1500
Golden Delicious	1000	Stayman	1500

11.4.3 Senescent Breakdown (McIntosh)

• Pesticide Application Notes

[39.1] The addition of calcium chloride to the postharvest scald and storage rot treatment is effective in reducing McIntosh breakdown. Only calcium chloride that meets Food Chemical Codex specifications can be used in postharvest treatment of apples. Calcium treatment will be of little benefit to apples harvested after the projected optimum harvest date. Fruit injury from calcium chloride has been found to be associated with iron in the solution. Coat steel tanks or use plastic tanks and piping to minimize this problem.

11.5 Notes on Scald Control

11.5.1 Materials

All DPA (diphenylamine) formulations are suspensions and become weaker with use. Replenishment with full-strength material does not replace the DPA removed by the apples. Test kits are available to determine concentrations of make-up material. Do not exceed 30 bins or 750 bushels/100 gal of made-up DPA; empty the reservoir tank and start again with fresh material.

Cartons containing apples that have been treated postharvest with DPA and fungicide must be so labeled.

11.5.2 Application Equipment

Bins of apples are sometimes dipped into a tank containing postharvest preservatives, but more often the bins are moved by conveyors, rollers, or truck bed under a cascade of the preservatives. The bins should be moved slowly under the cascade, with 35-40 gal of preservatives being delivered into each bin. The pump should be sized to deliver 35-40 gal of preservatives/bin at the desired rate of bin movement under the cascade. If stacked bins are moved under the cascade, the top bins should receive 35-40 gal and side nozzles should be positioned to deliver additional gallonage to the lower bins, even though drainage holes are provided in the bin floors. Application equipment is commercially available, but operators usually fabricate their applicators to meet the needs of their own operation. Dirty truckloads should be rinsed with clean water before treatment to minimize the accumulation of dirt in the reservoir tank.

11.5.3 Variety Requirements

Materials and concentrations for the major apple varieties in New England are listed in Table 11.5.1. Important: DPA retards chlorophyll loss in Golden Delicious and, therefore, should not be used unless the apples have developed full yellow color at harvest.

The very low susceptibility of Empire to scald indicates that it can be safely stored without any preservative treatment. However, if preservative treatment is demanded, then use 1000 ppm DPA in the drench solution.

11.6 Growth Regulator Use In Apples

11.6.1 Chemical Thinning

Fruit thinning is a management practice that reduces yield in the current season but results in increased fruit size and also increased return bloom and yield in the next season. Large fruit size is best obtained with consistent cropload reductions each year through chemical thinning. The use of growth regulating chemicals to thin apple trees is not an exact science and each grower must weigh and evaluate the many factors that affect chemical thinning response in deciding on a thinning program. Although the recommendations in this section are based on research and experience, growers are cautioned that their success with chemical thinning depends on many factors and they should use these recommendations only as a guide.

11.6.2 Weather Factors That Affect Thinning Response

Frost. Frost before application of thinners can greatly increase the amount of thinning obtained from chemical thinners. Frost at bloom can damage fruitlets and reduce seed set, which can result in increased natural drop and greater chemical thinning response. Frost can also damage spur leaves, resulting in greater chemical uptake and thus greater thinning response. Wherever flowers and leaves have been damaged by frost, extreme caution should be used with chemical thinners. Typically, lower rates would be used in such cases. Surfactants and oil additives should be avoided following a frost and may cause overthinning.

Sunlight Levels before Application. The amount of sunlight for the 3-5 days preceding application of chemical

thinners may have an important effect on chemical uptake and response. Intense cloudy weather before application of thinners can result in increased chemical uptake and thus the potential for greater thinning response, due to greater succulence of the leaves and a thin wax cuticle. In addition, intense cloudy weather results in reduced carbohydrate supply for fruit growth and reduced fruit growth rate. This results in increased natural drop.

Temperature at Time of Application. The uptake of chemical thinners is greater at higher temperatures than at lower temperatures. The optimum is between 70-80°F. Above 80°F, uptake is substantially greater than below 80°F. The time of day applications are made appears to be unimportant. Applications made in the morning or evening when it is cool have a longer drying time on the leaf, resulting in a slow but sustained uptake of chemical, while at higher temperatures during mid-day, drying times are shorter, resulting in a short but rapid uptake of chemical. Thus, the total amount of chemical taken into the plant appears to be very similar regardless of the time of day. Recent research results also indicate that similar thinning is achieved regardless of the time of day applications are made.

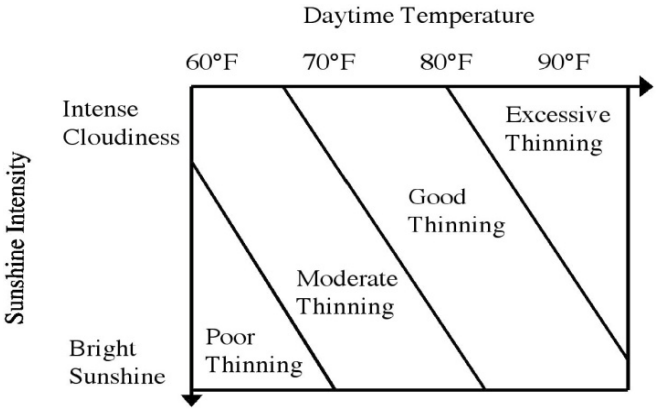

Figure 11.6.1. The interaction of temperature and sunlight intensity on thinner action.

Weather After Application. Temperature and sunlight levels for the 5-day period after application of thinners are the predominant weather factors affecting chemical thinning response. The interaction of temperature and sunlight affect the production and demand for carbohydrates within the tree. Warmer temperatures increase carbohydrate production (photosynthesis) up to about 80F but higher temperatures reduce photosynthesis. The demand for carbohydrate to support fruit growth and shoot growth increases linearly with increasing temperature. Increasing sunlight level increases photosynthesis. The combined effects of sunlight and temperature on chemical thinning are complex but a simplification is presented in Fig. 11.6.1. A more sophisticated estimate of the effects of light intensity and temperature on thinning is given by the Cornell Carbohdyrate thinning model available on the web at www.newa.cornell.edu

Night temperatures are also an important factor to consider. Warm night temperatures greater than 60°F give greater thinning response. With high night temperatures, fruits use up the carbohydrates that were produced during the day at a fast rate, resulting in a deficit of resources for fruit growth and causing the weakest fruits to drop. The greatest thinning can result if warm night temperatures are combined with intense cloudy/warm daytime weather. Under these conditions, the tree produces little reserves during the day and at night the fruits use up all of the reserves produced during the day, making the fruits very susceptible to the stress caused by chemical thinners. Under these conditions, excessive fruit drop can result. The least effective thinning is achieved when bright, warm daytime weather is accompanied by low night temperatures. Under these conditions, the tree produces large amounts of carbohydrates during the day and the fruits use them up at a slow rate during the night. With a large surplus of carbohydrates there is little stress created by chemical thinners and the thinning response is poor. At the time of application of thinnes, growers should critically examine the weather forecast for the upcoming 3-7-day period and adjust rates up or down 50% based on forecasted temperatures and sunlight levels. The Cornell Apple Carbohydrate Thinning Model available on the web at www.newa.cornell.edu is a simple tool that calculates the combined effects of forecasted temperature and sunlight for the upcoming 5 day period on tree carbohydrate balance and recommends an adjustement in thinning rates based on the carbohydrate balance.

11.6.3 Tree Factors That Affect Thinning Response

Pollination. Poor cross-pollination results in low viable seed number per fruit, greater post-bloom fruit drop and greater sensitivity to chemical thinners. In contrast, high seed numbers per fruit result in more difficult-to-thin conditions. In general, if seed numbers are less than 5, thinning rates should be reduced.

Initial Cropload (Fruit Set). A high initial cropload usually results in a relatively high final cropload, regardless of chemical thinning program. Therefore, to achieve a given cropload each year, the initial cropload must be considered when determining the aggressiveness of the thinning program. Growers should use a more aggressive thinning program when initial fruit set is high and a less aggressive thinning program when initial fruit set is lower.

Fruit Size at Time of Application. Fruitlets are more sensitive to NAA and BA at 10-12mm fruit diameter than at smaller or larger sizes. In warm years, when fruit growth rate is rapid, chemical thinners should be applied slightly before fruits reach 10 mm diameter (8-10 mm). In cool years, when fruit growth rate is slow, the application of chemical thinners should be delayed until fruits are 12-15 mm in diameter. Growers should attempt to time chemical

thinner application according to a suitable weather window within the preferred fruit size range.

Sensitivity of the Tree. The internal physiological status of the tree determines its sensitivity to chemical thinners. Growers should use a less aggressive thinning program under conditions when tree carbohydrate supply for the fruitlets is expected to be low, and a more aggressive thinning program when tree carbohydrate supply is expected to be high. The carbohydrate supply available to the fruitlets is a function of temperature and sunlight which affect photosynthesis (supply) and respiration (demand) of fruits and vegetative organs. The carbohydrate supply at the time of thinning is difficult to estimate without the aid of a computer model (developed by Alan Lakso) to calculate carbohydrate supply and demand. This model has been modified into a simple and useful chemical thinning tool for use by growers and consultants in estimating the sensitivity of the tree to chemical thinners. It is available on the web at www.newa.cornell.edu . In addition the sensitivity of a tree is increased by: 1) heavy croploads the previous year. 2) cloudy weather prior to and after application of chemical thinners. 3) heavy insect and disease damage to foliage during the previous season. 4) severe winter temperatures that damage vascular tissues necessary for the transport of reserves from the root to the top in the spring. 5) warm temperatures in late winter and early spring (Feb. 15-April 15), which cause the tree to use its carbohydrate reserves before bloom.

11.6.4 Chemicals Registered for Thinning in New England

Naphthaleneacetic acid (NAA) is an auxin-type growth regulator that induces fruit thinning at rates from 2.5-15 ppm depending on variety. NAA has some thinning activity from full bloom until fruits are 20 mm in diameter, with the optimum thinning activity when fruit diameter is between 10-12mm fruit size. It is sold as a sodium salt (Fruitone-N and Fruitone-L, PoMaxa). The two formulations give very similar thinning responses if used at the same rate of NAA. NAA stimulates ethylene production in the tree and at high concentrations also inhibits photosynthesis and fruit growth rate for a period of 7-10 days after application. The inhibition of fruit growth rate results in abscission of the weaker fruit on the tree. At early timings such as full bloom or petal fall, there appears to be little negative impact on fruit growth rate from NAA, which results in more modest thinning than at later timings (10-12mm). In some years and with some varieties like Empire, the temporary inhibition of fruit growth caused by NAA results in little gain in final fruit size at harvest. This negative side effect is most common if NAA is applied at rates greater than 10 ppm and at fruit sizes larger than 8 mm. High rates of NAA should be avoided on small fruited varieties. High rates of NAA may also cause pygmy fruit with Delicious and Fuji.

Naphthaleneacetamide (NAD or NAAm) is an amide form of NAA but has much lower activity than NAA. As a consequence, it is a mild but safe thinner that is used at rates from 25-50 ppm. Late timings result in pygmy fruit with Delicious, and are ineffective with other varieties. It is often used at petal fall on early ripening varieties and on certain hard-to-thin varieties such as Macoun.

6-Benzyl Adenine (BA) is a cytokinin-type growth regulator that induces fruit thinning at rates from 35-150 ppm. BA can be used from petal fall to 20 mm fruit size, but the thinning response is poor at either end of that window. The best response is when fruits are 10-12 mm in diameter. It is most effective when temperatures are warm (>70°F) for a 3-5-day period after application. It is sold in three formulations as either Maxcel (1.9% BA), or RiteWay (1.9% BA) or Exilis Plus (2.0% BA). The primary advantage of BA is that it results in larger fruit size than with other thinners due to a stimulation of cell division. The primary disadvantage of BA is that it often does not thin adequately by itself. However, when combined with Carbaryl it has performed satisfactorily. In some cases, the use of BA alone has resulted in significant fruit size improvement even though there was little thinning.

Carbaryl is a carbamate insecticide that also has moderate thinning action. It is relatively safe and has the added advantage of having good insecticidal properties on leafhoppers and plum curculio. It is relatively rate-insensitive, with similar thinning response from 0.25 lb up to 1.0 lb A.I./100 gallons. One of its best features is that it selectively removes the weaker fruits within the cluster, leaving predominantly one fruit per cluster. Carbaryl has been shown to enhance the effectiveness of NAA or BA when used in a tank mix. Currently it is most commonly used in combination with NAA or BA. Recent research indicates that the major mite predator mite in N.Y. (*Typhlodromus pyri*) has developed resistance to carbaryl. Thus, Carbaryl can be used in N.Y. without disrupting biological mite control programs. Carbaryl is very toxic to bees and the wettable powder particles of Carbaryl, which are similar in size to pollen grains, can be picked up by bees and carried back to the hive. The liquid formulations of carbaryl are not picked up as easily by bees, so their use is much safer. The liquid formulations have made it possible to apply Carbaryl at a wide range of timings from petal fall to 20 mm fruit size. The liquid formulations of carbaryl have significant amounts of added surfactants and thus have greater thinning activity than the wettable powder formulations. Under cloudy, rainy weather conditions, the liquid formulations may cause fruit skin damage, especially when foliar nutrients or captan are included in the thinning spray. With cloudy, rainy weather, we recommend the wettable powder formulations. With bright sunshine, we recommend the liquid formulations. The wettable powder formulation is also recommended following a frost since the surfactants included in the liquid formulation can cause significantly greater uptake of Carbaryl and overthinning.

***Vydate** is a broad spectrum carbamate insecticide that also has moderate thinning activity. It is similar to carbaryl in

thinning action and is used from 0.25 to 1.0 lb A.I./100 gallons. It is not commonly used in N.Y. for thinning since it is reported to be more toxic to predator mites. However, in pest control programs that do not attempt to conserve predatory mites, *Vydate can be useful as both a thinning agent and a broad spectrum insecticide. Like carbaryl, it is usually combined with NAA and BA for greater thinning.

Ethephon (Ethrel) is a growth regulator that stimulates ethylene production by the plant. It can be used to thin apple trees from full bloom to 20 mm fruit size. Its thinning action is highly affected by temperature and if temperatures in the 3-5 days after application rise above 80F it can give excessive thinning. In some cases it has defruited the trees. Nevertheless, it does have the advantage that it will thin large fruit (up to 20 mm). Ethrel also has a significant positive effect on return bloom in addition to the thinning effect. Ethrel can also be used as a return bloom enhancer after the thinning period is over. For this use, it is applied at low rates after the window for thinning has passed (usually 4-6 weeks after full bloom).

11.6.5 Chemicals Not Registered for Thinning that Influence Cropload

Lime sulfur is a foliar fungicide that, if used during bloom or during the early post-bloom period at rates of 2.5-3 gal/100 gal, will cause significant thinning. Lime sulfur in combination with oil or fish oil is used increasingly in organic apple production systems. Growers who use lime sulfur should account for the thinning action of this material when they develop their thinning programs.

Ammonium Thiosulfate (ATS) is a foliar nitrogen fertilizer that, if used during bloom at rates of 2-4 gal/100 gal, will cause significant thinning. Growers who use ATS should account for the thinning action of this material when they develop their thinning programs.

Oil or Fish oil are foliar insecticides that also significantly enhance chemical thinner response. Combinations of lime sulfur and oil (2%) or carbaryl and oil (0.25%) or BA and carbaryl and oil (0.25%) give greater thinning than either product alone. The use of oils near or with thinners should be considered with caution. They should only be used when leaf tissue is healthy and non-damaged. Oils with thinners should not be combined with Captan fungicide. The oils cause increase uptake of Captan which is toxic to the plant. The use of oils near or with chemical thinners should be avoided before or after a frost since the oil acts as a penetrant and can significantly increase chemical uptake and thinning response.

11.6.6 Spray Timings

Chemical thinning can be done at various times depending on the chemical used, beginning with full bloom and ending when fruits have reached 20 mm in diameter. The following four timing windows during the growing season should be considered when applying thinners.

50-80% Bloom. Bloom thinning can be done with caustic thinning chemicals such as ATS or with hormone-type thinners such as NAA. The timing window with caustic thinners is very narrow (1-2 days) since the goal is to allow the king bloom to be pollinated and then apply the chemical to prevent further pollination of other flowers. Thinning response with the caustic blossom thinners is not weather-dependent, but fruit skin injury can occur with high rates and slow drying conditions. Often a second application is needed 1-2 days after the first application. We suggest timings of 30% bloom for the first spray and 80% bloom for the second spray. Use of NAA at full bloom generally gives a moderate thinning response and is quite safe Bloom thinning is increasingly seen as necessary for biennial bearing varieties like Honeycrisp and for hard to thin varieties like Gala.

Petal Fall (1 week after full bloom). Thinning at petal fall has the advantage of allowing some assessment of pollination before making the decision about aggressiveness of thinning. As with bloom thinning, the objective is to remove a portion of the crop before competition between fruits reduces fruit size. In addition, after petals have fallen and bee hives have been removed from the orchard, Carbaryl can be used as a thinner. Thinning response with NAA, Carbaryl or BA at petal fall is usually moderate, thus the petal fall timing can be viewed as safe. Petal fall sprays alone are unlikely to provide adequately thinning in most years. Petal fall sprays are usually used as part of a multi-spray program, which allows a portion of the crop to be removed at petal fall and the balance of the thinning to be done 7-10 days later at 10-12 mm fruit diameter. Research trials indicate that the best timing for the petal fall spray is about 2-4 days after petal fall when king fruit diameter is about 5-6mm.

8-14 mm fruit size (2-3 weeks after full bloom). The traditional time to apply chemical thinners (hormone-type thinners) is when king fruits are 10 mm in diameter. By that time, growers can accurately assess fruit set. Growers should apply chemical thinners anytime when king fruits are between 10 and 14 mm when there is a satisfactory weather window as outlined above. When king fruit diameter exceeds 15 mm, the effectiveness of NAA and BA declines rapidly. The major disadvantages of waiting until the 10 mm timing is that this limits growers to only one opportunity to reduce cropload, and if poor weather conditions result in poor thinning, then expensive hand thinning will be required. A more successful approach is to use a multiple spray thinning program of which the 10mm spray is key spray.

15-20 mm fruit size (3-4 weeks after full bloom). Thinning when fruits are larger than 15 mm should only be done on an emergency or rescue basis when earlier attempts to reduce cropload have failed. Ethrel with oil, Carbaryl

with oil or BA plus Carbaryl plus oil as an adjuvant can be used for this purpose.

4-7 weeks after full bloom. With some varieties that are strongly biennial in their cropping pattern, an additional 3-4 weekly chemical sprays are useful to enhance repeat bloom the following year without causing additional thinning. This is done once fruitlets have exceeded 20 mm in diameter, when they are less susceptible to chemical thinners. Low doses of Ethephon (Ethrel) or NAA have a positive effect on repeat bloom without causing additional thinning when applied weekly between 4-7 weeks after bloom. This treatment is particularly useful on large-fruited varieties that are biennial. We suggest that NAA be used for varieties ripening in late August or early September while either NAA or Ethrel can be used for varieties ripening in late September or October.

11.6.7 Suggested Strategies for New England Growers

The myriad of possible combinations of chemicals, timings, rates and varieties provides a great number of possible thinning programs for growers. We suggest three basic thinning programs for NE growers:

1. **Single application at 10-14 mm fruit size.** For easy-to-thin varieties like McIntosh, Cortland, Gingergold, Mutsu, Idared and Granny Smith, a single application at the 10-14 mm fruit stage produces reliable results. Our suggested approach is to use Carbaryl at 0.5lb AI/100 and then add either NAA or BA at a rate that fits the variety, fruit set and environmental conditions. See Table 11.6.2 for specific variety recommendations.
2. **Multiple spray applications.** For hard-to-thin varieties like Empire, Gala, Jonamac, Macoun, Spur Delicious, Golden Delicious, Spur Rome, Fuji etc., we recommend multiple applications. With two, three or four opportunities to thin the trees, risks associated with over or under thinning are reduced. For very difficult to thin varieties we suggest growers begin with a Bloom Spray, followed by a Petal Fall Spray and then followed with a third spray at the 10-14 mm stage. A fourth spray, if needed, could be applied at the 15-20 mm stage. For moderately hard to thin varieties we suggest growers begin with a Petal Fall Spray followed by a second spray at the 10-14mm stage. A third spray if needed could be applied at the 15-20mm stage. See Table 11.6.2 for specific recommendations.
3. **Repeat bloom enhancer.** Regardless of the thinning program used, biennial bearing varieties should receive additional sprays of either NAA or Ethrel about 4-7 weeks after bloom to enhance repeat bloom. This program is useful for easy-to-thin biennial triploid varieties such as Jonagold and Mutsu and it is also useful for hard-to-thin, strongly biennial varieties such as Honeycrisp, Fuji and Golden Delicious. We suggest applying 4 weekly sprays of low doses of Ethrel or NAA about 4-7 weeks after bloom. See Table 11.6.2 for specific recommendations.

11.6.8 Summary

- The time of day when thinning applications are made has little effect on thinning response, thus, growers should not be too concerned about the temperature at time of application.
- Dark, cloudy weather for 2 or more days after application of thinners will increase thinning response; therefore, growers should reduce the rate of thinner if intense cloudy weather preceeds or follows application.
- High night temperatures (>60°F) and high day temperatures (>85°F) after application of thinners will increase thinning response; thus, growers should critically examine the weather forecast for the 3-5-day period following application of thinners to adjust rates of chemicals used based on forecasted night and daytime temperatures and sunlight levels. The Cornell Apple Carbohydrate thinning model which is availale in an easy to use tool on the web at www.newa.cornell.edu gives an estimate of the combined effects of temperature and sunlight on thinning efficacy.
- Optimum application timing of chemical thinners is when fruit size is 10-11 mm in warm years and 12-15 mm in cool years.
- Growers should attempt to time chemical thinner applications according to a suitable weather window within the desired fruit size range.
- High rates of NAA reduce fruit growth rate and should be avoided on small-fruited varieties such as Empire, Jonamac and Gala.
- BA alone is a mild thinner and should always be used in combination with carbaryl when thinning is desired.
- Return bloom can be enhanced by late June and early July applications of low doses of Ethrel or NAA.
- To reduce the risk of over thinning or under thinning, a multiple spray program should be employed on hard-to-thin varieties.

Table 11.6.1. Chemicals registered for use in apple thinning in New England.

Timing	Chemical	Commercial Product Name	Typical rates of formulated product/100 gallons based on a full TRV gallonage per acre	Max. rate of formulated product/acre
Bloom	Ammonium Thiosulfate	ATS (foliar nutrient)	2-4 gal	—
	Naphthaleneacetic Acid-Sodium	Fruitone-N, Fruitone-L	2-4 oz (5-10ppm)	24 oz

Table 11.6.1. Chemicals registered for use in apple thinning in New England.

Timing	Chemical	Commercial Product Name	Typical rates of formulated product/100 gallons based on a full TRV gallonage per acre	Max. rate of formulated product/acre
Petal Fall	Naphthaleneacetamide	Amid-Thin W	4-8 oz (25-50ppm)	2 lb
	Naphthaleneacetic Acid-Sodium	Fruitone-N, Fruitone-L, PoMaxa	2-4 oz (5-10ppm)	16 oz
	Carbaryl	Sevin XLR Plus, Sevin 4F	0.5-1.5 pt	6 pt
	Carbaryl	Sevin 80S	0.3-0.9 lb	3.6 lb
	Benzyl Adenine	Maxcel, Exilis Plus, RiteWay	32-64 fl oz (50-100ppm)	308 fl oz
8-13mm Fruit Size	Benzyl Adenine	Maxcel, Exilis Plus, RiteWay	32-64 fl oz (50-100ppm)	308 fl oz
	Naphthaleneacetic Acid-Sodium	Fruitone-N, Fruitone-L, PoMaxa	2-6 oz (5-15ppm)	24 oz
	Carbaryl	Sevin XLR Plus, Sevin 4F	0.5-1.5 pt	6 pt
	Carbaryl	Sevin 80S	0.3-0.9 lb	3.6 lb
15-20mm Fruit Size	Ethephon	Ethrel	1-1.5 pt (300-450ppm)	6 pt
	Carbaryl	Sevin XLR Plus Sevin 4F	0.5-1.5 pt	6 pt
	Carbaryl	Sevin 80S	0.3-0.9 lb	3.6 lb

*Tree Row Volume Gallonage (TRV) = (Tree Height X Tree Width X 43,560 X 0.7) / (Between Row Spacing X1,000).

Table 11.6.2. Recommendations for thinning specific apple varieties in New England.

The chemicals and rates suggested in this table are the "best suggestion" of the authors for mature trees with a heavy fruit set and "normal" fruit thinning weather. Our rates should be adjusted up or down by 50% depending on weather conditions, pollination, fruit set and tree sensitivity. Other chemicals, rates, timings and combinations may also work.

	APPLICATION TIMING			
	30-80% Full Bloom	**Petal Fall 5-6mm (1 week after bloom)**	**8-14 mm fruit size (2-3 weeks after bloom)**	**Return Bloom Enhancer (4-7 weeks after bloom)**
VARIETY	*Rates are per 100 gallons based on a full dilute TRV application**			
Ben Davis			3 oz Fruitone** plus 1 pt Sevin	
Cameo		2 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Cortland			2 oz Fruitone	
Delicious (Spur Type)	2 gal ATS	2 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin plus 1 qt Ultrafine spray oil **OR** 3 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays
Delicious (Non-Spur Type)		1 pt Sevin	48 oz 6-BA plus 1 pt Sevin **OR** 2 oz Fruitone plus 1 pt Sevin	
Early McIntosh		5.5 oz Amide Thin plus 1 pt Sevin		

Table 11.6.2. Recommendations for thinning specific apple varieties in New England.

The chemicals and rates suggested in this table are the "best suggestion" of the authors for mature trees with a heavy fruit set and "normal" fruit thinning weather. Our rates should be adjusted up or down by 50% depending on weather conditions, pollination, fruit set and tree sensitivity. Other chemicals, rates, timings and combinations may also work.

	APPLICATION TIMING			
	30-80% Full Bloom	**Petal Fall 5-6mm (1 week after bloom)**	**8-14 mm fruit size (2-3 weeks after bloom)**	**Return Bloom Enhancer (4-7 weeks after bloom)**
VARIETY	*Rates are per 100 gallons based on a full dilute TRV application**			
Empire		2 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone plus 1 pt Sevin	
Fortune		2 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Fuji	2 gal ATS	64 oz 6-BA plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Gala	2 gal ATS	3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin	
Gingergold			2 oz Fruitone plus 1 pt Sevin	
Golden Delicious (without use of Provide)		3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 6 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 2 oz Fruitone (4 weekly sprays)
Golden Delicious (with use of Provide)		3 oz Fruitone plus 1 pt Sevin	48 oz 6-BA plus 1 pt Sevin **OR** 4 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 2 oz Fruitone (4 weekly sprays)
Granny Smith			2 oz Fruitone plus 1 pt Sevin	
Honeycrisp	2 gal ATS	4 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	3 oz Fruitone (4 weekly sprays)
Idared			2 oz Fruitone plus 1 pt Sevin	
Jerseymac		2 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	
Jonagold			3 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 2 oz Fruitone (4 weekly sprays)
Jonamac	2 gal ATS	3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone plus 1 pt Sevin	
Jonathan			2 oz Fruitone plus 1 pt Sevin	
Lady Apples		3 oz Fruitone plus 1 pt Sevin	4 oz Fruitone plus 1 pt Sevin	

Table 11.6.2. Recommendations for thinning specific apple varieties in New England.

The chemicals and rates suggested in this table are the "best suggestion" of the authors for mature trees with a heavy fruit set and "normal" fruit thinning weather. Our rates should be adjusted up or down by 50% depending on weather conditions, pollination, fruit set and tree sensitivity. Other chemicals, rates, timings and combinations may also work.

	APPLICATION TIMING			
	30-80% Full Bloom	**Petal Fall 5-6mm (1 week after bloom)**	**8-14 mm fruit size (2-3 weeks after bloom)**	**Return Bloom Enhancer (4-7 weeks after bloom)**
VARIETY	*Rates are per 100 gallons based on a full dilute TRV application**			
Liberty		3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone Plus 1 pt Sevin	
Lodi		5.5 oz Amide Thin plus 1 pt Sevin		
Macoun	2 gal ATS	3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 4 oz Fruitone plus 1 pt Sevin	3 oz Fruitone (4 weekly sprays)
Milton			2 oz Fruitone plus 1 pt Sevin	
McIntosh (Non-Spur Type)			2 oz Fruitone or PoMaxa plus 1 pt Sevin **OR** 36 oz 6-BA plus 1 pt Sevin	
McIntosh (Spur Type)			3 oz Fruitone or PoMaxa plus 1 pt Sevin **OR** 48 oz 6-BA plus 1 pt Sevin	
Mutsu (Crispin)			2 oz Fruitone or Pomaxa plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Northern Spy		3 oz Fruitone plus 1 pt Sevin	2 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Autumn Crisp		2 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone plus 1 pt Sevin	
Paulared		3 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	
Quinte		5.5 oz Amide Thin plus 1 pt Sevin		
R.I. Greening			3 oz Fruitone plus 1 pt Sevin	
Rome Beauty (Non Spur)			2 oz Fruitone plus 1 pt Sevin	

Table 11.6.2. Recommendations for thinning specific apple varieties in New England.

The chemicals and rates suggested in this table are the "best suggestion" of the authors for mature trees with a heavy fruit set and "normal" fruit thinning weather. Our rates should be adjusted up or down by 50% depending on weather conditions, pollination, fruit set and tree sensitivity. Other chemicals, rates, timings and combinations may also work.

	APPLICATION TIMING			
	30-80% Full Bloom	**Petal Fall 5-6mm (1 week after bloom)**	**8-14 mm fruit size (2-3 weeks after bloom)**	**Return Bloom Enhancer (4-7 weeks after bloom)**
VARIETY	*Rates are per 100 gallons based on a full dilute TRV application**			
Rome Beauty (Spur)		2 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin **OR** 64 oz 6-BA plus 1 pt Sevin	
Spartan and Acey Mac		3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone plus 1 pt Sevin	
Stayman			2 oz Fruitone plus 1 pt Sevin	
Sweetango (with Provide)			2 oz Fruitone plus 1 pt Sev	
Tydeman			2 oz Fruitone plus 1 pt Sevin	
Vista Bella			2 oz Fruitone plus 1 pt Sevin	
Wealthy			3 oz Fruitone plus 1 pt Sevin	
Yellow Newtown			3 oz Fruitone plus 1 pt Sevin	
Yellow Transparent		5.5 oz AmideThin plus 1 pt Sevin		

* All rates are amounts per 100 gal assuming a full dilute tree row volume (TRV) spray. Rate per acre = amount/hundred gallons X hundreds of gallons per acre TRV dilute. Tree Row Volume dilute gallonage (TRV)= (Tree Height X Tree Width X 43560 X 0.7) / (Between Row Spacing X1000). The rate per acre may safely be concentrated 3X.

** Fruitone is sold either as the traditional powder (Fruitone-N) or as the new liquid (Fruitone-L). The recommended rates are the same in either fluid ounces or lb ounces.

Table 11.6.3. Conversion of ppm Maxcel or RiteWay BA thinners to fluid ounces for various TRV gallonages.

Dilute Gallonage per Acre	**PPM Maxcel**					
	25	**50**	**75**	**100**	**125**	**150**
	Fluid ounces per acre*					
50	8	16	24	32	40	48
100	16	32	48	64	80	96
150	24	48	72	96	120	144
200	32	64	96	128	160	192
250	40	80	120	160	200	240
300	48	96	144	192	240	288
350	56	112	168	224	280	
400	64	128	192	256		

*To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

Table 11.6.4. Conversion of ppm Exilis Plus to fluid ounces for various TRV gallonages.

Dilute Gallonage per Acre	PPM Exilis					
	25	50	75	100	125	150
	*Fluid ounces per acre**					
50	7.5	15	22.5	30	37.5	45
100	15	30	45	60	75	90
150	22.5	45	67.5	90	112.5	135
200	30	60	90	120	150	180
250	37.5	75	112.5	150	187.5	225
300	45	90	135	180	225	270
350	52.5	105	157.5	210	262.5	
400	60	150	180	240		

*To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

Table 11.6.5. Conversion of ppm Fruitone N to ounces (lb.) or Fruitone-L or PoMaxa to fluid ounces for various dilute TRV gallonages.

Dilute Gallonage per Acre	PPM Fruittone N or Fruitone-L, PoMaxa				
	2.5	5	7.5	10	12.5
	*Ounces (lb.) per acre for Fruitone-N or fluid ounces for Fruitone-L**				
50	0.5	1	1.5	2	2.5
100	1	2	3	4	5
150	1.5	3	4.5	6	7.5
200	2	4	6	8	10
250	2.5	5	7.5	10	12.5
300	3	6	9	12	15
350	3.5	7	10.5	14	17.5
400	4	8	12	16	20

*To convert ounces (lb) to grams, multiply fluid ounces by 28.3. To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

Table 11.6.6. Conversion of ppm of Amide-Thin W to ounces (lb.) for various dilute TRV gallonages.

Dilute Gallonage per Acre	PPM Amide-Thin W				
	10	20	30	40	50
	*Ounces (lb.) per acre**				
50	0.8	1.6	2.4	3.2	4
100	1.6	3.2	4.8	6.4	8
150	2.4	4.8	7.2	9.6	12
200	3.2	6.4	9.6	12.8	16
250	4	8	12	16	20
300	4.8	9.6	14.4	19.2	24
350	5.6	11.2	16.8	22.4	28
400	6.4	12.8	19.2	25.6	32

* To convert ounces (lb) to grams multiply, ounces by 28.3.

Table 11.6.7. Conversion of ppm of Ethrel to fluid ounces for various dilute TRV gallonages.

Dilute Gallonage per Acre	PPM Ethrel			
	150	300	450	600
	Fluid ounces per acre*			
50	4	8	12	16
100	8	16	24	32
150	12	24	36	48
200	16	32	48	64
250	20	40	60	80
300	24	48	72	96
350	28	56	84	112
400	32	64	96	128

*To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

Table 11.6.8. Conversion of lb. a.i. of Sevin XLR Plus or Sevin 4F to fluid ounces for various dilute TRV gallonages.

Dilute Gallonage per Acre	lb. ai. of Sevin XLR Plus or Sevin 4F			
	0.25	0.5	0.75	1.0
	*Fluid ounces per acre**			
50	4	8	12	16
100	8	16	24	32
150	12	24	36	48
200	16	32	48	64
250	20	40	60	80
300	24	48	72	96
350	28	56	84	112
400	32	64	96	128

*To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

11.7 Other Growth Regulator Uses In Apples

In addition to their use in chemical thinning, growth regulating chemicals are also used in apple production to modify tree growth and fruit development. Since growth regulating chemicals affect plant metabolism, good spray coverage and good uptake of the chemical are essential for proper response.

11.7.1 Growth Regulator Chemicals Registered in New England

BA/GA (Promalin, Perlan or Typy) are growth regulators containing a combination of equal parts of benzyl adenine (a cytokinin) and GA 4+7 (gibberellins). They are used to stimulate growth of fruits and/or lateral branches. Their primary effect on fruit growth is to increase the length:diameter ratio (typiness) of the fruit. Their primary use is with Delicious and Gala, where typiness can be an important marketing advantage. They have their best effect on typiness in a narrow timing window when king blooms are open. At later timings and at high rates, they can cause fruit thinning. The best response is obtained when temperatures are warm (>70°F) and the spray is applied as a fine mist in 50-100 gallons of water.

BA+GA is also used to induce lateral branching of nursery trees and young orchard trees, but at rates of 5-10 times those used to increase typiness. Applications are made on nursery trees when the tree is 28-48" high (mid-June through late July), while on young trees planted in the orchard trees, applications are made earlier, when shoots are ½ inch long (near half inch green). BA+GA can also be applied at bud break by painting or spraying it on the swollen buds.

GA 4+7 (Provide, Novagib, TypRus) are commercial formulations of gibberellins A4+7. They are used on apples to reduce fruit russeting. Russeting is associated with high humidity early in the season, frost and certain strains of yeast. Certain fungicides such as captan and Polyram reduce russeting by controlling these strains of yeast, but it GA 4+7 reduces russeting by stimulating cell division on skin surface to allow sufficient wax production to prevent cracks in the was layer. We recommend three-four sprays of GA 4+7 beginning at petal fall and continued every 7-10

days. The most susceptible varieties to russeting are: Golden Delicious, Fuji, Rome, Cortland, Idared, Crispin Jonagold and Sweetango. The use of a 4 spray program of GA 4+7 can induce some thinning. We recommend a lower rate of chemical thinners when GA 4+7 is used for russet control (see Table 11.6.2 for specific variety recommendations). The use of GA 4+7 may interact with the use of other growth regulators such as Apogee, since GA 4+7 is a gibberellin and Apogee inhibits synthesis of gibberelins.

Ethephon (Ethrel) is a growth regulator that stimulates ethylene production by the plant. It can be used to thin apples and improve flower bud development when used within a few weeks of bloom, and to improve fruit color and advance fruit maturation when used near harvest. Its use near harvest significantly reduces fruit storage life and shelf life, and can cause excessive fruit drop if fruits are not harvested within 10 days after application

Naphthaleneacetic acid (NAA) is an auxin-type growth regulator that can induce fruit thinning early in the season and reduce fruit drop late in the season. At very high rates, it can stop the development of watersprouts and rootsuckers. Its use as a chemical thinner is described in the thinning section. Its primary use as a growth regulator is to reduce preharvest drop. When it is used to reduce drop, it does not delay ripening, which may result in overripe fruit that have a shorter storage life if harvest is delayed. The level of drop control depends on rate, with 20 ppm giving better control than 10 ppm; however, the higher rate also advances ripening and may shorten fruit storage life. When combined with ReTain its negative effects on fruit ripening and storage life can be mitigated.

The use of NAA to control rootsuckers is with a formulation that is more active (Tre-Hold) and at rates 1,000 times that of its use as a chemical thinner or for drop control. The Tre-Hold formulation must never be used for thinning or drop control.

Prohexadione-calcium (Apogee) is a growth regulator that reduces vegetative growth by inhibiting the synthesis of gibberellins, which are naturally occurring plant hormones that control cell elongation. Growers can expect about a 40-50% reduction in growth from Apogee.

Apogee also limits fire blight development in apple shoots but will not protect against blossom blight infection. Although Apogee has no pesticidal activity on the fire blight bacteria itself, it affects the development of the shoot blight by causing a cessation of shoot growth, which in turn makes the shoots less susceptible to fire blight development. In order to get the maximum benefit in growth reduction and fireblight protection, it is important to make the first application when shoots are 1-3 inches long. This means Apogee must be applied at or before petal fall to have a large effect on shoot growth. Later applications will be less effective at stopping shoot growth. The onset of shoot growth control and resistance against shoot fire blight infections occurs 10 to 14 days after treatment. Thus, apple trees must be treated in a protective manner before shoot blight symptoms develop. After resistance is acquired, it should last from 4-6 weeks. To maintain fire blight protection, a second spray is required if shoots begin to grow again. A low dose provides growth controls for only about 3-4 weeks, while a high dose controls growth for 6-8 weeks. At least two applications will be required to achieve season-long growth control in most New England orchards.

Apogee-treated apple trees usually set more fruit than untreated trees and often Apogee negates the efficacy of chemical thinners, thus it is important that no Apogee be applied either 10 days before or 10 days after the application of chemical thinners. It may also be necessary to use a more agressive thinning strategy. This may mean using an increased dosage of a chemical thinner (30-50% more) or multiple applications of chemical thinners to achieve desired crop load and fruit size. High rates of Apogee (>18 oz/acre/year) can reduce return bloom in some years. Apogee may cause fruit finish and cracking problems on Empire apples.

ReTain is a commercial formulation of aminoethoxyvinylglycine (AVG). It is used to reduce preharvest drop and to delay harvest. It acts by inhibiting the synthesis of ethylene in the plant. Since ethylene production by the fruit increases dramatically as fruits ripen, ReTain must be applied several weeks before fruits are mature to hold ethylene production in check. This is usually 3-4 weeks before normal harvest. ReTain will generally delay harvest and fruit drop by 7-10 days, thus giving growers flexibility with harvest date. ReTain also delays other aspects of fruit ripening such as color development, starch degradation and firmness loss, but if harvest is delayed 7-10 days, ReTain-treated fruits achieve normal color and maturity. The combination of ReTain and NAA (Fruitone) has given better drop control that either chemical alone. A split application of ReTain plus NAA at 4 weeks before harvest followed by a second application of ReTain plus NAA at 2 weeks before harvest has given the longest drop control.

Table 11.7.1. Growth regulator uses in apples.

Timing	Product	Concentration	Rate of Formulated Product
Improve Shape (Typiness) of Delicious and Gala Apple Fruits			
Early King Bloom to 50% Bloom	Promalin, Perlan, Typy	25-50 ppm	1-2 pt/100 gal
Apply as a fine mist using 50-100 gallons/acre. Do not apply more than 2 pt/acre. Fruit thinning may occur at high rates. Use of a surfactant increases both typiness and thinning responses.			
Induction of Lateral Branching in Young Trees			
1/2" of Terminal Shoot Growth	Promalin Perlan, Typy, Maxcel	250-500 ppm	0.5-1 pt/5 gal
Include a non-ionic surfactant and apply as a directed spray to areas where additional branching is desired. This practice is more effective in the second and third growing seasons after planting. Response on weak or low-vigor trees is usually disappointing.			
Vegetative Growth Control/Fire Blight Suppression			
1-3 inches of new growth	Apogee	125-250 ppm	4.5-9 oz (lb)*/100 gal
(Late bloom-early petal fall)			
The first application should be made as soon as shoot growth begins with a second spray 3-4 weeks after the first. In some cases a third application may be required. Do not apply Apogee within 10 days of chemical thinners. Do not apply more than 48 ounces of Apogee per acre within any 21-day interval, and a max of 99 oz of Apogee per acre per season. Always use a surfactant and a water conditioner such as ammonium sulfate, Choice or Quest (these products control "hard water" deactivation of Apogee). Do not tank-mix with sprays containing calcium. Use of Apogee may necessitate use of increased chemical thinning to achieve desired crop load. Apogee must be applied well in advance of the appearance of fire blight symptoms to be effective for fire blight suppression. To control vigor in only the top of the tree, direct spray to the top of the tree.			
Induction of Lateral Branching in Nursery Trees			
When terminal Shoot is 28-48" long	Promalin	125-500ppm	0.25-1 pt/5 gal
	Maxcel	250-500ppm	128 oz/40 gal
Include a non-ionic surfactant and apply as a directed spray to areas where additional branching is desired when terminal shoot is at the height where branches are desired. Apply a second, third and fourth spray at 2 week intervals to stimulate additional branching as the shoot grows.			
Suppression of "Physiological" Fruit Russeting			
Petal Fall	TypRus 2% Liquid	15-20 ppm	10-13 fl oz/acre
	Pro-Vide 10 SG	15-25ppm	60-100 g/acre
Apply 2-4 applications beginning at petal fall and continuing at 7-10 day intervals. Spray at 100 gallons per acre. Max of 40 oz of ProVide per season. Do not use a surfactant when applying Pro-Vide.			
Increased Flower Bud Development			
Non bearing trees			
2-4 weeks after full bloom	Ethrel	300-450 ppm	1-1.5 pt/100 gal
Bearing trees			
4-6 weeks after full bloom	Ethrel or	150 ppm	0.5 pt/100 gal
	NAA	7.5ppm	3 oz*/100gal
Spray trees with enough water to uniformly cover the canopy. Apply 4 weekly applications. Avoid use of Ethrel on Macoun, Honeycrisp and McIntosh due to advanced ripening.			
Preharvest Fruit-Drop Control			
3-4 weeks before anticipated harvest	ReTain	30-130 ppm	84-333g/acre or 1/4-1 pouch
Varieties differ significantly in their sensitivity to ReTain. With some varieties the full rate reduces fruit color excessively. We recommend with Empire, Delicious, Jonagold, Idared and Rome a full rate of ReTain (1 pouch per acre) applied 4 weeks before harvest. For McIntosh we recommend a half rate of ReTain (1/2 pouch per acre) applied 3 weeks before harvest combined with 10ppm NAA. This will give 2 weeks of drop control. For longer drop control apply a second spray of a half rate of ReTain (1/2 pouch) at 1 week before harvest. For Gala we recommend a 1/3 rate (1/3 pouch per acre) applied 2 weeks before harvest. For Honeycrisp which is the most sensitive variety to ReTain we recommend a 1/4 rate (1/4 pouch per			

Table 11.7.1. Growth regulator uses in apples.

Timing	Product	Concentration	Rate of Formulated Product
acre) applied 2 weeks before harvest. Apply in sufficient water to ensure thorough but not excessive coverage. For mature trees, this should be 100 gal/acre. An organosilicone surfactant (12 oz/100 gal) should be used with ReTain. In hot years apply ReTain at least 4 weeks before harvest. In cooler years apply ReTain 3 weeks before anticipated harvest.			
Drop of first sound fruit	Fruitone-N, Fruitone-L, PoMaxa	10-20 ppm	4-8 oz*/ 100 gal
	Fruit-Fix 800	10-20 ppm	0.6-1.2 fl. oz./100 gal
Varieties such as McIntosh which are highly prone to preharvest drop require careful monitoring to determine when fruit drop is beginning. Limb-tapping should be used to help determine the onset of drop as fruit near maturity. Approximate duration of drop control varies with dosage: 10 ppm = 6 days; 20 ppm = 10 days. Do not make more than 2 applications. High rates of NAA advance fruit maturity and may shorten fruit storage life.When NAA is combined with ReTain at 3 or 2 weeks before harvest the negative effects of NAA on fruit maturity and storage life can be eliminated.			
Promote Fruit Coloring, Promote Uniform Ripening, Advance Fruit Maturation			
2 weeks before normal harvest	Ethrel	150-300 ppm	0.5-1 pt / 100 gal
If fruit is to placed in CA storage then harvest should be done 7 days after application. If fruit is to be left on the tree longer than 7 days after application of Ethrel then apply NAA at 10-20 ppm 3 days after Ethrel application to help control preharvest drop. Ethrel will cause excessive fruit preharvest drop about 10 days after application if NAA is not used. Any delay in harvest or cooling of fruit treated with Ethrel will result in unacceptable softening and short storage life.			

*To convert ounces (lb) to grams, multiply ounces by 28.3. To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

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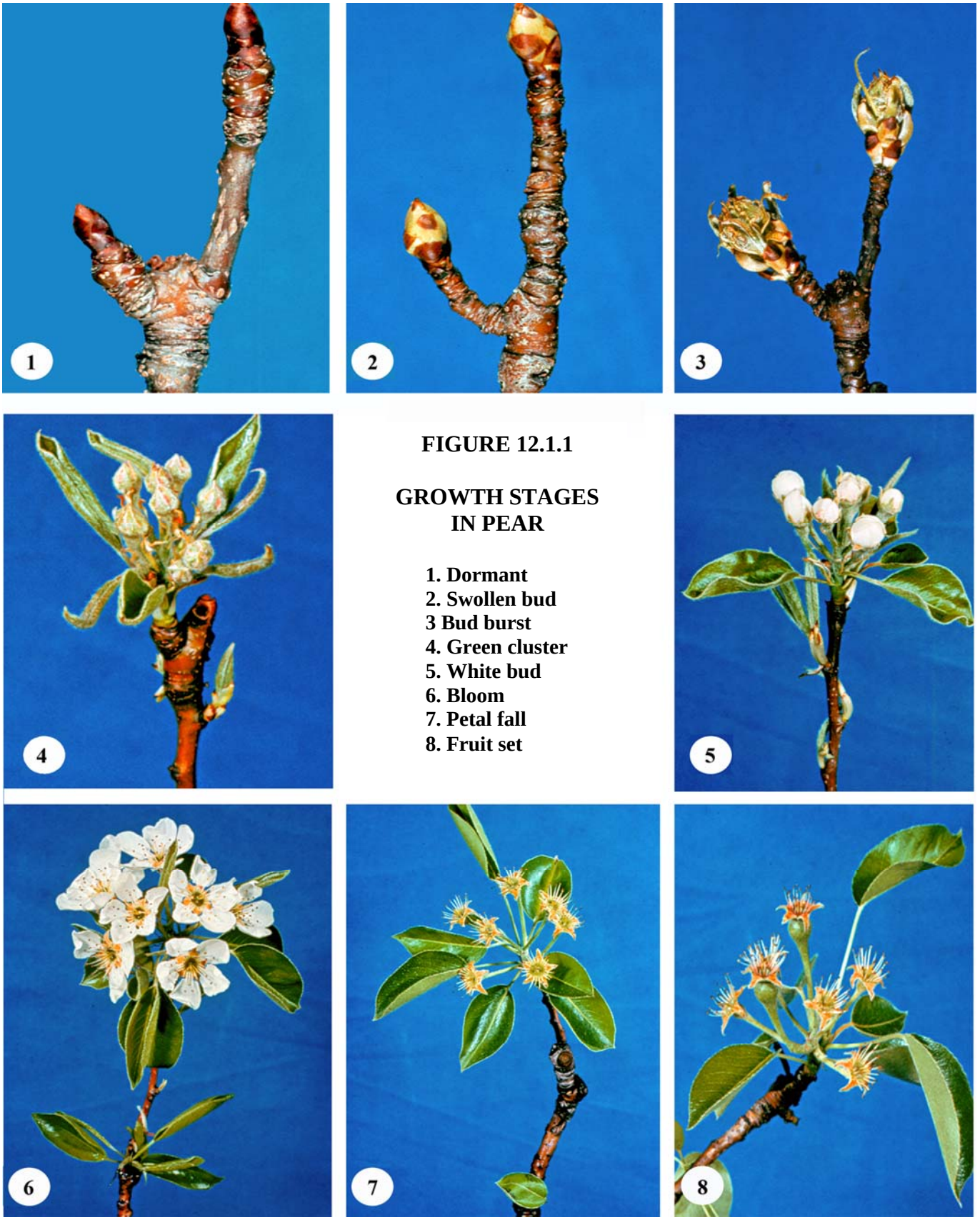

FIGURE 12.1.1

GROWTH STAGES IN PEAR

1. **Dormant**
2. **Swollen bud**
3. **Bud burst**
4. **Green cluster**
5. **White bud**
6. **Bloom**
7. **Petal fall**
8. **Fruit set**

12 Pears

12.1 Insecticides and Fungicides for Pears

See Sections 12.2 and 12.3 for comments related to this table.

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Dormant							
Pseudomonas spur blight (Fire blight)		Bordeaux mixture, 8-8-100					[2.3]
		(copper sulfate)	8 lb/100 gal	24	BL		
		(spray lime)	8 lb/100 gal				
		plus:					
		oil	1 qt/100 gal				
		C-O-C-S	12-15.6 lbs/A	48	–		
		Kocide 3000 or other coppers	5.25-7.0 lb/A see comments and labels	48	HIG		
Pear psylla, European red mite		oil	3 gal/100 gal	12	0		[12.1]
Pearleaf blister mite		oil	1-1.5 gal/100 gal	12	0		[14.1]
		plus:					
	1B	*Diazinon 50WP	1 lb/100 gal	96	21	high	
San Jose scale	4A	Assail 30SG	8 oz/A	12	7	moderate	[20.1]
	16	Centaur 0.7WDG	34.5-46.0 oz/A	12	14	high	
	7C	Esteem 35WP	4-5 oz/A	12	45	high	
	1B	*Lorsban Advanced 3.76EC	1.5-4 pt/A	96	PB	high	
	1B	Lorsban 75WG	2-2.67 lb/A	96	PB	high	
Swollen Bud							
Pear Midge	–	Aza-Direct 1.2L	11.5-42 fl oz/A	4	0	moderate	[11.1]
	3A	PyGanic 1.4EC	16-64 fl oz/A	12	0	moderate	
Pear psylla	4A	Actara 25WDG	5.5 oz/A	12	35	high	[12.2]
	3A	*Ambush 25WP	12.8-25.6 oz/A	12	PB	moderate	[12.2]
	3A	*Asana XL 0.66EC	7.3-12.8 fl oz/100 gal or 9.6-19.12 fl oz/A	12	28	moderate	[12.2]
	4A	Assail 30SG	4-8 oz/A	12	7	moderate	
	4A	Calypso 4F	1-2 fl oz/100 gal or 4-8 fl oz/A	12	30	high	
	16	Centaur 0.7WDG	34.5-46 oz/A	12	14	high	
	3A	*Danitol 2.4EC	16-21.3 fl oz/A	24	14	moderate	[12.2]
	5	Delegate 25WG	4.5-7 oz/A	4	7	high	[12.2]
	7C	Esteem 35WP	4-5 oz/A	12	45	high	[12.2]
	–	M-Pede 49L	2 gal/100 gal	12	0	moderate	[12.3]
	–	oil	1-2 gal/100 gal	12	0	high	[12.4]
	21A	Portal 0.4 EC	2 pt/Acre	12	14		
	3A	*Pounce 25WP	12.8-25.6 oz/A	12	PB	moderate	[12.2]
	–	Surround 95WP	50 lb/A	4	0	moderate	[12.6]
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	21	moderate	[12.2]

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Green Cluster							
Fabraea leaf spot	Same materials as recommended for pear scab						[1.2]
Pear scab		Topsin M WSB, 70WP	0.25 lb/100 gal or 1 lb/A	48	1		[3.2]
		or Thiophanate-methyl 85WDG	.2 lb/100 gal or .8 lb/A	48	1		
		or Inspire Super	8.5-12 fl oz/A	12	14		
		plus: Manzate Max/Penncozeb 75DF	1 lb/100 gal or 3 lb/A	24	BL, 77 (A)		[3.3]
		Manzate Max/ Penncozeb 75DF	2 lb/100 gal or 6 lb/A	24	BL, 77 (A)		[3.3]
		Topsin M WSB, 70WP	0.25 lb/100 gal or 1 lb/A	48	1		[3.2]
		Fontelis	16-20 fl oz/A	28	12		[3.7]
		Merivon	4-5.5 fl oz/acre				
Pear Midge	–	Aza-Direct 1.2L	11.5-42 fl oz/A	4	0	moderate	[11.1]
	3A	PyGanic 1.4EC	16-64 fl oz/A	12	0	moderate	
Tarnished plant bug, Pear plant bug	3A	*Baythroid XL 1EC	2-2.4 fl oz/A	12	7	high	[19.1]
	9C	Beleaf 50SG	2-2.8 oz/A	12	21	high	
	3A	*Brigade 10WSB or *Brigade 2EC	6.4-32 oz/A 2.6-12.8 fl oz/A	12	14	high	
	3A	*Danitol 2.4EC	16-21.3 fl oz/A	24	14	high	
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	21	high	
	The following pre-mix products are also labeled for use against these pests; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species present are appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	high	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	21	high	
White Bud							
Fabraea leaf spot	See Green Cluster sprays						
Pear scab	Choose from materials listed under Green Cluster						
		Flint 50WG	0.67-0.8 oz/100 gal or 2-2.5 fl oz/A	12	14		[3.4]
		Sovran 50WG	1.0-1.6 oz/100 gal or 3.2-6.4 oz/A	12	30		
		Fontelis	16-20 fl oz/A	28	12		[3.7]
Pear psylla	See Swollen Bud sprays						[12.2],[12.4]
Bloom							
Fire blight		Agrimycin 17WP, Streptrol 17WP, or Firewall 17WP	8 oz/100 gal or 24oz/A	12	30		[2.1], [2.8]
		Agrimycin 17WP, Streptrol 17WP, or Firewall 17WP *plus:*	8 oz/100 gal or 24oz/A	12	30		[2.1], [2.8]

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Bloom (continued)							
Fire blight (*continued*)		Glycerine (CP or USP grade)	2 qt/100 gal				
		or Regulaid	1 pt/100 gal				
		Mycoshield	1.0 lb/100 gal	12	60		[2.6]
		Serenade ASO	2-6 qt/A	4	0		[2.7]
		Bloomtime Biological FD	.33 lb/A	4	PF		[2.5]
Pear scab, Fabrea leaf spot	Choose from materials listed previously						
Petal Fall							
Pear scab, Fabrea leaf spot	Choose from materials listed previously						
		Manzate Max/ Penncozeb 75DF	1 lb/100 gal or 3 lb/A	24	BL, 77(A)		[3.3]
		Pristine 38WG	14.5-18.5 oz/A	12	0		
		Ziram 76DF	24-32 oz/100 gal	48	14		
Fire blight		Agrimycin 17WP, Streptrol 17WP, or Firewall 17WP	8 oz/100 gal or 24oz/A	12	30		[2.1], [2.8]
		Agrimycin 17WP, Streptrol 17WP, or Firewall 17WP	8 oz/100 gal or 24oz/A	12	30		[2.1], [2.8]
		plus:					
		Glycerine (CP or USP grade)	2 qt/100 gal				
		or Regulaid	1 pt/100 gal				
Aphids, including Spirea aphid	4A	Admire Pro 4.6SC	2.8 fl oz/A	12	7	high	
	4A	Assail 30SG	2.5-4 oz/A	12	7	high	
	–	Aza-Direct 1.2L	11.5-42 fl oz/A	4	0	moderate	
	9C	Beleaf 50SG	2-2.8 oz/A	12	21	high	
	4A	Calypso 4F	1-2 fl oz/100 gal or 4-8 fl oz/A	12	30	high	[5.1]
	1B	*Dimethoate 4EC	0.5-1 pt/100 gal or 1-2 qt/A	240 (10 days)	28	moderate	
	–	M-pede 49L	1- 2 gal/100gal	12	0	moderate	[5.2]
	23	Movento 240SC	6-9 fl oz/A	24	7	high	[5.1]
	–	Neemix 4.5L	5-7 fl oz/A	4	0	moderate	
	The following pre-mix products are also labeled for use against these pests; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	4A/6	*Agri-Flex SC	1.5-2.0 fl oz/100 gal or 5.5-8.5 fl oz/A	12	35	high	[5.1]
		plus:					
		Horticultural spray oil	1 qt/100 gal or 1 gal/A				
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	high	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Petal Fall (continued)							
Codling moth		Pheromone disruption: Checkmate CM-F	2.4-4.8 fl oz/A	4	0		[6.2]
Comstock mealybug	4A	Admire Pro 4.6SC	7 fl oz/A	12	7	high	[7.1]
	4A	Actara 25WDG	4.5-5.5 oz/A	12	35	high	[7.3]
	4A	Assail 30SG	4-4.8 oz/A	12	7	high	
	4A	Calypso 4F	1-2 fl oz/100 gal or 4-8 fl oz/A	12	30	high	
	16	Centaur 0.7WDG	34.5-46 oz/A	12	14	high	
	1B	*Diazinon 50WP	1 lb/100 gal	96	21	high	
	23	Movento 240SC	6-9 fl oz/A	24	7	high	
	21A	Portal 0.4EC	2 pt/A	12	14	high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	4A/6	*Agri-Flex SC *plus:* Horticultural spray oil	1.5-2.0 fl oz/100 gal or 5.5-8.5 fl oz/A 1 qt/100 gal or 1 gal/A	12	35	high	[7.3]
	4A/28	Voliam Flexi WDG	7 oz/A	12	35	high	
Green fruitworms	28	Altacor 35WDG	2.5-4 oz/A	4	5	high	[9.1]
	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	28	high	
	3A	*Baythroid XL 1EC	1.4-2 fl oz/A	12	7	high	
	28	Belt 4SC	3-5 fl oz/A	12	14	high	
	1A	*Lannate 2.4LV	0.75 pt/100 gal or 1.5-3 pt/A	48	7	high	
	1A	or *Lannate 90SP	0.5-1 lb/A			high	
	6	*Proclaim 5SG	0.8-1.2 oz/100 gal or 3.2-4.8 oz/A	12 or 48 (E)	14	high	
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	21	high	[12.2]
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-6 fl oz/A	24	35	high	
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	high	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	
	28/16	Tourismo	12-17 fl oz/acre	12	14	high	
	4A/28	Voliam Flexi WDG	4-7 oz/A	12	35	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	21	high	
Pear psylla	4A	Actara 25WDG	5.5 oz/A	12	35	high	[12.5]
	4A	Admire Pro 4.6SC	7 fl oz/A	12	7	moderate	
	6	*Agri-Mek 8SC	0.5-1 fl oz/100 gal or 2.25-4.25 fl oz/A	12	28	high	[12.5]

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Petal Fall (continued)							
Pear psylla (*continued*)	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	28	moderate	
	4A	Assail 30SG	4-8 oz/A	12	7	moderate	
	4A	Calypso 4F	1-2 fl oz/100 gal or 4-8 fl oz/A	12	30	high	[12.5]
	16	Centaur 0.7WDG	34.5-46 oz/A	12	14	high	
	3A	*Danitol 2.4EC	16-21.3 fl oz/A	24	14	moderate	
	5	Delegate 25WG	4.5-7 oz/A	4	7	high	[12.5]
	7C	Esteem 35WP	4-5 oz/A	12	45	high	[12.5]
	–	M-Pede 49L	2 gal/100 gal	12	0	moderate	[12.3]
	23	Movento 240SC	6-9 fl oz/A	24	7	high	[12.5]
	21	Portal 0.4EC	2 pt/A	12	14	high	[12.5]
	21	Nexter 75WS	6.6-10.67 oz/A	12	7	moderate	[12.5]
	–	Surround 95WP	50 lb/A	4	0	moderate	
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	21	moderate	[12.2]
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	4A/6	*Agri-Flex SC *plus:* Horticultural spray oil	1.5-2.0 fl oz/100 gal or 5.5-8.5 fl oz/A 1 qt/100 gal or 1 gal/A	12	35	high	[12.5]
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	high	
	4A/28	Voliam Flexi WDG	7 oz/A	12	35	high	
Pear rust mite	6	*Agri-Mek 8SC	0.5-1 fl oz/100 gal or 2.25-4.25 fl oz/A	12	28	high	[13.1], [8.1]
	21	Nexter 75WS	5.2-10.67 oz/A	12	7	moderate	
	21	Portal 0.4EC	2 pt/A	12	14	high	
	12B	*Vendex 50WP	6-8 oz/100 gal or 1-2 lb/A	48	14	moderate	
	The following pre-mix product is also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	4A/6	*Agri-Flex SC *plus:* Horticultural spray oil	1.5-2.0 fl oz/100 gal or 5.5-8.5 fl oz/A 1 qt/100 gal or 1 gal/A	12	35	high	[13.1]
Plum curculio	4A	Actara 25WDG	4.5-5.5 oz/A	12	35	high	[15.1]
	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	28	moderate	
	3A	*Baythroid XL 1EC	2.4-2.8 fl oz/A	12	7	moderate	
	3A	*Brigade 10WSB or *Brigade 2EC	6.4-32 oz/A 2.6-12.8 fl oz/A	12	14	moderate	

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Petal Fall (continued)							
Plum curculio (*continued*)	4A	Calypso 4F	1-2 fl oz/100 gal or 4-8 fl oz/A	12	30	high	
	1B	Imidan 70W	0.75-1 lb/100 gal or 2.13-5.75 lb/A	7 days	7	high	
	–	Surround 95WP	50 lb/A	4	0	moderate	[12.6]
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	21	moderate	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	4A/6	*Agri-Flex SC	1.5-2.0 fl oz/100 gal or 5.5-8.5 fl oz/A	12	35	high	[15.1]
		plus:					
		Horticultural spray oil	1 qt/100 gal or 1 gal/A				
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	moderate	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	
	4A/28	Voliam Flexi WDG	6-7 oz/A	12	35	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	21	moderate	
Obliquebanded leafroller	11A	Agree WG 3.8WS	1-2 lb/A	4	0	high	[10.1]
	28	Altacor 35WDG	2.5-4.5 oz/A	4	5	high	
	28	Belt 4SC	3-5 fl oz/A	12	14	high	
	5	Delegate 25WG	4.5-7 oz/A	4	7	high	
	11A	Deliver 18WG	0.5-2 lb/A	4	0	high	
	11A	Dipel 10.3DF	0.5-2 lb/A	4	0	high	
	5	Entrust 80WP	0.67-1 oz/100 gal or 2-3 oz/A	4	7	high	
	5	or Entrust 2SC	6-10 fl oz/A				
	18A	Intrepid 2F	8-16 fl oz/A	4	14	high	
	11A	Javelin 7.5 WDG	0.5-4 lb/A	4	0	high	
	1A	*Lannate 2.4LV	0.75 pt/100 gal or 1.5-3 pt/A	48	7	moderate	
	1A	or *Lannate 90SP	0.25 lb/100 gal or 0.5-1 lb/A				
	6	*Proclaim 5SG	0.8-1.2 oz/100 gal or 3.2-4.8 oz/A	12/48 (E	14	high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-6 fl oz/A	24	35	moderate	[10.3]
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	moderate	
	4A/28	Voliam Flexi WDG	4-7 oz/A	12	35	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	21	high	

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Additional Summer Sprays							
Fire blight (ONLY after a hailstorm)		Agrimycin 17WP, Streptrol 17WP, or Firewall 17WP	0.5 lb/100 gal or 24-48 oz/A	12	30		[2.4]
Pear scab, Fabraea leaf spot, Sooty blotch, Black rot	See Petal Fall sprays						
Codling moth	28	Altacor 35WDG	2.5-4.5 oz/A	4	5	high	[6.1]
	4A	Assail 30SG	4-8 oz/A	12	7	high	
	22	Avaunt 30WDG	5-6 oz/A	12	28	moderate	
	3A	*Baythroid XL 1EC	2-2.4 fl oz/A	12	7	moderate	
	28	Belt 4SC	3-5 fl oz/A	12	14	high	
	4A	Calypso 4F	1-2 fl oz/100 gal or 4-8 fl oz/A	12	30	high	
	–	Carpovirusine 0.99SC	0.5-1 pt/100 gal	4	0	moderate	
	–	Cyd-X 0.06SC	1-6 floz/A	4	0	moderate	
	3A	*Danitol 2.4EC	16-21.3 fl oz/A	24	14	moderate	
	5	Delegate 25WG	4.5-7 oz/A	4	7	high	
	11A	Deliver 18WG	0.5-2 lb/A	4	0	moderate	
	11A	Dipel 10.3DF	0.5-2 lb/A	4	0	moderate	
	5	Entrust 80WP	0.67-1 oz/100 gal or 2-3 oz/A	4	7	moderate	
	5	or Entrust 2SC	6-10 fl oz/A			moderate	
	1B	Imidan 70W	0.75-1 lb/100 gal or 2.13-5.75 lb/A	7 days	7	high	
	11A	Javelin 7.5WDG	0.5-4 lb/A	4	0	moderate	
	–	Pheromone disruption: Checkmate CM-F	2.4-4.8 fl oz/A	4	0	moderate	[6.2]
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-6 fl oz/A	24	35	moderate	[6.1]
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	moderate	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	
	28/16	Tourismo	12-17 fl oz/acre	12	14	high	
	4A/28	Voliam Flexi WDG	4-7 oz/A	12	35	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	21	high	
Comstock mealybug	4A	Actara 25WDG	4.5-5.5 oz/A	12	35	high	[7.2],[7.3]
	4A	Admire Pro 4.6SC	7.0 fl oz/A	12	7	high	
	4A	Assail 30SG	4-8 oz/A	12	7	high	
	4A	Calypso 4F	1-2 fl oz/100 gal or 4-8 fl oz/A	12	30	high	
	16	Centaur 0.7WDG	34.5-46 oz/A	12	14	high	
	1B	*Diazinon 50WP	1 lb/100 gal	96	21	high	
	23	Movento 240SC	6-9 fl oz/A	24	7	high	
	21A	Portal 0.4EC	2 pt/A	12	14	high	

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Comstock mealy bug (*continued*)	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	4A/6	*Agri-Flex SC	1.5-2.0 fl oz/100 gal or 5.5-8.5 fl oz/A	12	35	high	[7.3]
		plus:					
		Horticultural spray oil	1 qt/100 gal or 1 gal/A				
	4A/28	Voliam Flexi WDG	7 oz/A	12	35	high	
European red mite, Twospotted spider mite, Pear rust mite	6	*Agri-Mek 8SC	0.5-1 fl oz/100 gal or 2.25-4.25 fl oz/A	12	28	high/mod (ERM/ TSSM)	[8.1],[13.1]
	10A	Apollo 4SC	4-8 oz/A	12	21	high/poor	
	3A	*Brigade 10WSB or *Brigade 2EC	12.8-32 oz/A 5.12-12.8 fl oz/A	12	14	moderate	
	23	Envidor 2 SC	16-18 fl oz/acre	12	7	high	
	20B	Kanemite 15SC	21-31 fl oz/A	12	14	high	
	21	Nexter 75WS	4.4-10.67 oz/A	12	7	high/mod	
	10A	Onager 1EC	12-24 fl oz/A	12	28	high/poor	
	21	Portal 0.4EC	2 pt/A	12	14	high	
	10A	Savey 50DF	3-6 oz/A	12	28	high/poor	
	12B	*Vendex 50WP	6-8 oz/100 gal or 1-2 lb/A	48	14	moderate	
	10B	Zeal 72WS	2-3 oz/A	12	14	high	
	The following pre-mix product is also labeled for use against these pests; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	4A/6	*Agri-Flex SC	1.5-2.0 fl oz/100 gal or 5.5-8.5 fl oz/A	12	35	high/ moderate	[8.1]
		plus:					
		Horticultural spray oil	1 qt/100 gal or 1 gal/A				
	3A/6	*Gladiator EC	4.75 fl oz/100 gal or 19 fl oz/A	12	28	high/poor	
Obliquebanded leafroller	11A	Agree WG 3.8WS	1-2 lb/A	4	0	high	[10.2]
	28	Altacor 35WDG	2.5-4.5 oz/A	4	5	high	
	3A	*Baythroid XL 1EC	2.4-2.8 fl oz/A	12	7	moderate	
	28	Belt 4SC	3-5 fl oz/A	12	14	high	
	5	Delegate 25WG	4.5-7 oz/A	4	7	high	
	11A	Deliver 18WG	0.5-2 lb/A	4	0	high	
	11A	Dipel 10.3DF	0.5-2 lb/A	4	0	high	
	5	Entrust 80WP	0.67-1 oz/100 gal or 2-3 oz/A	4	7	high	
	5	or Entrust 2SC	6-10 fl oz/A			high	
	18A	Intrepid 2F	8-16 fl oz/A	4	14	high	
	11A	Javelin 7.5WDG	0.5-4 lb/A	4	0	high	

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Obliquebanded leafroller (*continued*)	1B	*Lannate 2.4LV	0.75 pt/100 gal or 1.5-3 pt/A	48	7	moderate	
	1B	or *Lannate 90SP	0.25 lb/100 gal or 0.5-1 lb/A			moderate	
	6	*Proclaim 5SG	0.8-1.2 oz/100 gal or 3.2-4.8 oz/A	12 or 48 (E)	14	high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-6 fl oz/A	24	35	moderate	[10.3]
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	moderate	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	moderate	
	4A/28	Voliam Flexi WDG	4-7 oz/A	12	35	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	21	high	
Pear psylla	Choose from materials listed under Petal Fall, except for Esteem						[12.5]
Pearleaf blister mite	1A	Sevin XLR Plus, 4F	1.5-3 qt/A	12	3	high	[14.2]
	1A	or Sevin 80S	1.88-3.75 lb/A			high	
Redbanded leafroller	11A	Agree WG 3.8WS	1-2 lb/A	4	0	high	[16.1]
	28	Altacor 35WDG	2.5-4.5 oz/A	4	5	high	
	3A	*Baythroid XL 1EC	2.4-2.8 fl oz/A	12	7	high	
	28	Belt 4SC	3-5 fl oz/A	12	14	high	
	5	Delegate 25WG	4.5-7 oz/A	4	7	high	
	11A	Deliver 18WG	0.5-2 lb/A	4	0	high	
	11A	Dipel 10.3DF	0.5-2 lb/A	4	0	high	
	1B	Imidan 70W	0.75-1 lb/100 gal or 2.13-5.75 lb/A	7 days	7	high	
	11A	Javelin 7.5WDG	0.5-4 lb/A	4	0	high	
	6	*Proclaim 5SG	0.8-1.2 oz/100 gal or 3.2-4.8 oz/A	48	14	high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	high	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	21	high	
San Jose scale	4A	Admire Pro 4.6SC	2.8 fl oz/A	12	7	moderate	[20.2]
	4A	Assail 30SG	8 oz/A	12	7	moderate	
	16	Centaur 0.7WDG	34.5-46 oz/A	12	14	high	
	7C	Esteem 35WP	4-5 oz/A	24	45	high	
	23	Movento 240SC	6-9 fl oz/A	24	7	high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-6 fl oz/A	24	35	moderate	

Table 12.1.1. Pesticide Spray Table – Pears

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
San Jose Scale (*continued*)	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	moderate	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	21	moderate	
Spotted wing Drosophila	5	Delegate 25WG	4.5-7 oz/A	4	7	moderate	[17.2]
	5	Entrust 80WP	1.5-3 oz/A	4	7	high	[17.2]
	5	or Entrust 2SC	4-10 fl oz/A			high	
	1B	Imidan 70W	0.75-1 lb/100 gal or 2.13-5.75 lb/A	7 days	7	moderate	
Stink bugs, including Brown marmorated stink bug	4A	Actara 25WDG	4.5-5.5 oz/A	12	35	moderate	[18.2]
	3A	*Baythroid XL 1EC	2-2.4 fl oz/A	12	7	moderate	
	3A	*Brigade 2EC	2.6-12.8 fl oz/A	12	14	high	
	3A	or *Brigade 10WSB	6.4-32 oz/A	12	14	high	
	3A	*Danitol 2.4EC	10.7-21.3 fl oz/A	24	14	moderate	[18.2]
	1A	*Lannate 2.4LV	2.25 pt/A	96	7	high	[18.2]
	1A	or *Lannate 90SP	0.75 lb/A	96	7	high	
	–	Surround 95WP	25-50 lb/A	4	0	moderate	
	1A	*Vydate 2L	1.5-3 pt/A	48	14	moderate	[18.2]
	3A	*Warrior II 2.08CS	1.28-2.56 fl oz/A	24	21	moderate	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-6 fl oz/A	24	35	high	
	3A/6	*Gladiator EC	3.5-4.75 fl oz/100 gal or 14-19 fl oz/A	12	28	moderate	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	moderate	
	4A/28	Voliam Flexi WDG	6-7 oz/A	12	35	moderate	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	21	moderate	

12.2 Pear Disease Notes

12.2.1 Fabraea Leaf Spot

• Biology & Cultural

[1.1] Bosc and Seckel are much more susceptible than Bartlett.

• Pesticide Application Notes

[1.2] It is important to prevent the establishment of early primary infections. Sprays should start at green cluster if the year is wet and disease was prevalent last year; otherwise, wait until white bud. Continue sprays at 10- to 14-day intervals through 1st or 2nd cover. In orchards with high inoculum, apply a mancozeb spray at 7-day intervals after petal fall until reaching either the 77-day PHI or the limit on the number of sprays per season. A 3-wk summer spray schedule will normally maintain control if early infections have been prevented. Summer applications of Sovran or Flint to control scab or sooty blotch will also control Fabraea leaf spot. Pear psylla can facilitate the spread of leafspot during summer, so controlling psylla is important in high-pressure orchards. Using summer oils to suppress pear psylla may also suppress spread of Fabraea leaf spot during late summer.

12.2.2 Fire Blight

• Biology & Cultural

[2.1] Fire blight is an even more serious disease on pears than it is on apples. In general, the control strategies recommended for apples apply equally to pears. Bartlett, Bosc, Clapps Favorite, and Gorham are all extremely susceptible varieties. D'Anjou is slightly less susceptible, but comparable to the most highly susceptible apple variety; Seckel is considered moderately susceptible. Refer to the discussion of this disease in the "General Pest Management Considerations for Apples" section. For more details on optimizing streptomycin blossom blight sprays, see footnote 8.3 in the apple section

[2.2] The best program for reducing summer spread of fire blight is good psylla control.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[2.3] While specifically labeled for control of pseudomonas blight, a copper spray also will assist with control of fire blight. However, it will not eliminate the need for streptomycin at bloom. It is effective in reducing the population of overwintering fire blight bacteria, and is a useful component in an overall fire blight control program. Thorough coverage of the entire tree is necessary for maximum effectiveness, so high-gallonage sprays are preferred. Leaf burning may occur if applied beyond bud burst, especially under slow drying conditions. The oil should be added at a rate of 1 qt per 100 gal of actual spray solution in the tank (i.e., do not concentrate the oil). If using Bordeaux mix, prepare as described in the "Fungicides" section of "Characteristics of Crop Protectants." Add the oil after adding lime, but before making up to volume. The 1 qt of oil is added to increase the efficiency of the copper compounds and is not sufficient for good psylla control. A separate oil application can be made for psylla, or 3 gal of oil can be used with the copper sprays. Several other commercial copper formulations in addition to those listed are labeled for this use on pears. Although they have not been tested, research on other crops suggests that most copper formulations should give comparable rates of control at comparable rates of metallic copper.

[2.4] Streptomycin is not recommended for routine summer use, but is strongly recommended for use within 24 hr after the start of a hailstorm.

[2.5] Bloomtime Biological is labeled for blossom blight control in pears. This biopesticide is consistently less effective than streptomycin, but may be a viable option in orchards with low levels of fire blight inoculum and during environmental conditions indicative of a low risk of infection. Currently, this product has not been evaluated on pears in New England. However, in NY apple orchards, this product has been shown to provide up to 50% control when applied during bloom compared to streptomycin.

[2.6] Mycoshield is registered for fire blight and can be included in the management program for blossom blight. This antibiotic is consistently less effective than streptomycin, but may be viable option as a resistant management tool when used in rotation with streptomycin. Use primarily in orchards with low levels of fire blight inoculum. Research conducted in New York suggests that this product may only provide up to 50% control when applied during bloom compared to streptomycin.

[2.7] Serenade can be integrated into a fire blight control program, but it has been consistently less effective than streptomycin. Therefore, Serenade should be used only in rotational programs with streptomycin and not as the sole bactericide for fire blight management. Research at Geneva suggests that streptomycin should be the first product applied during bloom, particularly when conditions are very favorable for the development of fire blight. Serenade should be applied 24 hr after the infection event.

• Pesticide Resistance

[2.8] The recommended action plan for fire blight management in New England is as follows:

1. All fire blight cankers should be removed during winter pruning.
2. Copper applications should be made at green tip.
3. Extension warnings of fire blight infection periods should be heeded, and recommended materials sprayed promptly.
4. Prohexadione-Calcium (Apogee) sprays should be used at high rate, applied at 2-3 inches shoot growth.
5. Fire blight strikes should be pruned out promptly and destroyed.
6. If severe blossom blight occurs contact CCE for SR Ea testing.

In all regions of New England the following action plan is recommended for newly planted orchards:

1. If possible, plant varieties grafted on fire blight-resistant rootstocks.
2. Trees should be carefully examined for fire blight infections before planting. Infected trees should be discarded. Samples should be submitted for strep-resistance testing.
3. Immediately after planting a copper spray should be applied. Wait until to the soil has settled to avoid phytoxicity issues.
4. Planting should be scouted at 7-day intervals for fire blight strikes until June 30. Infected tree should be removed. Plantings also need to be scouted 7-10 days after hail or severe summer storms and at the end of the season (mid-September). The NEWA/NRCC disease forecasting models for fire blight (newa.nrcc.cornell.edu/newaModel/apple_disease) can assist by providing an estimate of symptom emergence following a storm or other trauma event.
5. If possible, remove flowers before they open. Since most new plantings have many blossoms the first year, and many orchards are high density (i.e. 1000-2000 trees per acre), blossom removal may not be possible. If practiced, the blossoms should be removed before there is a high risk of FB infection.
6. Apply copper, tank mix of streptomycin and oxytetracycline at the full label rate for each during any remaining bloom based on blossom blight predictions. The NEWA/NRCC disease forecasting models for fire blight (newa.nrcc.cornell.edu/newaModel/apple_disease) will run nearly until August, and have an adjustable bloom date to account asynchronous or late bloom in new plantings.
7. Trees should receive a second copper spray at a stage equivalent to bloom. 48 hours REI before blossom removal.

8. Samples of any infections seen after planting should be submitted for streptomycin resistance testing.

12.2.3 Pear Scab

• Biology & Cultural

[3.1] Seckels are very susceptible to scab; Bosc and D'Anjou, somewhat less so; Bartlett is relatively resistant.

• Pesticide Application Notes

[3.2] If scab developed the previous year, sprays should begin at green cluster and continue at 7- to 10-day intervals through 2nd cover. In blocks with little history of scab, applications from white bud through 1st cover should provide sufficient protection. Additional cover sprays will be necessary if scab becomes established and the season remains wet. Use of Topsin M and Thiophanate-methyl should be limited during the early season if substantial use is anticipated later in the season for control of sooty blotch and Fabraea leaf spot. Note: Topsin M has a 48 hour REI. Thiophanate-methyl has a 3-day (76 hr) REI.

[3.3] Mancozeb fungicides are more effective than ferbam or ziram. It is labeled for use on pears in one of two different ways: (i) at a rate of 1.5-2 lb/100 gal (maximum 6 lb/A, no more than 24 lb/A per year), not to be applied after bloom; OR (ii) at a reduced rate of 3 lb/A (maximum 21 lb/A per year), which may be applied to within 77 days of harvest.

The latter program is particularly valuable where Fabraea leaf spot and sooty blotch must be controlled in the early summer. It is illegal to combine or integrate the two treatment regimes or to use any mancozeb sprays after bloom if any of the earlier sprays were applied at more than 3 lb/A of formulated product.

[3.4] Sovran and Flint are excellent protectants, and will be most reliable when used in this manner. They have 48-72 hr post infection activity against pear scab. They significantly reduce spore production from the lesions that develop when the fungicides are applied several days after the start of an infection period. They are not registered for control of Fabraea leaf spot but they control leaf spot when applied during the summer. They provide good control of black rot on apples, but they are not registered for control of this disease on pears and experience with control of black rot on pears is lacking. The strobilurins are prone to resistance development, and it appears that resistance to one member of this class of materials confers resistance to other products in the class (cross-resistance). The primary strategies for reducing the resistance risk are to: (i) rotate these materials with unrelated fungicides; and (ii) limit the number of seasonal applications of a strobilurin (e.g., three per year).

[3.6] The risk of primary scab is greatly reduced after 1st or 2nd cover. Where scab has been well controlled and there is no history of leafspot problems, it is possible to extend fungicide spray intervals to 14-21 days after the 3rd cover has been applied. If these diseases have not been controlled, fungicides should be applied at 10- to 14-day intervals throughout the summer, except during drought periods. Observe mancozeb restrictions detailed in [3.3].

[3.7] Fontelis has excellent protectant activity. Fontelis is most effective against scab when applied at 7-10-day intervals to control primary and secondary scab. Fontelis also has fairly good activity against powerdy mildew. There have been reports of phytotoxicity with tank mixes of Fontelis and captan applied from petal fall to 2nd cover. Hence, tank mixes of Fontelis and captan should be avoided during this timeframe.

12.2.4 Sooty Blotch

• Biology & Cultural

[4.1] Sooty blotch develops gradually during periods of rain, dew, and very high humidity. The disease is favored by frequent showers, poor air circulation, and proximity to sources of inoculum such as woods and brushy hedgerows. Fungicide control programs should begin around 1st cover, depending upon weather and inoculum pressure. Pruning to improve air circulation through the canopy will reduce the total fungicide need in most years. See [3.3] above, and remark [10.1] in the General Pest Management Considerations for Apples section for additional information about sooty blotch.

12.3 Pear Insect and Mite Notes

12.3.1 Aphids, Including Spirea Aphid

• Pesticide Application Notes

[5.1] Calypso or Movento applied at petal fall will also control Comstock mealybug. Movento must be used with a spray adjuvant having spreading and penetrating properties. *Agri-Flex must be used with a horticultural spray oil (not a dormant oil). Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Agri-Flex and *Leverage should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

[5.2] For enhanced residual control, combine M-Pede with another recommended product.

12.3.2 Brown Marmorated Stink Bug – refer to section 12.3.15 Stink Bugs

12.3.3 Codling Moth

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[6.1] A developmental model predicts the appropriate larval treatment period for CM as 250-360 degree-days (base 50°F) after 1st adult catch for each generation, and approximately 150 DD after this same biofix date for insecticides with ovicidal activity. Use of a non-ionic surfactant is recommended with Assail. Pyrethroid insecticides applied during summer against pear psylla will control codling moth. Use Sevin at 1 lb rate. Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product. Suggested action threshold: Avg. of >5 CM adults/week caught per pheromone trap once 150-360 DD (base 50°F) have accumulated since biofix.

• Biological & Non-chemical Control

[6.2] Better control is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Residual field life of CM-F may require re-application after 14 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

12.3.4 Comstock Mealybug

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[7.1] Sprays recommended at petal fall and 7d later, against newly emerged crawlers. Research suggests that treatments against 2nd generation crawlers are more effective, but petal fall sprays may be of use in keeping populations low. Movento must be used with a spray adjuvant having spreading and penetrating properties. Actara and Calypso will also control plum curculio and pear psylla when applied at petal fall.

[7.2] Two sprays recommended for the 2nd generation, 7 days apart, against newly hatched crawlers. Begin approximately Aug. 1 in southern New England, one week later in central New England.

[7.3] Multiple applications of Actara, *Agri-Flex or Voliam Flexi in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. of thiamethoxam containing products per acre per growing season. Movento must be used with a spray adjuvant having spreading and penetrating properties. *Agri-Flex must be used with a horticultural oil (not dormant oil). Suggested action threshold: 5% calyx infestation of previous year's crop.

12.3.5 European Red Mite, Twospotted Spider Mite

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[8.1] Applications advised as needed in summer. Acramite and Apollo are not effective against rust mite. Kanemite limited to a maximum of 2 applications per season; Portal limiated to 1 application per growing season; Kanemite not registered for pear rust mite. Savey and Acramite limited to 1 application per season. *Agri-Flex most effective from petal fall through 6 weeks past petal fall; must be applied in combination with a horticultural spray oil (not a dormant oil). Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. Suggested action threshold: 6 motile forms/leaf.

12.3.6 Green Fruitworms

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[9.1] Growers can usually wait until petal fall to assess the need for treatment. Only 1.8 lb AI/ acre of *Lannate permitted per season. It is recommended that pyrethroids not be used more than 1-2 times per season in any orchard. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product. Suggested action threshold: 3 larvae/tree on large trees (27-40 trees/A); 1 larva/tree at density of 140 trees/A.

12.3.7 Obliquebanded Leafroller

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for

current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[10.1] Spray recommended when last petals are falling. Only 1.8 lb AI/acre of *Lannate permitted per season. Will also help control Comstock mealybug. A pyrethroid applied now against pear psylla will also control obliquebanded leafroller. Suggested action threshold: 5-10% infested clusters.

[10.2] For 1st summer brood in July, begin applications approximately 360 DD [base 43°F] after 1st adult trap catch. Only 1.8 lb AI/acre in 2 applications of *Lannate permitted/season.

[10.3] Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

12.3.8 Pear Midge

• Pesticide Application Notes

[11.1] Two spray applications between the swollen bud and white bud stages.

12.3.9 Pear Psylla

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[12.1] To inhibit egg-laying by psylla, apply oil as soon as first eggs are laid in the spring; timing is especially critical (not effective if >20% of spring oviposition has occurred). Make 2nd application in 7 days if adults are still present. If 2 sprays are anticipated, drop rate to 2 gal for both. The 3 gal rate can also help reduce overwintering populations of European red mite, pearleaf blister mite, and Comstock mealybug. Suggested action threshold for pear psylla: 1 egg in a 3-minute inspection of buds.

[12.2] Apply insecticide from swollen bud through white bud. Pear rust mite may build up with repeated pyrethroid use. Seasonal maximum for *Ambush is 0.8 lbs. a.i./acre and *Pounce is 2 lb a.i./A; for *Asana, up to 0.2 lb a.i. during the dormant to white bud stage and up to 0.225 lb a.i. between bloom and harvest (but no more than 0.375 lb total a.i./Acre per season). *Warrior provides suppression only. Esteem may be applied once prebloom at 5 oz/A, or once prebloom and once at petal fall at 4-5 oz/A. Improved activity of Delegate may be obtained by addition of an adjuvant such as horticultural mineral oil. Movento must be used with a spray adjuvant having spreading and penetrating properties. Centaur may cause phytotoxicity in Oriental pear varieties when applied prior to petal fall. Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. Suggested action threshold before white bud: 6-10% of spurs with eggs.

[12.3] M-Pede can provide suppression when used in a seasonal program. Uniform drying conditions are required to prevent droplet residue on fruit; short residual period.

[12.4] One spray of oil at 2 gal rate, or 2 sprays at 1 gal rate, recommended through tight cluster.

[12.5] Nexter is limited to a maximum of 1 application per season. Multpile applications of Actara in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. of thiamethoxam containing products per acre per growing season.Portal limited to a maximum of 1 application per growing season. Esteem may be applied once prebloom at 5 oz/A, or once prebloom and once at petal fall at 4-5 oz/A. Suggested action threshold after fruit set: Avg of 1-2 nymphs per terminal leaf. *Agri-Mek can be used anytime from petal fall to about 4 weeks afterward, but is most effective when applied before foliage begins to harden off, generally within the first 2 weeks after petal fall. *Agri-Mek must be applied with a horticultural oil (not a dormant oil). Movento must be applied with a spray adjuvant having spreading and penetrating properties. , *Agri-Flex must be mixed with a horticultural spray oil. Improved activity of Delegate may be obtained by addition of an adjuvant such as horticultural mineral oil. Actara and Calypso will also control plum curculio and Comstock mealybug when applied at petal fall. Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

[12.6] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised in New England while there is active foliar growth.

• Pesticide Resistance

[12.7] Variable levels of pear psylla tolerance or resistance to pyrethroids may exist in New England, so growers should alternate use of pyrethroids with other materials to delay the development of resistance in their orchards. The preferred strategy would be to withhold their use until (and unless) needed in the summer.

12.3.10 Pear Rust Mite

• Pesticide Application Notes

[13.1] In blocks with a history of rust mite infestations, a preventive petal fall spray might be advisable. Nexter limited to a maximum of 1 application per season. See [8.1]. Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

12.3.11 Pearleaf Blister Mite

• Pesticide Application Notes

[14.1] A spray of oil plus diazinon in the spring, just before the green tissue begins to show, will benefit most control programs.

[14.2] A fall application post-harvest, when there is no danger of frost for at least 24-48 hr after the spray.

12.3.12 Plum Curculio

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[15.1] Sprays recommended at petal fall and 10 days later. 1st brood codling moth is also controlled by these materials; (see [6.1] for 2nd brood control). Imidan also controls fruit tree leafroller. Actara will also control pear psylla and Comstock mealybug when applied at petal fall. Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Agri-Flex, *Leverage, Voliam Flexi or *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

12.3.13 Redbanded Leafroller

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[16.1] Two sprays, from mid-July to early August, for 2nd brood control in problem blocks; note PHI restrictions. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

12.3.14 Spotted Wing Drosophila

•Biology & Cultural

[17.1] This is an exotic species of vinegar fruit fly, a group normally attracted to damaged and rotting fruit. But in contrast to endemic Drosophila fruit flies, it has a serrated ovipositor and will lay eggs in intact ripening fruit on the tree; it is also a pest of berry fruit crops. Originally known from Japan, it has now been found in New England, as well as in nearby states such as NY, PA, NJ, and MI. Refer to the reference materials list (17.4.2, Other References) at the end of this publication for fact sheets containing details on the biology and management of this species.

• Pesticide Application Notes

[17.2] Apply at first signs of adult activity. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. Delegate labeled for suppression only. Entrust use requires the ser to have a copy of the appropriate 2(ee) recommendation in their possession at time of use.

12.3.15 Stink Bugs (including Brown Marmorated Stink Bug)

• Biology & Cultural

[18.1] A number of native stink bug species can sometimes cause fruit damage in all tree fruits under conditions that are not fully understood. Adult feeding during bloom and shuck split can cause the fruit to abort, and feeding later in the summer can cause a deep catfacing injury such as that caused by tarnished plant bug, or depressed, dimpled, corky or water-soaked areas on the skin. All tree fruits are attacked, especially peaches and apples. Other species of stink bugs are predators. Elimination of alternate host broadleaf weeds, especially legumes, in the orchard will contribute to management efforts. If control is needed, insecticides should be timed to kill immigrating adults as they appear in the orchards to prevent feeding damage and subsequent mating and egglaying.

The brown marmorated stink bug is an invasive species from Asia that was first documented in Allentown, PA in 2001. This insect has spread across a number of eastern US States, and now extends to the west coast as well. It was first documented in NY in the Hudson Valley Region in 2008. Although it can be found throughout NY in and around structures and vehicles, extensive monitoring efforts in 2011 and 2012 have resulted in very few detections in agricultural crops; however, reports of sightings have been increasing. Refer to the reference materials list (17.4.2, Other References) at the end of this publication for fact sheets containing details on the biology and management of brown marmorated stink bug.

• Pesticide Application Notes

[18.2] Apply at first signs of infestation; BMSB are very mobile pests, and may reinfest the treated area quickly. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. Actara, *Danitol, *Lannate, and *Vydate have FIFRA Section 2(ee) recommendations for BMSB; the labeling must be in the possession of the user at the time of pesticide application. Only 1 application of *Vydate allowed per season. For best effectiveness and insecticide

resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

12.3.16 Tarnished Plant Bug, Pear Plant Bug

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[19.1] Recommended spray timing is from green cluster to white bud. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage or *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product. Suggested action threshold: plant bugs – 3 bleeding sites/tree, or a cumulative catch of 7 adults by white bud stage (white sticky-board trap). See Comment [12.7].

12.3.17 San Jose Scale

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[20.1] Apply during delayed dormant against overwintering immatures; thorough coverage improves efficacy. Addition of oil to Assail, Esteem and Lorsban will improve performance.

[20.2] 2 sprays against first and peak (7-10 days later) crawler activity in both generations. Movento must be used with a spray adjuvant having spreading and penetrating properties; most effective when used at petal fall to first cover.

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12.4 Growth Regulation of Pears

Table 12.4.1. Growth Regulator Uses in Pears.

Timing	*Product*	*Concentration*	*Rate of Formulated Product*
Chemical Thinning			
Petal Fall to 5-7 days after petal fall	Amid-Thin W (NAD)	25-50 ppm	4-8 oz / 100 gal
Labeled for use on Bartlett and Bosc. Apply between petal fall and 5-7 days after petal fall.			
7-28 days after full bloom	Fruitone-N, Fruitone-L	10-15 ppm	4-6 oz /100 gal
Labeled for use on Bartlett, Bosc and Comice. NAA is more effective at early timings and should be applied as soon as fruit set is apparent for greatest success. Late applications may result in reduced fruit size. Do not apply when temperature is below 60°F or above 85°F. NAA will not usually adequately thin Bartlett but the additon of a surfactant will improve thinning.			
Fruit Size 8-14mm (7-28 days after full bloom)	Maxcel, RiteWay	125-200 ppm	80-128 fl oz /100 gal
Rates of Maxcel for pears are significantly higher than for apples. We recommend 150ppm for Bartlett and 75 ppm for Bosc. Do not apply when temperature is below 60°F or above 85°F.			
Induction of Lateral Branching in Young Trees			
1-2" of Terminal Shoot Growth	Promalin, Perlan, Typy, Maxcel	125-1000 ppm (500 ppm Maxcel)	0.25-2 pt / 5 gal
Include a non-ionic surfactant and apply as a directed spray to areas where additional branching is desired. This practice is more effective in the second and third growing seasons after planting. Response on weak or low-vigor trees is usually disappointing. For nursery stock treat after trees have reached a terminal height at which lateral branching is desired.			
Preharvest Fruit-Drop Control			
1-2weeks before anticipated harvest	ReTain	132 ppm	333 g / acre or 1 pouch
Apply in sufficient water to ensure thorough but not excessive coverage. An organosilicone surfactant (12 oz/100 gal) should be used with ReTain.			
5-7 days before harvest	Fruitone-N, Fruitone-L	10-15ppm	4-6 oz (lb)/100 gal
Apply 7 days before harvest on D'Anjou, Bosc, and Bartlett. Make separate sprays to early and late maturing varieties.			

* To convert ounces (lb) to grams multiply ounces by 28.3. To convert fluid ounces to milliliters multiply fluid ounces by 29.57.

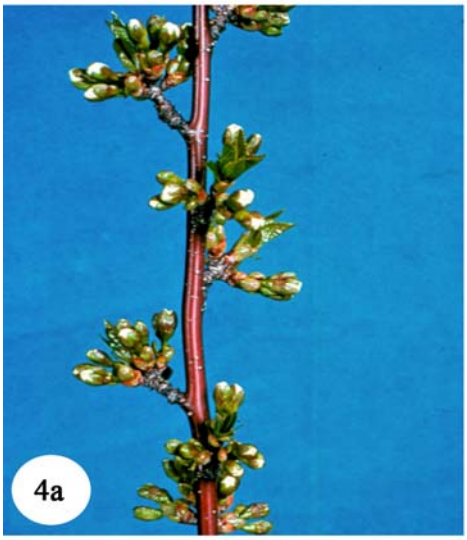

FIGURE 13.1.1

GROWTH STAGES IN TART CHERRY

1. Dormant
2. Swollen bud
3 Bud burst
4a. Early white bud
4b. White bud
5. Bloom
6. Petal fall
7. Fruit set

FIGURE 13.1.2

GROWTH STAGES IN SWEET CHERRY

1. Dormant
2. Swollen bud
3 Bud burst
4a. Early white bud
4b. White bud
5. Bloom
6. Petal fall
7. Fruit set

13 Cherries

13.1 Insecticides and Fungicides for Cherries

See Sections 13.2, 13.3, and 13.4 for comments related to this table.

Table 13.1.1. Pesticide Spray Table – Cherries

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Late Dormant							
Bacterial canker (*Pseudomonas syringae*)		Kocide 3000	1.1-2.3 lb/100 gal	48	BL, PH (C)		[1.1]
		or Cuprofix Ultra 40 Disperss	5-8 lb/A	48	BL, PH (C)		[1.2]
		or other coppers	see comments, read labels				
Phytophthora root, crown and collar rots		Ridomil Gold 4SL	2 qt/A	48	0		[5.2]
European red mite, Scales	–	oil	2 gal/100 gal	12	0	high	[11.1],[16.1]
European fruit lecanium scale, San Jose scale	4A	Assail 30SG	5.3-8 oz/A	12	7	moderate	[16.1]
	16	Centaur 0.7WDG	34.5-46.0 oz/A	12	14	high	
	7C	Esteem 35WP	4-5 oz/A	12	14	high	
	1B	*Lorsban Advanced 3.76EC	1.5-4 pt/A	96	PB	high	
	1B	Lorsban 75WG	1.33-2 lb/A	96	14	high	
White bud							
Brown rot (blossom blight)		Bravo Weather Stik 6F	1.0-1.375 pt/100 gal or 3.1-4.1 pt/A	12	SS		
		or other chlorothalonil formulations (see labels)					
		Captan 50WP	4 lb/A	24	0		[3.1],[3.2]
		or Captan 80 WDG	2.5 lb/A	24	0		
		or Captec 4L	0.75-1 qt/100 gal or 2 qt/A	24	0		
		Echo 720 or Echo 90DF	1.09-1.4 pt/100 gal 2.25-3.5 lbs/A	12	SS		
		Elevate 50WDG	0.33-0.5 lb/100 gal or 1.5 lb/A	12	0		
		Fontelis SC	14-20 fl oz /A	12	0		[3.8]
		Indar 2F	6fl oz/A	12	0		
		Merivon	4-6.7 fl oz.acre	12	0		
		Meteor 4F	1-2 pt/acre	24	PF		
		Tilt	1.0-1.6 fl oz/100 gal or 4 fl oz/A	12	0		
		Pristine 38WDG	10.5-14.5 oz/A	12	0		
		Cabrio EG	9.55 oz/A	12	0		
		Quash	2.5-3.5 oz/A	12	14		
		Rally 40 WSP	1.25-2 oz 100 gal or 2.5-6 oz/A	24	0		
		Rovral 4F	8fl oz/100 gal or 1 pt/A	24	PF		
		Sulfur 92WP	5-10 lb/100 gallons	24	0		
		Microthiol Disperss	10-20 bl/100 gallons	24	0		

Table 13.1.1. Pesticide Spray Table – Cherries

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
White bud (continued)							
Black cherry aphid	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	14	high	[9.1]
	4A	Assail 30SG	2.5-5.3 oz/A	12	7	high	
	–	Aza-Direct 1.2L	11.5-42 fl oz/A	4	0	moderate	
	–	Azatin XL Plus 3L	10-16 fl oz/A	4	0	moderate	
	3A	*Baythroid XL 1EC	2.4-2.8 fl oz/A	12	7	high	
	9C	Beleaf 50SG	2-2.8 oz/A	12	14	high	
	1B	Malathion 57EC	1.5 pt/A	12	3	moderate	
	–	M-Pede 49L	2 gal/100 gal	12	0	moderate	
	23	Movento	6-9 fl oz/acre	24	7	high	
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	14	high	
	The following pre-mix product is also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	high	[9.1]
Bloom							
Black knot		Bravo Ultrex 82.5 WDG or Bravo Weather Stik 6F	0.9-1.25 lb/100 gal or 2.8-3.8 lb/A 1.0-1.375 pt/100 gal	12	SS		[2.1],[2.2]
Brown rot (blossom blight)	See materials listed under White Bud						[3.1],[3.3], [3.4]
Petal fall							
Black knot	See recommendations under Bloom						[2.1],[2.2]
Brown rot	See recommendations under White Bud						[3.3],[3.5]
Leaf spot		Bravo Ultrex 82.5 WDG or Bravo Weather Stik 6F or other chlorothalonil formulations (see labels)	0.9-1.25 lb/100 gal or 2.8-3.8 lb/A 1.0-1.375 pt/100 gal	12	SS, PH		[4.1]
		Captan 50WP	1-2 lb/100 gal or 4 lb/A	24	0		
		or Captan 80 WDG	2.5 lb/A	24	0		
		or Captec 4L	0.75-1 qt/100 gal or 2 qt/A	24	0		
		Echo 720 or Echo 90DF	1.0-1.4 pt/100 gal 2.25-3.5 lbs/A	12	SS		
		Fontelis SC	14-20 fl oz /A	12	0		[3.8]
		Indar 2F	6- fl oz/A	12	0		
		Tilt	1.0-1.6 fl oz/100 gal or 4 fl oz/A	12	0		
		Rally 40 WSP	1.25-2 oz/100 gal or 2.5-6 oz/A	24	0		
		Gem 500SC	1.9-3.8 oz/A	12	1		
		Pristine 38WDG	10.5-14.5 oz/A	12	0		
		Quash	4 oz/A	12	14		
		Sulfur 92WP	5-10 lb/100 gallons	24	0		

Table 13.1.1. Pesticide Spray Table – Cherries

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Petal fall (continued)							
Leaf spot (*continued*)		Microthiol Disperss	10-20 bl/100 gallons	24	0		
American plum borer, Lesser peachtree borer	3A	*Ambush 25WP	6.4-12.8 oz/A	12	3	moderate	[8.1], [13.2]
	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	14	high	
	3A	*Baythroid XL 1EC	1.4-2.8 fl oz/A [see Comment 8.1]	12	7	high	
	1B	*Lorsban Advanced 3.76EC	1.5-3 qt/100 gal	96	21	high	
	1B	or Lorsban 75WG	1.3-2 lb/A	96	21	high	
	3A	*Pounce 25WP	6.4-12.8 oz/A	12	3	moderate	
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	14	high	
	–	Pheromone disruption ties: Isomate-PTB Dual	150 ties/A			high	[13.1]
	The following pre-mix products are also labeled for use against these pests; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species present are appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/6	*Gladiator EC	1.5-4.75 fl oz/100 gal or 6-19 fl oz/A	12	21	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	high	[8.1]
Black cherry aphid	[see Comment 9.2]						[9.2]
Plum curculio	4A	Actara 25WDG	4.5-5.5 oz/A	12	14	high	[15.1]
	3A	*Ambush 25WP	6.4-12.8 oz/A	12	3	high	
	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	14	high	
	22A	Avaunt 30WDG	5-6 oz/A	12	14	high	
	3A	*Baythroid XL 1EC	2.4-2.8 fl oz/A	12	7	high	
	1B	Imidan-70W (tart cherry only!)	0.75 lb/100 gal or 2.13 lb/A	72	7(C)	high	[15.3]
	1B	Lorsban 75WG	2 lb/A	96	14	high	[15.3]
	3A	*Pounce 25WP	6.4-12.8 oz/A	12	3	high	
	1A	Sevin XLR Plus, 4F	2-3 qt/A	12	3	moderate	
	1A	or Sevin 80S	2.5-3.75 lb/A			moderate	
	–	Surround 95WP	50 lb/A	4	0	moderate	[15.2]
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	14	high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/6	*Gladiator EC	1.5-4.75 fl oz/100 gal or 6-19 fl oz/A	12	21	high	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	[15.1]
	4A/28	Voliam Flexi WDG	6-7 oz/A	12	14	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	high	

Table 13.1.1. Pesticide Spray Table – Cherries

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Shuck split							
Brown rot, Leaf spot		Bravo Weather Stik 6F	1.0-1.375 pt/100 gal or 3.1-4.1 pt/A	12	SS		[3.1],[3.2]
		or other chlorothalonil formulations (see labels)					
		Captan 50WP	1-2 lb/100 gal or 4 lb/A	24	0		
		or Captan 80 WDG	2.5 lb/A	24	0		
		or Captec 4L	0.75-1 qt/100 gal or 2 qt/A	24	0		
		Echo 720 or Echo 90DF	1.0-1.4 pt/100 gal 2.25-3.5 lbs/A	12	SS		
		Fontelis SC	14-20 fl oz /A	12	0		[3.8]
		Merivon	4-6.7 fl oz/acre	12	0		
		Rally 40 WSP (brown rot only)	2.5-6 oz/acre	24	0		
		Gem 500SC	1.9-3.8 oz/A	12	1		
		Pristine 38WDG	10.5-14.5 oz/A	12	0		
		Cabrio EG	9.55 oz/A	12	0		
		Indar 2F	6fl oz/A	12	0		
		Quash	2.5-4. oz/A	12	14		
		Sulfur 92WP	5-10 lb/100 gallons	24	0		
		Microthiol Disperss	10-20 bl/100 gallons	24	0		
Black knot		Bravo Ultrex 82.5 WDG	0.9-1.25 lb/100 gal or 2.8-3.8 lb/A	12	SS		[2.1],[2.2]
		or Bravo Weather Stik 6F	1.0-1.375 pt/100 gal or 3.1-4.1 pt/A				
		or other chlorothalonil formulations (see labels)					
Black cherry aphid	4A	Admire Pro 4.6SC	1.4-2.8 fl oz/A	12	7	high	[9.1]
	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	14	high	
	4A	Assail 30SG	2.5-5.3 oz/A	12	7	high	
	–	Aza-Direct 1.2L	11.5-42 fl oz/A	4	0	moderate	
	–	Azatin XL Plus 3L	10-21 fl oz/A	4	0	moderate	
	3A	*Baythroid XL 1EC	2.4-2.8 fl oz/A	12	7	high	
	9C	Beleaf 50SG	2-2.8 oz/A	12	14	high	
	1B	Lorsban 75WG	2 lb/A	96	14	moderate	[9.3]
	1B	Malathion 57EC	1.5 pt/A	12	3	moderate	
	–	M-Pede 49L	2 gal/100 gal	12	0	moderate	
	23	Movento 240SC	6-9 fl oz/A	24	7	high	
	1A	Sevin XLR Plus, 4F	2-3 qt/A	12	3	high	
		or Sevin 80S	2.5-3.75 lb/A			high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-5.5 fl oz/A	24	14	high	[9.1]
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	
	4A/28	Voliam Flexi WDG	4-7 oz/A	12	14	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	high	[15.1]

Table 13.1.1. Pesticide Spray Table – Cherries

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Shuck split (continued)							
Plum curculio	See materials under Petal Fall						
Additional summer sprays							
Brown rot		Captan 50WP	1-2 lb/100 gal or 4 lb/A	24	0		[3.7]
		or Captan 80 WDG	2.5 lb/A	24	0		
		or Captec 4L	0.75-1 qt/100 gal or 2 qt/A	24	0		
		Elevate 50WDG	1.0 lb/A	12	0		
		Fontelis SC	14-20 fl oz /A	12	0		[3.8]
		Indar 2F	6 oz/A	12	0		
		Merivon	4-67 fl oz/acre	12	0		
		Tilt	1.0-1.6 fl oz/100 gal or 4 fl oz/A	12	0		
		Cabrio EG	9.55 oz/A	12	0		
		Gem 500 SC	2.9-3.8 oz/A	12	1		
		Pristine 38WDG	10.5-14.5 oz/A	12	0		
		Quash	2.5-4 oz/A	12	14		
		Rally 40 WSP	1.25-2 oz/100 gal or 2.5-6 oz/A	24	0		
Leaf spot	Choose from materials listed at Petal Fall.						[4.3]
Powdery mildew		Quintec	7fl oz/A	12	7		[6.1]
		Rally 40WSP	1.25-2 oz/100 gal or 2.5-6 oz/A	24	0		
		Tilt	1.0-1.6 fl oz/100 gal or 4 fl oz/A	12	0		
		Procure 480SC	8-16 oz/A	12	1		
		Fontelis SC	14-20 fl oz /A	12	0		[3.8]
		Gem 500SC	1.9-3.8 oz/A	12	1		
		Cabrio EG	9.55 oz/A	12	0		
		Pristine 38WDG	10.5-14.5 oz/A	12	0		
		Quash	2.5-4 oz/A	12	14		
		Sulfur 92WP	5-10 lb/100 gal	24	0		
		Microthiol Disperss	10-20 lb/100 gal	24	0		
American plum borer	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	14	moderate	[8.1]
	3A	*Baythroid XL 1EC	2.4-2.8 fl oz/A	12	7	moderate	
	1B	Lorsban 75WG	2-3 lb/A	96	21	high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-5.5 fl oz/A	24	14	high	[8.1]
	3A/6	*Gladiator EC	1.5-4.75 fl oz/100 gal or 6-19 fl oz/A	12	21	moderate	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	moderate	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	moderate	

Table 13.1.1. Pesticide Spray Table – Cherries

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Additional summer sprays (continued)							
Black cherry fruit fly, Cherry fruit fly	4A	Actara 25WDG	4.5-5.5 oz/A	12	14	moderate	[10.1]
	4A	Admire Pro 4.6SC	1.4-2.8 fl oz/A	12	7	moderate	
	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	14	high	
	4A	Assail 30SG	5.3-8 oz/A	12	7	high	
	3A	*Baythroid XL 1EC	2.4-2.8 fl oz/A	12	7	high	
	5	Delegate 25WG	4.5-7 oz/A	4	7	high	
	1B	*Diazinon 50WP	1 lb/100 gal	96	21	high	
	5	Entrust 80WP	0.42-0.83 oz/100 gal or 1.25-2.5 oz/A	4	7	moderate	
	5	or Entrust 2SC	1.3-2.7 fl oz/100 gal or 4-8 fl oz/A			moderate	
	1B	Imidan 70-W (tart cherry only)	0.75 lb/100 gal or 2.13 lb/A	72	7(C)	high	[10.3]
	1B	Lorsban 75WG	2 lb/A	96	14	high	[10.3]
	1A	Sevin XLR Plus, 4F	2-3 qt/A	12	3	high	
	1A	or Sevin 80S	2.5-3.75 lb/A			high	
	–	Surround 95WP	50 lb/A	4	0	moderate	[10.2]
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	14	high	
	The following pre-mix products are also labeled for use against these pests; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-5.5 fl oz/A	24	14	moderate	[10.1]
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	
	4A/28	Voliam Flexi WDG	6-7 oz/A	12	14	moderate	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	high	
European red mite, Twospotted spider mite	10A	Apollo 4SC	2-8 oz/A	12	21	high/poor (ERM/ TSSM)	[11.4]
	3A	*Danitol 2.4EC	10.7-21.3 fl oz/A	24	3	moderate	
	21	Nexter 75WS	4.4-10.67 oz/A	12	300(PH)	high/mod	[11.3]
	10A	Onager 1EC	12-24 fl oz/A	12	7	high/poor	
	21	Portal 0.4EC	2 pt/A	12	7	high	
	10A	Savey 50DF	3-6 oz/A	12	28	high/poor	[11.4]
	12B	*Vendex 50WP	1-5-3 lb/A	48	14	moderate	[11.2]
	10B	Zeal 72WS	2-3 oz/A	12	7	high	[11.4]
	The following pre-mix product is also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/6	*Gladiator EC	4.75 fl oz/100 gal 19 fl oz/A	12	21	moderate	
Japanese beetle	4A	Admire Pro 4.6SC	1.4-2.8 fl oz/A	12	7	moderate	[12.2]
	4A	Assail 30SG	5.3-8 oz/A	12	7	high	
	1B	Imidan 70-W (tart cherry only)	0.75 lb/100 gal or 2.13 lb/A	72	7(C)	moderate	

Table 13.1.1. Pesticide Spray Table – Cherries

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Additional summer sprays (continued)							
Japanese beetle (*continued*)	1A	Sevin XLR Plus, 4F or Sevin 80S	2-3 qt/A 2.5-3.75 lb/A	12	3	high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-5.5 fl oz/A	24	14	high	[12.2]
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	high	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	high	
San Jose scale	4A	Admire Pro 4.6SC	2.8 fl oz/A	12	7	moderate	[16.2]
	4A	Assail 30SG	8 oz/A	12	7	moderate	
	16	Centaur 0.7WDG	34.5-46 oz/A	12	14	high	
	7C	Esteem 35WP	4-5 oz/A	12	14	high	
	23	Movento 240SC	6-9 fl oz/A	24	7	high	
	The following pre-mix product is also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	moderate	
Lesser peachtree borer	–	Pheromone disruption ties: Isomate-PTB Dual	150 ties/A			high	[13.1]
	3A	*Ambush 25WP	6.4-12.8 oz/A	12	3	moderate	[13.2]
	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	14	high	
	3A	*Baythroid XL 1EC	1.4-2 fl oz /A	12	7	high	
	1B	or Lorsban 75WG	1.3-2 lb/A	96	14	high	
	3A	*Pounce 25WP	6.4-12.8 oz/A	12	3	moderate	
	3A	*Warrior II 2.08 CS	1.28-2.56 fl oz/A	24	14	high	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-5.5 fl oz/A	24	14	high	[13.2]
	3A/6	*Gladiator EC	1.5-4.75 fl oz/100 gal or 6-19 fl oz/A	12	21	moderate	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	high	
Obliquebanded leafroller	28	Altacor 35WDG	3-4.5 oz/A	4	10	high	[14.1]
	3A	*Baythroid XL 1EC	2.4-2.8 fl oz/A	12	7	moderate	
	28	Belt 4SC	3-4 fl oz/A	12	7	high	
	3A	*Danitol 2.4EC	10.7-21.3 fl oz/A	24	3	moderate	
	5	Delegate 25WG	4.5-7 oz/A	4	7	high	
	11A	Deliver 18WG	0.5-2 lb/A	4	0	high	
	5	Entrust 80WP	0.42-0.83 oz/100 gal or 1.25-2.5 oz/A	4	7	moderate	
	5	or Entrust 2SC	1.3-2.7 fl oz/100 gal or 4-8 fl oz/A			moderate	
	11A	Javelin 7.5 WDG	0.25-4 lb/A	4	0	high	

Table 13.1.1. Pesticide Spray Table – Cherries

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Additional summer sprays (continued)							
Obliquebanded leafroller (*continued*)	1B	Lorsban 75WG	1.3-2 lb/A	96	14	moderate	[14.2]
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-5.5 fl oz/A	24	14	moderate	[14.1]
	3A/6	*Gladiator EC	1.5-4.75 fl oz/100 gal or 6-19 fl oz/A	12	21	moderate	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	moderate	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	high	
Spotted wing Drosophila	5	Delegate 25WG	4.5-7 oz/A	4	7	moderate	[17.2]
	5	Entrust 80WP	0.42-0.83 oz/100 gal or 1.25-2.5 oz/A	4	7	high	[17.2]
	5	or Entrust 2SC	1.3-2.7 fl oz/100 gal or 4-8 fl oz/A			high	
	1B	Imidan 70WS	0.75 lb/100 gal or 2.13 lb/A	72	7(C)	moderate	[17.2]
	3A	*Lambda-Cy 1EC	5.12 fl oz/A	24	14	high	
Stink bugs, including Brown marmorated stink bug	4A	Actara 25WDG	4.5-5.5 oz/A	12	14	moderate	[18.2]
	3A	*Asana XL 0.66EC	2-5.8 fl oz/100 gal or 4.8-14.5 fl oz/A	12	14	moderate	
	3A	*Baythroid XL 1EC	2-2.4 fl oz/A	12	7	moderate	
	3A	*Danitol 2.4EC	10.7-21.3 fl oz/A	24	3	moderate	[18.2]
	3A	*Warrior II 2.08CS	1.28-2.56 fl oz/A	24	14	moderate	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.						
	3A/4A	*Endigo ZC	5-5.5 fl oz/A	24	14	high	
	3A/4A	*Leverage 360	2.4-2.8 fl oz/A	12	7	moderate	
	4A/28	Voliam Flexi WDG	6-7 oz/A	12	14	moderate	
	3A/28	*Voliam Xpress	6-12 fl oz/A	24	14	moderate	
Postharvest							
Leaf spot		Bravo Ultrex 82.5 WDG or Bravo Weather Stik 6F	0.9-1.25 lb/100 gal or 2.8-3.8 lb/A 0.75-1 lb/100 gal	12	–		
		Captan 50WP	1-2 lb/100 gal or 4 lb/A	24	–		
		or Captan 80 WDG	2.5 lb/A	24	–		
		or Captec 4L	0.75-1 qt/100 gal or 2 qt/A	24	–		
		C-O-C-S *plus:* hydrated lime formulations (see labels)	8-15.5 lbs/A 3 lb/100 gal	48	–		[4.4]
		Echo 720 or Echo 90DF	1.0-1.4 pt/100 gal 2.25-3.5 lbs/A	12	–		

Table 13.1.1. Pesticide Spray Table – Cherries

Refer to back of book for key to abbreviations and footnotes.

Pest	IRAC/ FRAC Code	Product	Rate(s)	REI (hrs)	PHI (days)	Efficacy	Comments (see text)
Postharvest							
Leaf spots (*continued*)		Rally 40WSP	1.25-2 oz/100 gal or 2.5-6 oz/A	24	–		
		Fontelis SC	14-20 fl oz /A	12	0		[3.8]
		Indar 2F	6 fl oz/A	12	–		
		Syllit FL	1.5-3 pint/A	48	–		
		Pristine 38WDG	10.5-14.5 oz/A	12	–		
		Topsin 4.5FL	7.5-10 fl oz/100 gal or 22.5-30 fl oz/A	48	–		
		Topsin M WSB	0.375-0.5 lb/100 gal or 1.125-1.5 lb/A	48	–		
		Sulfur 92WP	5-10 lb/100 gallons	24	0		
		Microthiol Disperss	10-20 bl/100 gallons	24	0		
Powdery mildew		Rally 40WSP	1.25-2 oz/100 gal or 2.5-6 oz/A	24	–		[4.4]
		Procure 480SC	10-16 oz/A	12	–		
		Gem 500SC	1.9-3.8 oz/A	12	–		
		Fontelis SC	14-20 fl oz /A	12	0		[3.8]
		Cabrio EG	9.55 oz/A	12	0		
		Pristine 38WDG	10.5-14.5 oz/A	12	–		
		Quintec	7fl oz/A	12	7		
		Sulfur 92WP	5-10 lb/100 gallons	24	0		
		Microthiol Disperss	10-20 bl/100 gallons	24	0		
European red mite, Twospotted spider mite	21	Nexter 75WS	4.4-10.67 oz/A	12	300(PH)	high/mod	[11.3]
	3A	*Danitol 2.4EC	10.7-21.3 fl oz/A	24	3	moderate	
Control of Storage Disorders							
Storage rots		Scholar SC	16 fl oz/100 gal (see comments & label)				[19.1]
Autumn							
Bacterial canker (*Pseudomonas syringae*)		Kocide 3000	1.1-2.3 lb/100 gal (max 12 lb/A)	48	BL, PH (C)		[1.1]
		or Cuprofix Ultra 40 Disperss or other coppers	5-8 lb/A (see comments)	48	BL, PH (C)		[1.2]

13.2 Cherry Disease Notes

13.2.1 Bacterial Canker (*Pseudomonas syringae*)

• Biology & Cultural

[1.1] The pathogen causing bacterial canker is favored by cool, wet weather (spring and fall). It can invade leaf scars in fall and fresh pruning wounds in spring if pruning is done under cool, wet conditions. When pruning, make sure to leave a 6-inch stub, especially when removing scaffold branches as the bacteria appear to be arrested within the stub. Avoid flush cut pruning.

• Pesticide Application Notes

[1.2] We recommend copper applications at 20% and 80% leaf drop in the fall, and one application in the spring late dormant. Position the two applications around any fall pruning. If you are treating sweet cherries, just make one application at 50% leaf drop. Try to time these applications to a warm, dry period. An additional application is also labeled for use after harvest in orchards where disease is severe, although this application should be avoided on sweet cherries in New England due to the potential for leaf injury. Several other commercial copper formulations in addition to those listed may be labeled for this use on cherries. Although they have not been tested,

research on other crops suggests that most copper formulations should give comparable rates of control at comparable rates of metallic copper.

13.2.2 Black Knot

• Biology & Cultural

[2.1] Black knot has become an increasingly important problem on sour cherries in recent years. It is a difficult disease to control completely, but good sanitation – removing and destroying infected (knotted) limbs as they appear (make pruning cuts at least 6-8 in below visible swellings), destroying infected fence row trees and adjacent abandoned orchards (when possible) – is critical. Fungicide sprays are unlikely to provide satisfactory control without good sanitation practices. The most critical time for protecting against infection with fungicides is between white bud and shuck split. Black knot infection periods require rain and temperatures above 55°F; thus, fungicide sprays are most likely to be beneficial under these conditions.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this disease.

• Pesticide Application Notes

[2.2] Bravo is the most effective fungicide for black knot control. Note that a minimum 10-day re-treatment interval is specified on the label.

13.2.3 Brown Rot (Blossom & Shoot Blight)

• Biology & Cultural

[3.1] Blossom blight is most likely to occur when the weather is warm (above 60°F) and wet during bloom or when large numbers of fruit were not harvested the previous year. Blossom blight may also be serious at lower temperatures if prolonged wetting periods occur. Blossom sprays on tart cherries may often be reduced or eliminated if none of these conditions occur. Blossom blight is much more serious on sweet cherry than on sour cherry.

[3.2] Sweet (but not sour) cherry fruit are very susceptible to brown rot for the first few weeks after they set. Protection is therefore important at this time, particularly in wet weather.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this disease.

[3.3] *Monlinia laxa* commonly refered to as European brown rot is present in the region and can cause extensive blossom and shoot blight in cool wet weather at bloom. *M. laxa* may affect both sweet and tart cherries, but is primarily a problem on European or dark-fleshed tart cherry varieties.

• Pesticide Application Notes

[3.3] When used at a rate of 10 oz/100 gal, Rovral provides 24-48 hr kickback activity against blossom blight infections. Only 2 sprays of Rovral are allowed per season. Indar, and Tilt also have significant kickback activity. For resistance management purposes, it is recommended that the SI fungicides (Indar, Tilt, Rally, Quash) should not be used routinely throughout the season for BOTH blossom blight AND fruit rot control.

[3.4] More than one blossom blight spray is rarely needed unless disease pressure is extreme.

[3.5] Young sweet cherry fruit are very susceptible to brown rot. Thus, a petal fall spray is recommended on sweet cherries if weather is wet; much less necessary on sour cherries.

[3.6] Do not use chlorothalonil (Bravo, Echo, Equus) after shuck split; may resume use after harvest. Chlorothalonil has much longer residual activity than other fungicides labeled at shuck split, and is recommended if prolonged protection is needed. Indar is the most effective fungicide against brown rot on cherries. Also, chlorothalonil has a limited effect on *Monlinia laxa,* and should be used in combination with a material from 3.7 in orchards where both *M. laxa* and *M. fructicola* are present.

[3.7] Fruit becomes increasingly susceptible to brown rot during the last 3 wks before harvest. It is therefore recommended that spray intervals be tightened during this period and that superior brown rot fungicides be used if disease pressure is high (warm and wet), especially on sweet cherries.

Indar is the most effective fungicide for control of brown rot under high disease pressure, and provides excellent residual activity. It may be applied at 7-10-day intervals as needed. Tilt, Quash, Gem, Cabrio, and Pristine are also excellent brown rot fungicides with no preharvest interval restrictions. Sulfur, captan plus sulfur, and ferbam plus sulfur do not provide adequate control on sweet cherries. The maximum allowable rate of 4 lb/A for captan is inadequate on trees greater than 10 ft tall, particularly on sweet cherries.

[3.8] Fontelis has excellent protectant activity against stone fruit diseases. Fontelis is most effective against stone fruit diseases when applied at 7-14-day intervals to control primary and secondary scab. Reports out of Michigan suggest that Fontelis is not as strong against cherry leaf spot as other fungicides, but it is effective. There have been reports of phytotoxicity with tank mixes of Fontelis in apple. However, university trials throughout the region and extensive grower reports suggest that Fontelis is safe for stone fruit even under slow drying conditions.

13.2.4 Leaf Spot

• Pesticide Application Notes

[4.1] Primary leaf spot infections can occur from petal fall until after harvest; it is, therefore, important to maintain adequate spray deposits prior to infection periods (see Table 6.2.5) throughout this time. Chlorothalonil fungicides (Bravo, Echo, Equus) have the longest residual activity. They also provide some control of black knot.

Indar, and Tilt have approximately 3 days of post-infection activity, and can be used in this manner when necessary. However, leaf spot has shown resistance to SI

fungicides in some orchards in Michigan, and regular use of post-infection timing will spread selection for resistance. Thiophanate-methyl (Topsin M) is no longer recommended for use on cherries because of widespread brown rot resistance and suspected leaf spot resistance. Captan may cause leaf injury on Schmidt, Emperor Francis, and Giant sweet cherries if used between petal fall and harvest. Sulfur has short residual activity and must be reapplied frequently in wet seasons. Syllit has little effect against brown rot.

[4.2] Do not use chlorothalonil (Bravo, Echo, Equus) after shuck split; may resume use after harvest. Chlorothalonil has much longer residual activity than other fungicides labeled at shuck split, and is recommended if prolonged protection is needed.

[4.3] Do not use captan on sensitive sweet cherry varieties in the preharvest sprays. Do not use chlorothalonil between shuck split and harvest.

[4.4] Do not use copper on sweet cherries.

13.2.5 Phytophthora Root, Crown, and Collar Rots

• Biology & Cultural

[5.1] Cherry rootstocks are significantly more susceptible to Phytophthora root, crown, and collar rots than are apples. Mahaleb is more susceptible than Mazzard or Colt. The main defenses against these diseases should be providing good soil drainage through proper site selection and physical manipulations such as tiling or planting on berms; in marginal sites or very wet years, berms are much more effective than tiling. Highly susceptible rootstocks (e.g., Mahaleb) also should be avoided on marginal sites. However, Ridomil will provide additional protection in wet years, on marginal sites, or in wetter sections of the orchard. See comment **5.2** about applications.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this disease.

• Pesticide Application Notes

[5.2] Ridomil applications should be made just before growth starts in the spring and at 2-3-month intervals thereafter if soil conditions are very wet. Apply to the soil beneath the tree canopy in sufficient water to ensure good coverage (material is moved into the soil by subsequent rain or irrigation). Do not apply Ridomil to newly planted trees. See label for further details.

13.2.6 Powdery Mildew

• Pesticide Notes

[6.1] To control mildew, include an appropriate fungicide in each spray from 2nd fruit fly spray through the postharvest application. Rally is most effective.

[6.2] Do not use copper on sweet cherries.

13.2.7 X-Disease

• Pesticide Application Notes

[7.1] Refer to "Early Spring" section in the Pesticide Spray Table for Peaches and Nectarines.

13.3 Cherry Insect and Mite Notes

13.3.1 American Plum Borer

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[8.1] Application recommended against newly emerging adults, shortly after petal fall. If fresh borer activity is noted in early July, follow up with an additional application by mid-July. For *Lorsban Advanced and *Asana, apply as a coarse, low-pressure spray to give uniform coverage of tree trunks and lower limbs. *Ambush and *Pounce not labeled for American plum borer. Avoid Lorsban contact with foliage in sweet cherries; 50WS and 75WG formulations not labeled in sweet cherries. Rate of *Baythroid for lesser peachtree borer: 1.4-2.0 fl oz/A; for American plum borer: 2.4-2.8 fl oz/A. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

[8.2] The July and August lesser peachtree borer sprays will additionally provide control of 2nd brood American plum borer. Refer to comment [13.2].

13.3.2 Black Cherry Aphid

• Pesticide Application Notes

[9.1] Prebloom spray recommended, just before blossoms open, and during summer if needed. Because of toxicity to bees, Sevin is not recommended for prebloom aphid treatments. Movento must be used with a spray adjuvant having spreading and penetrating properties. Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product. Suggested action threshold: 4 infested terminals/tree.

[9.2] No separate spray recommended at petal fall. Sevin and Imidan applied for plum curculio will also control black cherry aphid.

[9.3] Lorsban not labeled for foliar use on sweet cherries.

13.3.3 Black Cherry Fruit Fly, Cherry Fruit Fly

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of these pests.

• Pesticide Application Notes

[10.1] Make 1st spray 7 days after flies emerge (when Early Richmond starts to color); 2nd and 3rd sprays at 7- to 10-day intervals. Sevin is recommended as an emergency treatment near harvest. Imidan is for use on tart cherries only; not registered for black cherry fruit fly. Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

[10.2] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised in New England while there is active foliar growth.

[10.3] Use Imidan and Lorsban on tart cherries only.

13.3.4 Brown Marmorated Stink Bug – refer to section 13.3.12 Stink Bugs

13.3.5 European Red Mite

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[11.1] Apply oil against overwintering eggs.

[11.2] Do not apply *Vendex more than 2 times per season.

[11.3] Use lower rate of Nexter for European red mite, higher rate for twospotted spider mite; postharvest use only.

[11.4] Apollo, Savey and Zeal limited to 1 application per season.

13.3.6 Japanese Beetle

• Biology & Cultural

[12.1] Adults emerge from the soil between early July and mid-August to feed on numerous trees and shrubs. In cherry trees, beetles devour the tissue between the veins, leaving a lace-like skeleton. Severely injured leaves turn brown and often drop. Adults are most active during the warmest parts of the day and prefer to feed on plants that are fully exposed to the sun.

• Pesticide Application Notes

[12.2] Although pheromone traps are available and can be hung in the orchard in early July to detect the beetles' presence, they are generally NOT effective at trapping out the beetles. Fruit and foliage may be protected from damage by applying Sevin, Assail, *Leverage, Admire Pro or *Provado; repeated applications may be required. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

13.3.7 Lesser Peachtree Borer

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Biological & Non-chemical Control

[13.1] In orchards where lesser peachtree borer is the primary borer pest, hang pheromone ties in late May before flight begins. Use 250/A rate in high-pressure (e.g., border) areas.

• Pesticide Application Notes

[13.2] For Lorsban and pyrethroids, apply as a coarse spray to trunk and lower limbs in up to 3 sprays; June 1-10, July 7-15, and August 1-10. Do not spray fruit; 21-day PHI for *Lorsban 4EC and Lorsban 75WG, 14 days for Lorsban 50WS, *Asana and *Warrior, 3 days for *Ambush and *Pounce. The July and August sprays will additionally provide control of 2nd brood American plum borer. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

13.3.8 Obliquebanded Leafroller

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[14.1] Apply in early July when larvae are small (approximately 360-450 DD [base 43°F] after 1st trap catch. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

[14.2] Lorsban not labeled in sweet cherries.

13.3.9 Plum Curculio

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[15.1] Apply sprays when last petals are falling (early fruit set) and at 8- to 10-day intervals. Use 3-4 sprays. Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. Imidan is for use on tart cherries only; causes severe foliage injury to sweet cherries. Sevin and Imidan will also control black cherry aphid. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

[15.2] Frequent applications (7-10 day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised in New England while there is active foliar growth.

[15.3] Not labeled for use on sweet cherries.

13.3.10 Scales, including European Lecanium and San Jose Scale

• Pesticide Application Notes

[16.1] Apply oil at budburst against overwintering immatures; thorough coverage improves efficacy. Addition of oil improves performance of Assail, Esteem, and Lorsban.

[16.2] Apply 4-6 weeks after shuck split against crawler stages. Movento must be used with a spray adjuvant that has spreading and penetrating properties.

13.3.11 Spotted Wing Drosophila

•Biology & Cultural

[17.1] This is an exotic species of vinegar fruit fly, a group normally attracted to damaged and rotting fruit. But in contrast to endemic Drosophila fruit flies, it has a serrated ovipositor and will lay eggs in intact ripening fruit on the tree; it is also a pest of berry fruit crops. Originally known from Japan, it has now been found in New England, as well as in nearby states such as New York , PA, NJ, and MI. Refer to the reference materials list (17.4.2, Other References) at the end of this publication for fact sheets containing details on the biology and management of this species.

• Pesticide Application Notes

[17.2] Apply at first signs of adult activity. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. Delegate labeled for suppression only. Entrust use requires user to have a copy of the 2(ee) recommendation in their possession at time of use.Imidan is for use on tart cherries only.

13.3.12 Stink Bugs (including Brown Marmorated Stink Bug)

• Biology & Cultural

[18.1] A number of native stink bug species can sometimes cause fruit damage in all tree fruits under conditions that are not fully understood. Adult feeding during bloom and shuck split can cause the fruit to abort, and feeding later in the summer can cause a deep catfacing injury such as that caused by tarnished plant bug, or depressed, dimpled, corky or water-soaked areas on the skin. All tree fruits are attacked, especially peaches and apples. Other species of stink bugs are predators. Elimination of alternate host broadleaf weeds, especially legumes, in the orchard will contribute to management efforts. If control is needed, insecticides should be timed to kill immigrating adults as they appear in the orchards to prevent feeding damage and subsequent mating and egglaying.

The brown marmorated stink bug is an invasive species from Asia that was first documented in Allentown, PA in 2001. This insect has spread across a number of eastern US States, and now extends to the west coast as well. It was first documented in NY in the Hudson Valley Region in 2008. Although it can be found throughout NY in and around structures and vehicles, extensive monitoring efforts in 2011 and 2012 have resulted in very few detections in agricultural crops; however, reports of sightings have been increasing. Refer to the reference materials list (17.4.2, Other References) at the end of this publication for fact sheets containing details on the biology and management of brown marmorated stink bug.

• Pesticide Application Notes

[18.2] Apply at first signs of infestation; BMSB are very mobile pests, and may reinfest the treated area quickly. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. *Danitol has a FIFRA Section 2(ee) recommendation for BMSB; the labeling must be in the possession of the user at the time of pesticide application. Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

13.4 Storage Rot Notes

• Pesticide Application Notes

[19.1] A postharvest treatment with Scholar SC via flooders, T-jet, or similar system for control of storage rots is recommended for fruit coming from orchards where sporulating brown rot was observed, or when one hopes keep fruit in cold storage for a few days prior to sale. Holding tanks in postharvest treatment equipment must have excellent agitation to keep fungicides in suspension. Solutions must be replenished regularly as directed on the product label. Never expose treated fruit to direct sunlight. This will cause the fungicide to break down.

13.5 Growth Regulation of Cherries

Table 13.5.1. Growth Regulator Uses in Cherries

Refer to back of book for key to abbreviations and footnotes.

Timing	Product	Concentration Product	Rate of Formulated Product
***PROMOTE LATERAL BRANCHING IN TART CHERRY:** (to counteract the adverse effects of tart cherry yellows virus on formation of vegetative buds)*			
14-21 days after petal fall	Pro-Gibb 4%, Falgro 4L	10-15 ppm	4-6 fl oz/100 gal
Apply at the 3-5 leaf stage or 1-3 inches of terminal extension on bearing trees. Apply with a nonionic surfactant as a dilute spray using 200-300 gal/acre. Use low rate on vigorous trees and high rate on low vigor trees.			
Promote vegetative growth of young non-bearing trees			
2-4 weeks after bloom	Pro-Gibb 4%, Fargo 4L	50-100 ppm	20-40 fl oz/100 gal
Apply at the 5-7 leaf stage. Reduces crop in year after treatment. Do not spray first year trees. For low vigor trees make two applications no closer than 7 days apart.			
Induction of lateral branching in nursery trees			
SWEET CHERRIES			
When terminal shoot is 26-32" long	Promalin, Perlan, Typy, Maxcel	250-1,000 ppm (Maxcel 500 ppm)	0.5-2 qt/5 gal
Include a non-ionic surfactant and apply as a directed spray to top part of tree after trees have reached a terminal height at which lateral branching is desired.			
Induction of lateral branching in young non-bearing trees			
SWEET CHERRIES			
Bud Swell	Promalin, Perlan, Typy, Maxcel	5,000-7,500 ppm	3.2-5.3 fl oz/1pt latex paint
Mix with latex paint and paint on buds. Do not apply the Promalin-latex paint mixture after bud break which may cause some injury to tender shoot tips. The best results in New York are obtained by scoring above the bud and then paintin the cut and the bud with the Promalin-latex paint mixture.			
Delay harvest and increase firmness and size of sweet cherries			
Fruit is light green to straw color(about 3-4 weeks before harvest)	Pro-Gibb 4%, Falgro 4L Pro-Gibb 4%	10-30 ppm 10-15ppm	16-48 fl oz/acre 16-48g/acre
High rates may delay fruit color development but give the maximum delay in harvest. Apply lower rates for less delay in ripening and less inhibition of color. Do not apply within 1 week of harvest			
Promote fruit loosening for mechanical harvesting			
TART CHERRIES			
7-14 days before anticipated harvest	Ethrel	150 ppm	0.5 pt/100 gal
Apply with a nonionic surfactant. Do not apply to weak trees or trees under heat or moisture stress.			
SWEET CHERRIES			
7-14 days before anticipated harvest	Ethrel	300-450 ppm	1-1.5 pt/100 gal
Apply with a nonionic surfactant. Do not apply to weak trees or trees under heat or moisture stress.			

To convert ounces (lb) to grams multiply ounces by 28.3. To convert fluid ounces to milliliters multiply fluid ounces by 29.57.

FIGURE 14.1.1

GROWTH STAGES IN PEACH

1. Dormant
2. Swollen bud
3 Bud burst
4. Pink
5. Bloom
6. Petal fall
7a. Fruit set – shucks on
7b. Fruit set – shucks off

14 Peaches and Nectarines

14.1 Insecticides and Fungicides for Peaches and Nectarines

See Sections 14.2, 14.3, and 14.4 for comments reltated to this table.

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Dormant						
Bacterial Spot	C-O-C-S WDG	4.0 lb/100 gal	12-16 lb/A	24	PF	[1.2]
	Kocide 2000		6-12 lb/A	48	21	
	Kocide 3000		3.5-7.0 lb/A	48	0	
	Cuprofix Ultra 40D		5.0-7.5 lb/A	48	SS	
	§Champ WG		8-16 lb/A	48	21	
	or other (§)copper formulations (see label)					
Peach leaf curl	Bravo Ultrex 82.5WDG	0.9-1.25 lb/100 gal	2.8-3.8 lb/A	12 hr-7days (E)	SS	[3.1]
	or Bravo Weather Stik 6F	1.0-1.4 pt/100 gal	3.1-4.1 pt/A			
	or other chlorothalonil formulations (see labels)					
	C-O-C-S	4 lb/100 gal	12-16 lb/A	24	PF	
	or other (§)copper formulations; see labels					
	Echo 720	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	12hr/7 days (E)	SS	
	or Echo 90DF	0.75-1.2 lb/100 gal	2.25-3.5 lb/A			
	Ferbam Granuflo	1.5 lb/100 gal	4.5 lb/A	24	21	
	Kocide 2000		6-12 lb/A	48	21	
	Kocide 3000		3.5-7.0 lb/A	48	0	
	Thiram Granuflo	1.2 lb/100 gal	3.5 lb/A	24	7	
	Ziram 76DF	1.25-2.7 lb/100 gal	3.75-8 lb/A	48	14	
Phytophthora root, crown, and collar rots	Ridomil Gold SL 4EC		2 qt/A	48	0	[6.2]
Cottony peach scale, European fruit lecanium, San Jose scale, European red mite	(§)oil	2-3 gal/100 gal		12	0	[11.1], [11.1],[12.1]
	Centaur		34.5 oz/A	12	14	
Pink						
Brown rot (blossom blight)	Bravo WeatherStik 6F	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	12hr/7 days (E)	SS	
	or other chlorothalonil formulations (see labels)					
	Captan 50WP	1-2 lb/100 gal	4-8 lb/A	24	0	
	or Captan 80WDG		2.5-5 lb/A	24	0	
	or Captec 4L	0.75-1 qt/100 gal		24	0	
	Echo 720	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	12 hr/7 days(E)	SS	
	or Echo 90DF	0.75-1.2 lb/100 gal	2.25-3.5 lb/A			
	Elevate 50WDG		1.5 lb/A	12	0	
	Fontelis 1.67		14-20 fl oz/A	12	0	
	Gem 500SC		1.9-3.8 oz/A	12	1	[2.8]
	Indar 2F		6 fl oz/A	12	0	[2.8]
	Inspire Super		16-20 fl oz/A	12	2	
	Merivon		4.0-6.7 fl oz/A	12	0	

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Pink (continued)						
Brown rot (blossom blight) (*continued*)	Meteor 4F		1-2 pt/A	24	PF	
	Pristine 38 WDG		10.5-14.5 oz/A	12	0	
	Quash 50WDG		2.5-3.5 oz/A	12	14	
	Rally 40WSP		2.5-6 oz/A	24	0	[2.8]
	Rovral 4F		1-2 pt/A	24	PF	[2.3]
	Scala SC		9-18 fl oz/A	12	2	
	Sulfur 92WP	5-10 lb/100 gal		24	0	
	§Microthiol Disperss or other (§)sulfur products	 See labels	10-20 lb/A	24		
	Thiram Granuflo	1.2 lb/100 gal	3.5 lb/A	24	7	[2.3]
	Tilt 3.6 EC		4 fl oz/A	12	0	[2.8]
	Topsin M 70 WP,WSB or Topsin 4.5 Fl	0.33-0.5 lb/100 gal 6.7-10 fl oz/100 gal	1-1.5 lb/A 20-30 fl oz/A	48 48	1 1	
Tarnished plant bug	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	[21.1],[21.2]
	Assail 30SG		5.3-8.0 oz/A	12	7	
	*Baythroid XL 1 EC		2.0-2.4 fl oz/A	12	7	
	Beleaf 50 SG		2.0-2.8 oz/A	12	14	
	*Pounce 25WP		6.4-16 oz/A	12	14	
	*Proaxis 0.5 CS		2.6-5.1 fl oz/A	24	14	
	*Warrior II 2.08 CS		1.3-2.5 fl oz/A	24	14	
	The following pre-mix product is also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Voliam Xpress		6-12 fl oz/A	24	14	
Bloom						
Brown rot (blossom blight)	See materials listed under Pink					
Oriental fruit moth	See comments [16.1] regarding pheromone disruption					
Petal Fall						
Brown rot (blossom blight)	See materials listed under Pink					[2.5]
American plum borer, Peachtree borer, Lesser peachtree borer	Asana XL 0.66Ec	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	[10.1]
	*Baythroid XL 1EC		[see comment]	12	7	[10.2]
	*Lorsban 4EC	3 qt/100 gal		96	14	[10.1]
	or *Lorsban Advanced 3.8EC	3 qt/100 gal		96	14	
	or Lorsban 75 WG	4 lb/100		96	14	
	*Pounce 25WP		6.4-16.0 oz/A	12	14	[10.2]
	*Proaxis		2.6-5.1 fl oz/A	24	14	
	Scorpion		5.25-7 fl oz/A	12	7	[10.3]
	*Warrior II		1.3-2.6 fl oz/A	24	14	
	(§)Pheromone disruption ties: Isomate PTB-Dual		 150 ties/A			 [17.1]

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Petal Fall (continued)						
American plum borer, Peachtree borer, Lesser peachtree borer (*continued*)	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Green peach aphid	Actara		3.0-4.0 oz/A	12	14	[13.1]
	Assail 30SG		2.5-5.3 oz/A	12	7	
	Beleaf 50SG		2.0-2.8 oz/A	12	14	
	*Lannate LV 2.4L	0.75 pt/100 gal	3 pt/A	96	4	[13.1]
	or *Lannate 90SP	0.25 lb/100 gal	1 lb/A	96	4	
	Movento SC		6.0-9.0 fl oz/A	24	7	[13.1]
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	
Oriental fruit moth	See materials listed under Shuck Split					
Tarnished plant bug	See materials listed under Pink plus					
	Actara		4.5-5.5 oz/A	12	14	[21.3]
	Belay 2.1 EC		6 fl oz/A	12	21	[21.3]
	The following pre-mix product is also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
Western flower thrips	Actara 25WDG		4.5-5.5 oz/A	12	14	
	Delegate 25 WG		4.5-7 oz/A	4	1	
	§Entrust 80WP	0.4-0.8 oz/100 gal	1.25-2.5 oz/A	4	1	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	Voliam Flexi		4.0-7.0 oz/A	12	14	
	*Voliam Express		6-12 fl oz/A	24	14	
Shuck Split						
Brown rot	Bravo WeatherStik 6F	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	12hr/7	SS	[2.6]
	or other chlorothalonil formulations (see labels)			days(E)		
	Captan 50WP	1-2 lb/100 gal	4-8 lb/A	24	0	
	or Captan 80 WDG		2.5-5 lb/A	24	0	
	or Captec 4L	0.75- 1 qt/100 gal		24	0	
	Echo 720	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	12hr/7	SS	
	or Echo 90DF	0.75-1.2 lb/100 gal	2.25-3.5 lb/A	days(E)	SS	
	Elevate 50WDG		1.5 lb/A	12	0	

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Shuck Split (continued)						
Brown rot (*continued*)	Fontelis 1.67		14-20 fl oz/A	12	0	
	Indar 2F		6 fl oz/A	12	0	[2.8]
	Inspire Super		16-20 fl oz/A	12	2	
	Merivon		4.0-6.7 fl oz/A	12	0	
	Pristine 38WDG		10.5-14.5 oz/A	12	0	
	Quash 50 WDG		2.5-3.5 oz/A	12	14	
	Rally 40WSP		2.5-6 oz/A	24	0	[2.8]
	Sulfur 92WP	5-10 lb/100 gal		24	0	[2.6]
	§Microthiol Disperss		10-20 lb/A	24	0	
	or other (§)sulfur products	See labels				
	Thiram Granuflo	1.2 lb/100 gal	3.5 lb/A	24	7	
	Tilt 3.6EC		4 fl oz/A	12	0	[2.8]
	Topsin M 70 WP, WSB	0.33-0.5 lb/100 gal	1-1.5 lb/A	48	1	
	Topsin 4.5 FL	6.7-10 fl oz/100 gal	20-30 fl oz/A	48	1	
Bacterial spot	§Mycoshield 17WP	12 oz/100 gal		12	21	[1.3]
	FireLine 17 WP	12 oz/100 gal		12	21	
	(§)copper products	See comments				[1.4]
Peach scab	Bravo Ultrex 82.5WDG	0.9-1.25 lb/100 gal	2.8-3.8 lb/A	12 hr/7	SS	[4.2]
	or Bravo Weather Stik 6F	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	days(E)		
	or other chlorothalonil formulations (see labels)					
	Echo 720	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	12hr/7	SS	
	or Echo 90DF	0.75-1.2 lb/100 gal	2.25-3.5 lb/A	days(E)	SS	
	Captan 50WP	1-2 lb/100 gal	4-8 lb/A	24	0	
	or Captan 80 WDG		2.5-5 lb/A	24	0	
	or Captec 4L	0.75-1 qt/100 gal		24	0	
	Gem 500SC		1.9-3.8 oz/A	12	1	
	Indar 2F		6 fl oz/A	12	0	
	Inspire Super		16-20 fl oz/A	12	2	
	Sulfur 92WP	5-10 lb/100 gal		24	0	
	or §Microthiol Disperss 80DF		6-12 lb/A	24	0	
	or other (§)sulfur products	See labels				
	Quash		2.5-3.5 oz/A	12	14	
	Thiram Granuflo	1.2 lb/100 gal	3.5 lb/A	24	7	[2.3]
	Topsin M 70WP		0.5-0.75 lb/A	48	1	
	plus					
	Captan 80 WDG		1.25-2.5 lb/A	24	0	
Obliquebanded leafroller	Altacor 35 WDG		3.0-4.5 oz/A	4	10	[15.1]
	*Baythroid XL 1EC		2.4-2.8 fl oz/A	12	7	
	Belt SC		3.0-4.0 fl oz/A	12	7	
	§Biobit HP		0.5-2.0 lb/A	4	0	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25 WG		4.5-7.0 oz/A	4	1	[15.1]
	§Deliver		0.5-2.0 lb/A	4	0	
	§Dipel DF		0.5-2.0 lb/A	4	0	
	§Entrust 80WP	0.4-0.8 oz/100 gal	1.25-2.5 oz/A	4	1	[15.1]

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Shuck Split (continued)						
Obliquebanded leafroller (*continued*)	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Tourismo		10-14 fl oz/A	12	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Oriental fruit moth, Lesser peachtree borer, Plum curculio	Actara		4.5-5.5 oz/A	12	14	[16.2]
	Altacor 35 WDG		3.0-4.5 oz/A	4	10	[16.2],[17.2]
	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	
	Assail 30SG		5.3-8.0 oz/A	12	7	[17.2]
	Avaunt 30WDG		5.0-6.0 oz/A	12	14	[16.2]
	§Aza-Direct 1.2L		1-2 pts/A	4	0	
	Azatin XL 3L		10-21 fl oz/A	4	0	
	*Baythroid XL 1EC					[10.2],[17.3]
	for lesser peachtree borer:		1.4-2.0 fl oz/A	12	7	
	for oriental fruit moth:		2.0-2.4 fl oz/A	12	7	
	for plum curculio:		2.4-2.8 fl oz/A	12	7	
	Belay		6.0 fl oz/A	12	21	[18.1],[16.2], [17.2]
	Belt SC		3.0-4.0 fl oz/A	12	14	[16.2]
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25WG		6.0-7.0 oz/A	4	1	[16.2]
	Imidan 70W	0.75-1.0 lb/100 gal	2.1-4.25 lb/A	96	14	[16.4]
	Intrepid 2F		10-16 fl oz/A	4	7	[16.2]
	*Pounce 25WP		6.4-16.0 oz/A	12	14	[10.2]
	*Proaxis 0.5CS		2.6-5.1 fl oz/A	24	14	
	Sevin XLR Plus, 4F		2-3 qt/A	12	3	
	§Surround 95WP		25-50 lb/A	4	0	[18.2]
	*Warrior II		1.3-2.6 fl oz/A	24	14	
	(§)Pheromone disruption:					
	§Checkmate OFM Dispenser		100-200 dispensers/A			[16.1]
	or Checkmate OFM Flowable		1.3-2.9 fl oz/A			[16.1]
	or Isomate-M 100		100 ties/A			[16.1]
	or Isomate PTB-Dual		150 ties/A			[17.1]
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Tourismo		10-14 fl oz/A	12	14	
	Voliam Flexi		4.0-7.0 oz/A	12	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Shuck Split (continued)						
San Jose Scale, Lecanium Scale	Centaur		34.5-46.0 oz/A	12	14	[11.2]
	Admire Pro		1.4-2.8 fl oz/A	12	0	
	Esteem 0.86EC		13-16 fl oz/A	12	14	
	Movento		6.0-9.0 fl oz/A	24	7	
Tarnished plant bug	See materials listed under Petal Fall					
Additional Summer Sprays						
Bacterial spot	§Mycoshield 17WP	12 oz/100 gal		12	21	[1.3]
	FireLine 17WP	12 oz/100 gal		12	21	
	(§)copper products	See comments				[1.4]
Brown rot	Captan 50WP	1-2 lb/100 gal	4-8 lb/A	24	0	[2.8]
	or Captan 80 WDG		2.5-5 lb/A	24	0	
	or Captec 4L	0.75-1 qt/100 gal		24	0	
	Elevate 50WDG		1.5 lb/A	12	0	
	Fontelis 1.67		14-20 fl oz/A	12	0	
	Indar 2F		6 fl oz/A	12	0	
	Inspire Super		16-20 fl oz/A	12	2	
	Merivon		4.0-6.7 fl oz/A	12	0	
	Pristine 38WDG		10.5-14.5 oz/A	12	0	
	Quash 50WDG		2.5-4.0 oz/A	12	14	
	Rally 40WSP		2.5-6 oz/A	24	0	
	Thiram Granuflo	1.2 lb/100 gal	3.5 lb/A	24	7	[2.3]
	Tilt 3.6EC		4 fl oz/A	12	0	
	Sulfur 92WP	5-10 lb/100 gal		24	0	
	§Microthiol Disperss		10-20 lb/A	24	0	
	or other (§)sulfur products	See labels				
Peach scab	Captan 50WP	1-2 lb/100 gal	4-8 lb/A	24	0	[4.2]
	or Captan 80 WDG		2.5-5 lb/A	24	0	
	or Captec 4L	0.75-1 qt/100 gal		24	0	
	Gem 500SC		1.9-3.8 oz/A	12	1	
	Inspire Super		16-20 fl oz/A	12	2	
	Sulfur 92WP	6-8 lb/100 gal		24	0	
	or §Microthiol Disperss 80DF		6-12 lb/A	24	0	
	Thiram Granuflo	1.2 lb/100 gal	3.5 lb/A	24	7	[2.3]
	Topsin M 70WP		0.5-0.75 lb/A	48	1	
	plus:					
	Captan 80 WDG		1.25-2.5 lb/A	24	0	
Powdery mildew (rusty spot)	Sulfur 92WP	5-10 lb/100 gal		24	0	[7.2]
	§Microthiol Disperss		10-20 lb/A	24	0	
	Inspire Super		16-20 fl oz/A	12	2	
	Quintec 2.08EC		7 fl oz/A	12	7	
European red mite, Twospotted spider mite	Acramite 50WS		0.75-1.0 lb/A	12	3	[12.2]
	Apollo 4SC		2.0-8.0 oz/A	12	21	
	Envidor 2SC		16-18 fl oz/A	12	7	[12.2]
	Nexter 75WS		4.4-10.7 oz/A	12	7	[12.2]
	Onager 1EC		12-24 fl oz/A	12	28	
	Portal		2 pts/A	12	365	[12.3]

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Additional Summer Sprays (continued)						
European red mite, Twospotted spider mite (*continued*)	Savey 50DF		3.0-6.0 oz/A	12	28	
	*Vendex 50WP		1.0-2.0 lb/A	48	14	
	Zeal 72 WS		2.0-3.0 oz/A	12	7	
Green peach aphid	Actara		3.0-4.0 oz/A	12	14	[13.1]
	Admire Pro		1.4-2.8 fl oz/A	12	0	
	Assail 30SG		2.5-5.3 oz/A	12	7	
	Beleaf 50SG		2.0-2.8 oz/A	12	14	
	*Lannate LV 2.4L	0.75 pt/100 gal	3 pt/A	96	4	[13.1]
	or *Lannate 90SP	0.25 lb/100 gal	1 lb/A	96	4	
	Movento		6.0-9.0 fl oz/A	24	7	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	
Japanese Beetle	Admire Pro		1.4-2.8 fl oz/A	12	0	[14.2]
	Assail 30SG		5.3-8.0 oz/A	12	7	
	Imidan 70W	0.75-1.0 lb/100 gal	2.1-4.25 lb/A	4-14 days	14	[14.3]
	Sevin XLR Plus, 4F		2-3 qt/A	12	3	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	*Voliam Express		6-12 fl oz/A	24	14	
Lecanium scale, San Jose scale	Admire Pro		1.4-2.8 fl oz/A	12	0	[11.2]
	Centaur		34.5-46 oz/A	12	14	
	Esteem 0.86EC		13-16 fl oz/A	12	14	
	Movento		6.0-9.0 fl oz/A	24	7	
Oriental fruit moth	(§)Pheromone disruption:					[16.1]
	§Checkmate OFM Dispenser		100-200 dispensers/A			
	or Checkmate OFM Flowable		1.3-2.9 fl oz/A			
	or Isomate-M 100		100 ties/A			
	Altacor 35 WDG		3.0-4.5 oz/A	4	10	[16.2], [16.3]
	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	
	Assail 30SG		5.3-8.0 oz/A	12	7	
	Avaunt 30 WDG		5.0-6.0 oz/A	12	14	
	*Baythroid XL 1L		2.0-2.4 fl oz/A	12	7	
	Belt SC		3.0-4.0 fl oz/A	12	14	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25 WG		6.0-7.0 oz/A	4	1	

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Additional Summer Sprays (continued)						
Oriental fruit moth *(continued)*	§Entrust 80WP	0.4-0.8 oz/100 gal	1.25-2.5 oz/A	4	1	
	Imidan 70W	0.75-1.0 lb/100 gal	2.1-4.25 lb/A	14 days	14	[16.4]
	Intrepid 2F		10-16 fl oz/A	4	7	
	Proaxis 0.5CS		2.6-5.1 fl oz/A	24	14	
	Sevin XLR Plus, 4F		2-3 qt/A	12	3	
	*Warrior II		1.3-2.6 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Tourismo		10-14 fl oz/A	12	14	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	
American plum borer, Peachtree borer, Lesser Peachtree borer	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	[17.3]
	*Baythroid XL 1EC		1.4-2.0 fl oz/A	12	7	
	*Lorsban 4EC	3 qt/100 gal		96	14	
	or Lorsban 75WG	4 lb/100 gal		96	14	
	or *Lorsban Advanced 3.8EC	3 qt/100 gal		96	14	
	*Pounce 25WP		6.4-16 oz/A	12	14	
	Proaxis 0.5CS		2.6-5.1 fl oz/A	24	14	
	*Warrior II		1.3-2.6 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Spotted wing Drosophila	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	[19.3]
	Actara		4.5-5.5 oz/A	12	14	
	Admire Pro		1.4-2.8 oz/A	12	0	
	Assail	5.3-8 oz/100 gal		12	7	
	*Baythroid XL		2.4-2.8 fl oz/A	12	7	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25WG		6-7 oz/A	4	1	
	*Diazinon AG500	1 pt/100 gal		96	21	
	§Entrust 80WP	0.4-0.8 oz/100 gal	1.25-2.5 oz/A	4	1	
	Imidan 70W	0.75-1 lb/100 gal	2.13-4.25 lb/A	96	14	[19.4]
	*Lannate 2.4LV		3 pt/A	96	4	[19.3]
	or *Lannate 90SP		1 lb/A	96	4	
	Malathion 5EC		2.5-4.8 pts/A	24	7	
	Mustang Max		4 oz./A	12	14	
	Pyganic		1 pt- 2 qt/A	12	0	[19.3]
	Sevin XLR Plus		2-3 qts/A	12	3	

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Additional Summer Sprays (continued)						
Spotted wing Drosophila *(continued)*	Venom		2-4 oz	12	3	[19.5]
	The following pre-mix product is also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
Stink bugs, including Brown marmorated stink bug	Actara		3.0-4.0 oz/A	12	14	[20.2]
	Assail 30SG		5.3-8.0 oz/A	12	7	
	Belay		6.0 fl oz/A	12	21	[20.2]
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	[20.2]
	*Lannate 2.4LV		2.25 pt/A	96	4	[20.2]
	or *Lannate 90SP		0.75 lb/A	96	4	
	Scorpion		5.25-7 fl oz/A	12	3	
	*Warrior IICS		1.28-2.56 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Voliam Flexi		6-7 fl oz/A	12	14	
Tarnished plant bug	Actara		4.5-5.5 oz/A	12	14	[21.2, 21.3]
	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	
	Assail 30SG		5.3-8.0 oz/A	12	7	
	*Baythroid XL 1 L		2.0-2.4 fl oz/A	12	7	
	Belay 2.1 EC		6 fl oz/A	12	21	[21.3]
	Beleaf 50SG		2.0-2.8 oz/A	12	14	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	*Lannate LV 2.4L	0.75 pt/100 gal	3 pt/A	96	4	[21.3]
	or *Lannate 90SP	0.25 lb/100 gal	1 lb/A	96	4	
	*Pounce 25WP		6.4-16.0 oz/A	12	14	
	Proaxis 0.5CS		2.6-5.1fl oz/A	24	14	
	*Warrior II 2.08 CS		1.3-2.5 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, its use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Western flower thrips	Actara 25WDG		4.5-5.5 oz/A	12	14	[22.2]
	§Entrust 80WP		1.25-2.5 oz/A	4	1	
	Delegate WG		4.5-7 oz/A	4	1	

Table 14.1.1. Pesticide Spray Table – Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.
Refer to label for registration status before applying any pesticide to nectarines.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Additional Summer Sprays (continued)						
Western flower thrips *(continued)*	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	
	*Voliam Xpress		6-12 oz/A	24	14	
X-Disease	Remove chokecherries	See comments				[9.1], [9.2]
Control of Storage Disorders						
Storage rots	Scholar SC	16 fl oz/100 gal (see comments & label)				[23.1]
After Harvest, Before Leaf Drop						
Prunus stem pitting virus	Product 2,4-D as described in the weed control section for "Dandelion and other broadleaf weeds in sod cover"					

14.2 Diseases

14.2.1 Bacterial Spot

• Biology & Cultural

[1.1] Bacterial spot is a devastating disease of peaches and nectarines as well as plums, prunes and apricots. This disease is most likely to be a problem on susceptible varieties (e.g., Autumnglo, Babygold 5, Redhaven, California white-fleshed varieties, nectarines). Any variety developed in drier climates and then grown in the more humid climate of New England has a strong likely hood of being susceptible. Also, this disease will be more severe in the warmer southern portions of New England, in wet years, in orchards with lighter (sandy) soils, and in windy orchard sites. The bacterial spot pathogen, *Xanthomonas arboricola* pv. *pruni* infects leaf scars at leaf drop and overwinters in infected twigs. Bacteria populations subsequently multiply during warm weather and ooze out during spring rains. Immature tissues are less susceptible to the bacterial infection, and as such, infections will not begin until petal fall/shuck split. Early season §copper applications are quite effective for controlling the bacterial populations, but are also likely to induce phytotoxicity if one is not careful. Moreover, copper phytotoxicity can cause symptoms similar to that of bacterial spot. Do not plant susceptible peach varieties near plums, prunes, or apricots. Prunes, plum, and apricots are also susceptible to bacterial spot, and no materials are registered for use on bacterial spot of prunes, plum, and apricots.

• Pesticide Application Notes

[1.2] Where susceptible varieties are planted, a delayed dormant application of (§)copper may help reduce bacterial spot disease pressure for the season. Along these lines, if applications of copper were made to manage peach leaf curl, these applications will substitute for those needed for bacterial spot. Apply copper with caution. Peaches are very susceptible to copper injury, especially after bud break. Copper phytotoxicity will be exacerbated by cool wet weather and environmental acidity.

[1.3] Where control is needed, apply sprays of oxytetracycline products such as Mycoshield or FireLine every 7-10 days from shuck split until 3 wk before harvest. The sprays immediately after shuck split are the most important for protecting the fruit. Thorough coverage is essential. Copper sprays applied for peach leaf curl at leaf drop should also aid in bacterial spot control.

[1.4] Low rates of copper can be applied post-bloom to reduce harvest damage and build up of bacterial populations in susceptible varieties. Take caution with post-bloom copper applications. These copper applications may result in phytotoxicity, especially if no rains occur between applications. If copper sprays are applied under acidic conditions (e.g., with LI-700 or other acidifiers) these may be more phytotoxic than copper applied alone. Copper products should be alternated with oxytetracycline products (e.g. Mycoshield, FireLine) for resistance management. See 1.3 above. This approach also reduces phtotoxicity from the copper and lowers the overall cost as compared to using oxytetracycline alone.

Kocide 3000 is the only copper product that can be applied up to six times after bloom. However, the recommended rate for foliar applications is only 0.75 to 1.5 oz/A which is **much lower** than label rates. The low rates are needed to prevent damage to the leaves and fruit, especially on nectarines. Other copper products allow postbloom applications but are limited to first and second covers. If other copper products are used, the rates need to be much lower than those stated on the label. Consult with your state fruit specialist or crop advisor for rate information.

14.2.2 Brown Rot (Blossom Blight)

• Biology & Cultural

[2.1] Blossom blight is most likely to occur when the weather is warm (above 60° F) and wet during bloom or when significant numbers of fruit were left unharvested the previous year. Blossom blight may also be serious at lower temperatures if prolonged wetting periods occur. However, blossom sprays on peaches may often be reduced or eliminated if these conditions do not occur. Nectarines are more susceptible to brown rot than most peach cultivars.

[2.2] Good insect control is important to prevent formation of entry points for the brown rot fungus. Pay special attention to control of plum curculio, oriental fruit moth, and tarnished plant bug. Fruits thinned after pit hardening are likely to become infected on the orchard floor and provide a source of inoculum for spread to ripening fruits in the tree; in contrast, fruits thinned prior to pit hardening are much less likely to do so.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this disease.

• Pesticide Application Notes

[2.3] When used at a rate of 10 oz/100 gal dilute, Rovral 50WP provides 24-48 hr kickback activity against blossom blight infections at 68° F. Meteor applied at 2 pt/A provides 24-48 hr kickback. Only 2 applications of Rovral are allowed per year. Indar, Quash, and Tilt also have significant kickback activity. Also, note that Thiram Granuflo is not labeled for use on nectarines

[2.4] More than one blossom blight spray is rarely needed unless disease pressure is extreme.

[2.5] If a previous brown rot spray was applied, a petal fall application is necessary on peaches only if warm and wet weather persists.

[2.6] Fruit are very susceptible to infection for the first 3 wk after shuck split; therefore, the shuck split and 1st cover sprays are important for controlling brown rot, particularly in wet weather. Chlorothalonil (Bravo, Echo) has longer residual activity than captan or sulfur, but do not use Chlorothalonil after shuck split. Indar is also highly effective.

[2.7] Indar and Tilt can be used until the day of harvest. Fruit becomes increasingly susceptible to infection the last 3 wk before harvest. It is therefore suggested that spray intervals be tightened up during this period and that Indar, Quash or Tilt be used if disease pressure is high.

• Pesticide Resistance

[2.8] For resistance management purposes, the SI fungicides (Indar, Quash, Tilt and Rally) should not be used routinely throughout the season for BOTH blossom blight AND fruit rot control. Where peaches within the same block ripen over an extended season, continued use of SI fungicides as preharvest sprays for successive varieties will also create selection pressure for fungicide resistance. Use captan, Gem or Pristine to break the string of preharvest SI fungicides applied to varieties with varied ripening or harvest dates.

14.2.3 Peach Leaf Curl

• Pesticide Application Notes

[3.1] Leaf curl sprays are especially important in years following crop failures because inoculum can build in orchards that do not receive brown rot sprays. Leaf curl sprays can be applied anytime between leaf fall and bud swell. Treatment applied after bud swell may not provide 100% control. (§)Fixed copper compounds applied at leaf fall should also improve bacterial spot control by reducing the inoculum that overwinters in leaf scars. Several other commercial copper formulations in addition to those listed may be labeled for this use on peaches. Most copper formulations should give comparable rates of control at comparable rates of metallic copper.

14.2.4 Peach Scab

• Biology & Cultural

[4.1] Most likely to develop if weather is warm and wet the first several weeks following shuck split. Generally more of a problem on later varieties, and following a year when spring frosts destroyed the crop and no fungicides were applied.

• Pesticide Application Notes

[4.2] Where control is needed, apply sprays at 10- to 14-day intervals beginning at shuck split and continuing until 6 wk before harvest. Spray intervals can be lengthened during extended periods of dry weather. Bravo or Echo applied at shuck split will provide at least 14 days of protection for young fruits. Do not use Bravo, Echo or other chlorothalonil products after shuck split.

14.2.5 Perennial (Cytospora, Valsa) Canker

• Biology & Cultural

[5.1] Perennial canker is the most destructive disease of peach trees in New England and other cold-climate regions. Infections usually become established in pruning wounds or winter-injured tissue, from which they slowly expand and girdle the infected trunk or limbs. The most common point of entry is small, weak shoots that develop in the centers of the trees, then become killed during the winter. Thus, the most effective means of controlling this disease is to prune trees so that their centers are open. Other control practices include establishing new plantings at a distance from old, cankered blocks; training to promote wide crotch angles (reduced breakage and winter injury); delaying annual pruning until bloom or later, to allow pruning cuts to "heal" quickly; and standard horticultural practices to promote winter hardiness, such as the application of white trunk paint. Some fungicides applied for brown rot control after pruning may help protect these wounds from infection, but such benefits are unproven and likely to be minor. *This disease is controlled almost entirely through horticultural practices!!!*

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this disease.

14.2.6 Phytophthora Root, Crown, and Collar Rots

• Biology & Cultural

[6.1] Peach rootstocks are significantly more susceptible to Phytophthora root, crown, and collar rots than are apples (peach is similar to cherry in susceptibility). The main defense against these diseases should be providing good soil drainage through proper site selection and physical manipulations such as tiling or planting on berms; in marginal sites or very wet years, berms are much more effective than tiling. Ridomil will provide additional protection in wet years, on marginal sites, or in wetter sections of the orchard. See comment about application.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[6.2] Applications should be made just before growth starts in the spring and at 2-3-month intervals thereafter if soil conditions are very wet. Apply to the soil beneath the tree canopy in sufficient water to assure good coverage (material is moved into the soil by subsequent rain or irrigation). See label for further details.

14.2.7 Powdery Mildew (Rusty Spot)

• Biology & Cultural

[7.1] Only a problem on certain susceptible varieties (e.g., Rio-Oso-Gem, Redskin). Can be particularly severe if peaches are planted adjacent to mildew-susceptible apple cultivars.

• Pesticide Application Notes

[7.2] Where disease has been a problem, add sulfur to each spray from petal fall through pit hardening. This rate of sulfur may be combined with 1 lb captan/100 gal in the early cover sprays for brown rot protection. When applied for brown rot control, the SI fungicides (Indar, Quash, Tilt) also should provide control of powdery mildew.

14.2.8 Prunus Stem Pitting Virus

• Biology & Cultural

[8.1] Prunus stem pitting virus is spread from broadleaf weed species to trees by the dagger nematode. The virus is seed-transmitted and enters orchards via windblown seeds from infected weed species. Broadleaf weeds in the sodded row middles should be controlled annually using 2,4-D after harvest to minimize the potential sources of virus in the orchard.

14.2.9 X-Disease

• Biology & Cultural

[9.1] The only effective control for X-disease of peach, nectarine, and cherry is the destruction of infected host plants within a 500-ft radius of the orchard. Chokecherry (*Prunus virginianae*) and wild sweet cherry seedlings are the wild hosts that provide most of the inoculum for leafhopper vectors of this disease. Wild black cherry (*Prunus serotina*) is not a host for X-disease. Infected sweet and tart cherry trees (particularly those on Mazzard rootstock) and wild sweet cherry seedlings can also serve as inoculum sources, but leafhoppers cannot acquire the disease from infected peach or nectarine trees. Where X-disease is a concern, new peach and nectarine plantings should be isolated from plantings of sweet cherries that might harbor X-disease.

All chokecherry and wild sweet cherry seedlings within 500 ft of peach, nectarine, and cherry orchards should be eradicated either by physically removing the plants or through use of brush killers. DO NOT USE BRUSH KILLERS WITHIN THE ORCHARD. Where chokecherries have been removed or treated with brush killers, check for regrowth of chokecherry sprouts during the season following treatment. Some broadleaf weeds can also harbor the X-disease pathogen, and weeds encourage high populations of X-disease vectors. To minimize risks of X-disease, stone fruit orchards should be treated annually (in autumn) with 2,4-D herbicide to eliminate broadleaf weeds in the grass ground cover.

• Pesticide Application Notes

[9.2] There are a number of brush killers labeled for non-crop sites. However, Garlon (triclopyr) specifically lists chokecherries on the label. Also, Crossbow (a mixture of triclopyr and 2,4-D) lists cherries on the label. These herbicides should be applied as a spot treatment to chokecherries only in areas **outside** the orchard in early to mid-summer. **DO NOT USE BRUSH KILLERS IN THE ORCHARD.**

14.3 Insects and Mites

14.3.1 American Plum Borer

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[10.1] Apply spray against newly emerging adults, shortly after petal fall. For *Asana and *Lorsban products, apply as a coarse, low-pressure spray to give uniform coverage of tree trunks and lower limbs. Particularly a problem in trees with split trunks from Perennial canker or winter injury. Will also contribute to control of peachtree borer and lesser peachtree borer; see comment [17.3]. Only 1 application of Lorsban permitted per season on peaches and nectarines.

[10.2] *Pounce not labeled for American plum borer; *Baythroid, *Leverage, and *Pounce not labeled for peachtree borer. Rate of Baythroid XL for lesser peachtree borer: 1.4-2.0 fl oz/A; for American plum borer: 2.4-2.8 fl oz/A. For best effectiveness and insecticide resistance

management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

14.3.2 Brown Marmorated Stink Bug - refer to section on Stink Bugs

14.3.3 Cottony Peach Scale, European Fruit Lecanium Scale, San Jose Scale

• Pesticide Application Notes

[11.1] Low rate of (§)oil during dormant period for European fruit lecanium, high rate for cottony peach scale.

[11.2] One application at completion of crawler hatch in mid-June, directed to leaf undersides, trunk, and scaffold limbs. Movento must be used with a horticultural mineral oil or nonionic spray adjuvant. Admire Pro labeled only for San Jose scale.

[10.3] Scorpion is suppression only.

14.3.4 European Red Mite

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[12.1] High rate of (§)oil during dormant period.

[12.2] Apply as mites appear in summer; use lower rate of Nexter for European red mite, higher rate for twospotted spider mite (see label). Acramite, Apollo, Envidor, Onager, and Savey limited to 1 application per season.

[12.3] Portal has a supplemental label for bearing stone fruit.

14.3.5 Green Peach Aphid

• Pesticide Application Notes

[13.1] Apply spray postbloom, before excessive leaf curling occurs. Do not apply Actara between the pre-bloom (swollen bud) and post bloom (petal fall) growth stages. Lannate not registered for nectarines. Movento must be used with a horticultural mineral oil or nonionic spray adjuvant.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and Voliam Flexi should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

14.3.6 Japanese Beetle

• Biology & Cultural

[14.1] Adults emerge from the soil between early July and mid-August to feed on numerous trees and shrubs. In peach trees, beetles devour the tissue between the veins, leaving a lace-like skeleton, and also feed on the surface of the fruit. Severely injured leaves turn brown and often drop. Adults are most active during the warmest parts of the day and prefer to feed on plants that are fully exposed to the sun.

• Pesticide Application Notes

[14.2] Although pheromone traps are available and can be hung in the orchard in early July to detect the beetles' presence, they are generally NOT effective at trapping out the beetles. Fruit and foliage may be protected from damage by applying Sevin, Assail, Imidan, *Leverage, or Admire Pro; repeated applications may be required. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

[14.3] Persons not covered by the Worker Protection Standard (WPS), such as members of the general public involved in “pick-your-own”, “U-pick” or similar operations, cannot enter a treated area for 14 days after application of Imidan.

14.3.7 Obliquebanded Leafroller

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[15.1] Up to 3 sprays may be needed: end of May (shuck split), 1st hatch (mid-late June: 360 DD43 after 1st trap catch), and 2 wk later. Best results obtained if materials are alternated by chemical class. Control with Entrust or Delegate may be improved by addition of an adjuvant. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage, Tourismo and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

14.3.8 Oriental Fruit Moth

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Biological & Non-chemical Control

[16.1] (§)Pheromone disruption is economically justified if 2-3 sprays are normally applied, and if no other

insecticide sprays are routinely needed for other pests after petal fall. For this reason, disruption may not be economical for the 1st brood. If chosen correctly, certain plum curculio sprays used at this time will also control oriental fruit moth. Pheromones should be applied in mid-June before initiation of the 2nd flight; the need for re-application depends on residual field life of specific formulations: Isomate-M 100 and §Checkmate OFM Dispenser, 90 days; Checkmate OFM Flowable, 30 days. Border insecticide sprays may be needed in orchards adjacent to sources of adult immigration or in other high pressure situations.

• Pesticide Application Notes

[16.2] Against adults, beginning at petal fall. Use 2 applications at a 10-14-day interval. Do not apply Actara between the pre-bloom (swollen bud) and post bloom (petal fall) growth stages. Actara should also control tarnished plant bug and plum curculio. Altacor, Belt, Intrepid and Tourismo will only control oriental fruit moth. Pyrethroids should also control plum curculio, lesser peachtree borer, and tarnished plant bug. Belay will only control plum curculio. Belay is not registered for nectarines in New England. Avaunt will provide suppression of oriental fruit moth and control of plum curculio. Sevin will not control lesser peachtree borer. Imidan, Avaunt and Delegate not registered for lesser peachtree borer.

[16.3] Summer sprays should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45°F) after the first sustained adult catch of the second brood, with a second application in 10-14 days. In high pressure blocks, a final spray should be applied 2 wk before harvest to control late season larvae. Suggested action threshold: Avg. of >10 adults/week caught per pheromone trap.

[16.4] Persons not covered by the Worker Protection Standard (WPS), such as members of the general public involved in “pick-your-own”, “U-pick” or similar operations, cannot enter a treated area for 14 days after application of Imidan.

[16.5] For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Tourismo, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

14.3.9 Peachtree Borers (Including Lesser Peachtree Borer)

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Biological & Non-chemical Control

[17.1] Hang (§)pheromone ties at shucksplit before moth flight begins. Pruning should be done before hanging dispensers. Use Isomate PTB-Dual at a rate of 150 per acre. Use a higher rate (200-250/A) for outside edges of border blocks, areas that haven’t been disrupted before and have high populations, and in blocks smaller than 5 acres. Isomate PTB-Dual is effective on both Peachtree Borer and Lesser Peachtree Borer.

• Pesticide Application Notes

[17.2] Against adults, when first shucks start to split. Will also control plum curculio, oriental fruit moth, and tarnished plant bug. Altacor registered for oriental fruit moth only. Sevin will not control lesser peachtree borer. Imidan, Avaunt and Assail not registered for lesser peachtree borer. Belay will only control plum curculio. Belay is not registered on nectarines in new England.

[17.3] Up to 3 sprays of pyrethroids to trunk and scaffold limbs against larvae: June 1-10, July 7-15, and August 1-10. 1 application of Lorsban to trunk at any time from petal fall to August or post-harvest. Do not apply *Lorsban to fruit. Only 1 application of Lorsban permitted per season. *Baythroid, *Leverage and *Pounce not labeled for peachtree borer.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage and *Voliam should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product

Suggested action threshold: 1st emergence of adults plus 8 days or 1-2 larvae or pupal cases/tree.

Note: Preplant dipping of roots and crowns of peach tree seedlings before planting has given complete control of the peachtree borer for the 1st growing season and has reduced borers during the 2nd season. The only product labeled for this use is Lorsban. See the labels for each Lorsban product for specific rates and instructions for Preplant Dip Application. SPECIAL PRECAUTIONS: Wear full PPE to avoid exposing skin to insecticide. Dispose of excess material with extreme care.

14.3.10 Plum Curculio

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring and Forecasting

Monitor for adults beginning at bloom using beating trays. Examine fruit, especially along border rows, beginning at shuck-split. Suggested threshold is 1-2 % new damage. Use degree day model to determine when immigration into orchard should be complete. This is at 308 DD (base 50^0) from apple petal fall.

• Pesticide Application Notes

[18.1] Against adults, when first shucks start to split; continue at 7- to 10-day intervals. Use 2-3 applications. Pyrethroids will also control oriental fruit moth, lesser peachtree borer, and tarnished plant bug.

Altacor registered for oriental fruit moth only. Belay is not registered for nectarines in New England.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product

[18.2] Frequent applications (7-10-day intervals) of §Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth. If fresh market stone fruit cannot be washed according to label instructions, discontinue Surround sprays when the fruit are approximately ¾ inch in diameter.

14.3.11 Spotted Wing Drosophila

• Biology & Cultural

[19.1] This is an exotic species of vinegar fruit fly, a group normally attracted to damaged and rotting fruit. But in contrast to endemic Drosophila fruit flies, it has a serrated ovipositor and will lay eggs in intact ripening fruit on the tree and on the farmstand shelf. It is also a pest of berry fruit crops. Originally known from Japan, it has been found throughout New England since 2011. Refer to the reference materials list (17.4) at the end of this publication for fact sheets containing details on the biology and management of this species.

• Monitoring

[19.2] Vinegar-baited traps are not effective as an indicator of first emergence. There is a baited trap that is more effective: Standard Yeast Bait consisting of water+sugar+active dried yeast+unscented dishwasher soap. Inspect ripening fruit for larvae.

• Pesticide Application Notes

[19.3] Apply at first signs of adult activity when fruits are beginning to ripen. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. Pyganic can provide adult knockdown but has a very short residual of 0-2 days. Lannate not registered on nectarines.

[19.4]] Persons not covered by the Worker Protection Standard (WPS), such as members of the general public involved in “pick-your-own”, “U-pick” or similar operations, cannot enter a treated area for 14 days after application of Imidan.

[19.5] Venom supplemental label through August 2015.

14.3.12 Stink Bugs (including Brown Marmorated Stink Bug)

• Biology & Cultural

[20.1] A number of native stink bug species (Brown, Dusky and Green Stink Bugs) can sometimes cause fruit damage in all tree fruits under conditions that are not fully understood. Adult feeding during bloom and shuck split can cause the fruit to abort, and feeding later in the summer can cause a deep catfacing injury such as that caused by tarnished plant bug, or depressed, dimpled, corky or water-soaked areas on the skin. All tree fruits are attacked, especially peaches and apples. Other species of stink bugs are predators. Elimination of alternate host broadleaf weeds, especially legumes, in the orchard will contribute to management efforts. If control is needed, insecticides should be timed to kill immigrating adults as they appear in the orchards to prevent feeding damage and subsequent mating and egglaying.

The brown marmorated stink bug is an invasive species from Asia that was first documented in Allentown, PA in 2001. It has caused extensive damage to apple and peach crops in the Mid-Atlantic states in recent years. It has a wide host range and is more likely to reproduce in orchards as compared to native species. This insect has spread across a number of eastern US States, and now extends to the west coast as well. It was first documented in Connecticut in 2008. Although it can be found throughout Connecticut in and around structures, extensive monitoring efforts in 2011 - 2013 resulted in few detections in agricultural crops; however, reports of sightings have been increasing. Refer to the reference materials list (17.4) at the end of this publication for fact sheets containing details on the biology and management of brown marmorated stink bug.

• Pesticide Application Notes

[20.2] Apply at first signs of infestation; BMSB are very mobile pests, and may reinfest the treated area quickly. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, *Voliam Xpress and Voliam Flexi should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

14.3.13 Tarnished Plant Bug

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest. Satisfactory control requires adequate management of orchard weeds that attract tarnished plant bugs and act as alternate hosts. This includes broadleaved winter annuals and legumes in and around the orchard.

• Monitoring & Forecasting

[21.1] Most catfacing injury is caused before shuck split. Later season feeding generally results in only minor surface scarring.

[21.2] Apply spray as insects appear and if the action threshold is reached.. Suggested action threshold: At pink, 3 bleeding sites/tree; at petal fall, 3 bleeding sites/tree; or 1-2% of fruit with new injury.

• Pesticide Application Notes

[21.3] Do not apply Actara between the prebloom (swollen bud) and post bloom (petal fall) growth stages. Lannate and Belay not registered for nectarines. Actara will also control plum curculio. Do not apply *Leverage pre-bloom or during bloom when bees are actively foraging. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

14.3.14 Western Flower Thrips

• Biology & Cultural

Drought conditions and high temperatures may encourage damaging populations in nectarines, although it has not been a particular problem in New England. Adults move from alternate weed or crop hosts to fruit just prior to and during harvest, feed on the fruit surface in protected sites, such as in the stem end, the suture, under leaves and branches, and between fruit. Feeding results in silver stippling or patches; injury is particularly obvious on highly colored varieties.

• Pesticide Application Notes

[22.1] In orchards with severe infestations, a petal fall application may be warranted against thrips feeding in fruit clusters. Control using §Entrust or Delegate may be improved by addition of an adjuvant.

[22.2] An application after the first harvest may prevent subsequent losses; however, an additional application may be needed if pressure is severe. Control with §Entrust or Delegate may be improved by addition of an adjuvant.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product

14.4 Storage Rots

• Pesticide Application Notes

[23.1] A postharvest treatment with Scholar SC via dipping, flooders, T-jet, or similar system for control of storage rots is recommended for fruit coming from orchards where sporulating brown rot was observed, or when one hopes to keep fruit in cold storage for a few days prior to sale. Holding tanks in postharvest treatment equipment must have excellent agitation to keep fungicides in suspension. Solutions must be replenished regularly as directed on the product label. Never expose treated fruit to direct sunlight. This will cause the fungicide to break down.

14.5 Growth Regulation of Peaches and Nectarines

Table 14.5.1. Growth Regulator Uses in Peaches and Nectarines.

Refer to back of book for key to abbreviations and footnotes.

Refer to label for registration status before applying any pesticide to nectarines.

Timing	Product	Concentration	Rate of Formulated Product	Comments
Chemical Thinning				
50-80% Bloom	ATS (foliar nutrient)		4-6 gal/100 gal	Apply 100 gal/acre.
Preharvest Fruit Drop Control				
1-2 weeks before anticipated harvest	ReTain	132 ppm	333 g/acre (1 pouch)	Apply in sufficient water to ensure thorough but not excessive coverage. An organosilicone surfactant (12 oz/100 gal) should be used with ReTain.

15 Apricots

15.1 Insecticides and Fungicides for Apricots

See sections 15.2, 15.3, and 15.4 for comments related to this table.

Table 15.1.1. Pesticide Spray Table – Apricots.

Refer to inside back cover for key to abbreviations and footnotes.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Late Dormant						
Phytophthora root, crown and collar rots	Ridomil Gold SL 4EC		2 qt/A	48	0	[5.2]
Bacterial canker (*Pseudomonas syringae*)	Kocide 2000		6-12 lb/A	48	PH,BL	[1.1]
	or Kocide 3000		3.5-7.0 lb/A	48	PH,BL	
	or Cuprofix Ultra 40 Disperss		5.0-8.0 lb/A	48	BL,PH	
	§Champ WG		8-16 lb/A	48	21	
	other (§)coppers	See comments [1.1]				
European red mite, Scale insects	(§)oil	2 gal/100 gal	See label	12	0	[6.1],[11.1]
	Centaur		34.5 oz/A	12	14	
Popcorn						
Brown rot (Blossom blight)	Bravo Weather Stik 6F	1.0-1.3 pt/100 gal	3.1-4.1 pt/A	12 hr/7 days(E)	SS	[2.1]
	or other chlorothalonil formulations (see labels)					
	Captan 50WP	2 lb/100 gal	3.0-5.0 lb/A	24	0	
	or Captec 4L	0.75-1 qt/100 gal	2.5 qt/A	24	0	
	Echo 720 6F	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	12 hr/7 days (E)	SS	
	or Echo 90DF	0.75-1.2 lb/100 gal	2.25-3.5 lb/A			
	Elevate 50WDG		1.5 lb/A	12	0	
	Fontelis 1.67		14-20 fl oz/A	12	0	
	Indar 2F		6 fl oz/A	12	0	
	Inspire Super		16-20 fl oz/A	12	2	
	Merivon		4.0-6.7 fl oz/A	12	0	
	Meteor 4F		1-2 pt/A	24	PF	
	Pristine 38 WDG		10.5-14.5 oz/A	12	0	
	Quash		2.5-3.5 oz/A	12	14	
	Rally 40 WSP		2.5-6.0 oz/A	24	0	
	Rovral 4F		1.0-2.0pt/A	24	PF	
	Scala 600SC		9.0-18.0 fl oz/A	12	2	
	Tilt 3.6EC		4 fl oz/A	12	0	
Tarnished plant bug	See materials listed under Petal Fall, except DO NOT USE Actara until Petal Fall.					[14.1]
Bloom						
Brown rot (blossom blight)	See materials and comments listed under Popcorn.					
Petal Fall						
Brown rot	See materials and comments listed under Popcorn, except Vangard, which cannot be used after bloom.					
Plum curculio	Actara		4.5-5.5 oz/A	12	14	[10.1]
	Avaunt 30 WDG		5.0-6.0 oz/A	12	14	
	*Baythroid XL 1EC		2.4-2.8 fl oz/A	12	7	

Table 15.1.1. Pesticide Spray Table – Apricots.

Refer to inside back cover for key to abbreviations and footnotes.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Petal Fall (continued)						
Plum curculio (*continued*)	Imidan 70W	0.75-1 lb/100 gal	2.1-4.25 lb/A	7-14 days	14	[10.3]
	Sevin XLR Plus, 4F		2.0-3.0 qt/A	12	3	
	§Surround 95WP		25-50 lb/A	4	0	[10.2]
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Leverage 360		2.4–2.8 fl oz/A	12	7	[10.1]
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	[10.1]
	*Voliam Xpress		6-12 fl oz/A	24	14	[10.1]
Peachtree borer and Lesser peachtree borer)	(§)Pheromone disruption ties: Isomate-PTB-Dual	150 ties per acre				[9.1]
Tarnished plant bug	Actara		4.5-5.5 oz/A	12	14	[14.3]
	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	[14.2]
	Assail 30SG		5.3-8.0 oz/A	12	7	
	*Baythroid XL 1 EC		2.0-2.4 fl oz/A	12	7	
	Beleaf 50SG		2.0-2.8 oz/A	12	14	
	*Proaxis 0.5CS		2.6-5.1 fl oz/A	24	14	
	*Warrior II		1.3-2.6 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Western flower thrips	Delegate WG		4.5-7 oz/A	4	14	
	§Entrust 80WP	0.4-0.8 oz/100 gal	1.25-2.5 oz/A	4	14	[15.2]
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	[10.1]
	*Voliam Xpress		6-12 fl oz/A	24	14	[15.2]
Shuck Split						
Brown rot	Bravo Weather Stik 6F or other chlorothalonil formulations (see labels)	1.0-1.3 pt/100 gal	3.1-4.1 pt/A	12hr/7 days(E)	SS	[2.2]
	Captan 50WP	2 lb/100 gal	3.0-5.0 lb/A	24	0	
	or Captec 4L	0.75-1 qt/100 gal	2.5 qt/A	24	0	
	Echo 720 6F	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	12hr/7 days (E)	SS	
	or Echo 90DF	0.75-1.2 lb/100 gal	2.25-3.5 lb/A			
	Fontelis 1.67		14-20 fl oz/A	12	0	
	Inspire Super		16-20 fl oz/A	12	2	
	Merivon		4.0-6.7 fl oz/A	12	0	

Table 15.1.1. Pesticide Spray Table – Apricots.

Refer to inside back cover for key to abbreviations and footnotes.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Shuck Split (continued)						
Brown rot (*continued*)	Pristine 38WDG		10.5-14.5 oz/A	12	0	
	Quash		2.5-3.5 oz/A	12	14	
	Rally 40 WSP		2.5-6.0 oz/A	24	0	
Peach Scab	Any of the products listed above (except Fontelis, Merivon or Quash) for brown rot at shuck split.					[3.1]
	Gem 500SC		1.9-3.8 fl oz/A	12	1	
Additional Summer Sprays						
Brown rot	Captan 50WP	2 lb/100 gal	3.0-5.0 lb/A	24	0	[2.3]
	or Captec 4L	0.75-1 qt/100 gal	2.5 qt/A	24	0	
	Elevate 50WDG		1.5 lb/A	12	0	
	Fontelis 1.67		14-20 fl oz/A	12	0	
	Indar 2F		6.0 fl oz/A	12	0	
	Inspire Super		16-20 fl oz/A	12	2	
	Merivon		4.0-6.7 fl oz/A	12	0	
	Pristine 38WDG		10.5-14.5 oz/A	12	0	
	Quash		2.5-3.5 oz/A	12	14	
	Rally 40 WSP		2.5-6.0 oz/A	24	0	
	Tilt 3.6EC		4 fl oz/A	12	0	
European red mite, Twospotted spider mite	Acramite 50WS		0.75-1.0 lb/A	12	3	[6.2]
	Apollo 4SC		2.0-8.0 oz/A	12	21	[6.2]
	Envidor 2SC		16-18 fl oz/A	12	7	[6.2]
	Nexter 75WS		4.4-10.7 oz/A	12	300 (PH)	[6.3]
	Onager 1 EC		12.0-24.0 oz/A	12	7	[6.2]
	Portal		2 pts/A	12	365	[6.4]
	Savey 50DF		3.0-6.0 oz/A	12	28	[6.2]
	Zeal 72 WS		2.0-3.0 oz/A	12	7	
Japanese Beetle	Admire Pro		1.4-2.8 fl oz/A	12	0	[7.2]
	Assail 30SG		5.3-8.0 oz/A	12	7	
	Provado 1.6F		4.0-8.0 fl oz/A	12	0	
	Sevin XLR Plus, 4F		2-3 qt/A	12	3	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	*Voliam Express		6-12 fl oz/A	24	14	
Lecanium scale, San Jose scale	Centaur 0.7WDG		34.5-46.0 oz/A	12	14	[11.2]
	Esteem 35WP		4.0-5.0 oz/A	12	14	[11.2]
	Movento SC		6.0-9.0 fl oz/A	24	7	
Oriental fruit moth	(**§**)Pheromone disruption:					[8.1]
	Checkmate OFM-F		1.3-2.9 fl oz/A			
	or §Checkmate OFM		100-200			
	Dispenser		dispensers/A			
	or Isomate-M 100		100 ties/A			
	Altacor 35WDG		3.0-4.5 oz/A	4	10	[8.2]
	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	

Table 15.1.1. Pesticide Spray Table – Apricots.

Refer to inside back cover for key to abbreviations and footnotes.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Additional Summer Sprays (continued)						
Oriental fruit moth (*continued*)	Assail 30SG		5.3-8.0 oz/A	12	7	
	Avaunt 30 WDG		6.0 oz/A	12	14	
	*Baythroid XL 1EC		2.0-2.4 fl oz/A	12	7	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25 WG		6.0-7.0 oz/A	4	14	
	§Entrust 80WP	0.4-0.8 oz/100 gal	1.25-2.5 oz/A	4	14	
	Intrepid 2F		10-16 fl oz/A	4	7	
	*Proaxis 0.5CS		2.6-5.1 fl oz/A	24	14	
	Sevin XLR Plus, 4F		2.0-3.0 qt/A	12	3	
	*Warrior II		1.3-2.6 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	[10.1]
	*Voliam Xpress		6-12 fl oz/A	24	14	
Peachtree borer, Lesser peachtree borer	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	[9.2]
	*Baythroid XL 1EC		1.4-2.0 fl oz/A	12	7	
	*Proaxis 0.5CS		2.6-5.1 fl oz/A	24	14	
	*Warrior II		1.3-2.6 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Spotted wing Drosophila	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	[12.3]
	Actara		4.5-5.5 oz/A	12	14	
	Admire Pro		1.4-2.8 oz/A	12	0	
	Assail	5.3-8 oz/100 gal		12	7	
	*Baythroid XL 1 L		2.0-2.4 fl oz/A	12	7	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25WG		4.5-7 oz/A	4	14	[12.3]
	*Diazinon AG500	1 pt/100 gal		96	21	
	§Entrust 80WP		1.25-2.5 oz/A	4	14	[12.3]
	Imidan 70W		2.13-4.25 lb/A	7 days	14	[12.4]
	Malathion 5EC		2 pts/A	12	6	
	Mustang Max		4 oz./A	12	14	
	Pyganic		1 pt- 2 qt/A	12	0	[12.3]
	Sevin XLR Plus		2-3 qts/A	12	3	
	The following pre-mix product is also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Leverage 360		2.4-2.8 fl oz/A	12	7	

Table 15.1.1. Pesticide Spray Table – Apricots.

Refer to inside back cover for key to abbreviations and footnotes.

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Additional Summer Sprays (continued)						
Stink bugs, including Brown marmorated stink bug	Actara 25WDG		4.5-5.5 oz/A	12	14	[13.2]
	Assail 30SG		5.3-8.0 oz/A	12	7	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	[13.2]
	*Warrior IICS		1.28-2.56 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Voliam Flexi		6-7 fl oz/A	12	14	
Tarnished plant bug	Actara		4.5-5.5 oz/A	12	14	[14.3]
	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	[14.2]
	Assail 30SG		5.3-8.0 oz/A	12	7	
	*Baythroid XL 1EC		2.0-2.4 fl oz/A	12	7	
	Beleaf 50 SG		2.0-2.8 oz/A	12	14	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Proaxis 0.5CS		2.6-5.1 fl oz/A	24	14	
	*Warrior II		1.3-2.5 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Western flower thrips	§Entrust 80WP	0.4-0.8 oz/100 gal	1.25-2.5 oz/A	4	14	[15.2]
	Delegate WG		4.5-7.0 oz/A	4	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Postharvest						
European red mite, Twospotted spider mite	Nexter 75WS		4.4-10.7 oz/A	12	300 (PH)	[6.3]
Control of Storage Disorders						
Storage rots	Scholar SC	16 fl oz/100 gal (see comments and label)				[16.1]
Autumn						
Bacterial canker *(Pseudomonas syringae)*	Kocide 2000		6-12 lb/A	48	BL,PH	[1.1]
	or Kocide 3000		3.5-7.0 lb/A	48	BL,PH	
	or Cuprofix Ultra 40 Disperss		5-8 lb/A	48	BL,PH	
	or §Champ WG		8-16 lb/A	48	PH	
	or other (§)coppers	See comments				

15.2 Diseases

15.2.1 Bacterial Canker (*Pseudomonas syringae*)

• Biology & Cultural

See the description of pathogen biology and (§)copper spray timing for this disease under "Cherries—Diseases." No recent research has been done on bacterial canker in apricots under east coast conditions. However, this pathogen is probably responsible for much of the early tree death that follows limb die-back and trunk cankers that commonly develop in young apricot plantings. *P. syringae* can also cause a severe blossom blast on apricots if pathogen populations are high when a bloom-time frost occurs. Blossom blast can kill most of the spurs on affected trees.

When pruning, make sure to leave a 6-inch stub, especially when removing scaffold branches as the bacteria appear to be arrested within the stub. Avoid flush cut pruning.

To minimize the potential for severe losses from bacterial canker, apricot plantings should not be located adjacent to old sweet cherry orchards nor close to hedgerows or woodlots that contain wild Prunus (especially wild black cherry, *Prunus serotina*). Copper sprays should be applied in spring and fall as for sweet cherries. The spring copper spray may be even more important on apricot than on sweet cherry because apricots appear more sensitive to blossom blast. Entry of the pathogen through pruning wounds can be minimized if pruning is done during hot, dry weather after bloom or after harvest, because *P. syringae* is suppressed by hot weather. Trunks and scaffolds on apricot trees should be painted with white latex paint in autumn to reduce the potential for winter injury, as *P. syringae* can also enter where bark is injured during winter.

• Pesticide Application Notes

[1.1] Optimum timing and effectiveness of (§)copper applications for control of bacterial canker and blossom blast of apricots has not been determined under eastern conditions. However, applying copper at the maximum labeled rates at the late dormant stage should increase the likelihood that effective copper residues will remain on the trees throughout the bloom period. Copper applications are especially important on young trees because trees less than five years old can be killed by bacterial canker if infections reach the main trunk.

15.2.2 Bacterial Spot *(Xanthomonas arboricola pv. pruni)*

• Biology & Cultural

Bacterial spot can be devastating to apricots. Apricot varieties developed in drier climates and then grown in the more humid climate of New England are the most likely to be susceptible. This disease will be more severe in the warmer southern portions of New England, in wet years, in orchards with lighter (sandy) soils, and in windy orchard sites. The bacterial spot pathogen, *Xanthomonas arboricola* pv. *pruni* infects leaf scars at leaf drop and overwinters in infected twigs. Bacteria populations subsequently multiply during warm weather and ooze out during spring rains. Immature tissues are less susceptible to the bacterial infection, and as such, infections will not begin until petal fall/shuck split. Early season copper applications applied to manage bacterial canker are quite effective for controlling the bacterial spot populations, but also likely to induce phytotoxicity if one is not careful.

• Pesticide Application Notes

Unfortunately, there are no materials registered for bacterial spot on apricots. Despite the effectiveness, do not make a dormant (§)copper application for bacterial spot. Copper applications to manage bacterial canker and bacterial blast are still allowed whether or not the planting has bacterial spot.

15.2.3Brown Rot

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this disease. *Monilinia laxa* commonly referred to as European brown rot is present in the region and can cause extensive blossom and shoot blight in cool wet weather at bloom. *M. laxa* is primarily a problem on European or dark-fleshed tart cherry varieties, but in wet years causes considerable problems in apricots.

• Pesticide Application Notes

[2.1] Apricots are much more susceptible to blossom blight than any other stone-fruit species. At least 1 protective spray should be applied each year; repeat at full bloom and/or petal fall if wet weather prevails during bloom. Pristine, Gem, Indar, Rally, Quash and Tilt are generally more effective than captan or Bravo. When used at a rate of 10 oz/100 gal dilute, Rovral 50WP provides 24-48 hr kickback activity against blossom blight infections at 68° F; Indar and Tilt also have significant kickback activity. Scala, Vangard, and Elevate have not been tested on apricots, but they have been effective for blossom blight on peaches.

[2.2] The shuck split application is an important spray. Chlorothalonil (Bravo, Echo) provides a longer period of protection than either captan or sulfur, but do not use chlorothalonil after shuck split. Also, chlorothalonil has a limited effect on *Monilinia laxa*, and should be used in combination with a material from 2.1 in orchards where both *M. laxa* and *M. fructicola* are present.

[2.3] Fruit are very susceptible to brown rot prior to pit hardening and the last 3 wk before harvest. It is recommended that spray intervals be shortened during the preharvest period and that Indar, Tilt, Quash, or Pristine be used if disease pressure is high (warm, wet). Indar and Tilt are registered for use beginning 3 weeks before harvest. Of these materials, Indar has the longest residual activity.

• Pesticide Resistance

[2.4] For resistance management purposes, the SI fungicides (Indar & Tilt) should not be used routinely throughout the season for BOTH blossom blight AND fruit rot control. Where stone fruits within the same block ripen over an extended season, continued use of SI fungicides as preharvest sprays for successive varieties will also create selection pressure for fungicide resistance. Use captan or Pristine to break the string of preharvest SI fungicides applied to varieties with varied ripening or harvest dates.

15.2.4 Peach Scab

• Biology & Cultural

Peach scab can severely damage apricot if spring weather is warm and wet and no fungicides are applied at shuck split and first cover. The disease is more common following a year when spring frosts caused a crop failure, because trees grown for an entire summer without fungicides are more likely to carry peach scab infections the following year.

• Pesticide Application Notes

[3.1] Apply 2 or 3 sprays at 10-14-day intervals beginning at shuck split. Under light disease pressure, a single application of Bravo or Echo applied at shuck split may provide season-long control. Bravo and Echo cannot be applied after shuck split.

15.2.5 Perennial (Cytospora, Valsa) Canker

• Biology & Cultural

[4.1] See discussion of this disease under Peaches. Also, refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this disease.

15.2.6 Phytophthora Root, Crown, and Collar Rots

• Biology & Cultural

[5.1] Apricot rootstocks are perhaps more susceptible to Phytophthora root, crown, and collar rots than any other fruit tree rootstock grown in New England. The main defenses against these diseases should be providing good soil drainage through proper site selection and physical manipulations such as tiling or planting on berms. In general, berms are much more effective than tiling. See comment [5.2] about pesticide applications.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this disease.

• Pesticide Application Notes

[5.2] In addition to the cultural practices noted in comment [5.1], Ridomil will provide additional protection in wet years, on marginal sites, or in wetter sections of the orchard. Applications should be made just before growth starts in the spring and at 2-3 month intervals thereafter if soil conditions are very wet. Apply to the soil beneath the tree canopy in sufficient water to assure good coverage (material is moved into the soil by subsequent rain or irrigation). See label for further details.

15.3 Insects and Mites

15.3.1 Brown Marmorated Stink Bug – refer to section on Stink Bugs

15.3.2 European Red Mite, Twospotted Spider Mite

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[6.1] Apply (§)oil against overwintering eggs.

[6.2] Apply as mites appear in a minimum of 50 gal/A. Acramite, Apollo, Envidor, Onager and Savey limited to 1 application per season.

[6.3]Use lower rate of Nexter for European red mite, and higher rate of Nexter, for twospotted spider mite (see label). Apricots can only be treated with Nexter after harvest and have a 300 day pre harvest interval.

[6.4] Portal Has a supplemental label for stone fruits.

15.3.3 Japanese Beetle

• Biology & Cultural

[7.1] Adults emerge from the soil between early July and mid-August to feed on numerous trees and shrubs. In peach trees, beetles devour the tissue between the veins, leaving a lace-like skeleton, and also feed on the surface of the fruit. Severely injured leaves turn brown and often drop. Adults are most active during the warmest parts of the day and prefer to feed on plants that are fully exposed to the sun.

• Pesticide Application Notes

[7.2] Although pheromone traps are available and can be hung in the orchard in early July to detect the beetles' presence, they are generally NOT effective at trapping out the beetles. Fruit and foliage may be protected from damage by applying Sevin, Assail, *Leverage, or Admire Pro; repeated applications may be required. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

15.3.4 Oriental Fruit Moth

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Biological & Non-chemical Control

[8.1] (§)Pheromone disruption is economically justified if 2-3 sprays are normally applied, and if no other insecticide sprays are routinely needed for other pests after petal fall. For this reason, disruption may not be economical for the 1st brood, as plum curculio sprays at this time normally would also control oriental fruit moth. Pheromones should be applied in mid-June before initiation of the 2nd flight; the need for re-application depends on residual field life of specific formulations: Isomate-M 100 and §Checkmate OFM Dispenser, 90 days; Checkmate OFM-F, 30 days. Insecticide sprays or a double rate of pheromone may be needed in orchards adjacent to sources of adult immigration or in other high pressure situations.

• Pesticide Application Notes

[8.2] Summer sprays should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45° F) after the first adult catch of the second brood, with a second application in 10-14 days. In high pressure blocks, a final spray should be applied 2 wk before harvest to control late season larvae.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

Suggested action threshold: Avg. of >10 adults/ week caught per pheromone trap.

15.3.5 Peachtree Borers (including Lesser peachtree borer)

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Biological & Non-chemical Control

[9.1] Hang (§)pheromone ties at shucksplit before moth flight begins. Pruning should be done before hanging dispensers. Use Isomate PTB-Dual at a rate of 150 per acre. Use a higher rate (200-250/A) for outside edges of border blocks; areas that haven't been disrupted before and have high populations; and in blocks smaller than 5 acres. Isomate PTB-Dual is effective on both Peachtree Borer and Lesser Peachtree Borer.

• Pesticide Application Notes

[9.2] Up to 3 sprays of pyrethroids to trunk and scaffold limbs against larvae: June 1-10, July 7-15, and August 1-10 (do not spray fruit). *Baythroid not labeled for peachtree borer.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

Suggested action threshold: 1st emergence of adults plus 8 days (in blocks with a history of damage), or 1-2 larvae or pupal cases/tree.

15.3.6 Plum Curculio

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring and Forecasting

Monitor for adults beginning at bloom using beating trays. Examine fruit, especially along border rows, beginning at shuck-split. Suggested threshold is 1-2 % new damage. Use degree day model to determine when immigration into orchard should be complete. This is at 308 DD (base 50^0) from apple petal fall.

• Pesticide Application Notes

[10.1] 2-3 applications. Begin at fruit set (shucks on) and follow at 8-10-day (for Sevin) or 10-14-day (for other products) intervals. Do not apply Actara between the pre-bloom (swollen bud) and post bloom (petal fall) growth stages.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

[10.2] Frequent applications (7-10-day intervals) of §Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth. If fresh market stone fruit cannot be washed according to label instructions, discontinue sprays when the fruit are approximately 3/4 inch in diameter.

[10.3] Persons not covered by the Worker Protection Standard (WPS), such as members of the general public involved in "pick-your-own", "U-Pick" or similar operations, cannot enter a treated area for 14 days after application of Imidan.

15.3.7 Scales, including European Lecanium and San Jose Scale

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of San Jose scale.

• Pesticide Application Notes

[11.1] Apply (§)oil against overwintering immatures.

[11.2] One application 4-6 weeks after shuck split, against newly hatched crawlers. Movento must be used with an organosilicone or nonionic spray adjuvant.

15.3.8 Spotted Wing Drosophila

• Biology & Cultural

[12.1] This is an exotic species of vinegar fruit fly, a group normally attracted to damaged and rotting fruit. But in contrast to endemic Drosophila fruit flies, it has a serrated ovipositor and will lay eggs in intact ripening fruit on the tree and on the farmstand shelf. It is also a pest of berry fruit crops. Originally known from Japan, it has been found throughout New England since 2011. Refer to the reference materials list (17.4) at the end of this publication for fact sheets containing details on the biology and management of this species.

• Monitoring

[12.2] Vinegar-baited traps are not effective as an indicator of first emergence. There is a baited traps that is more effective Standard Yeast Bait consisting of water+sugar+active dried yeast+unscented dishwasher soap.Inspect ripening fruit for the larvae.

• Pesticide Application Notes

[12.3] Apply at first signs of adult activity. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. Pyganic can provide adult knockdown but has a very short residual of 0-2 days.

[12.4] Persons not covered by the Worker Protection Standard (WPS), such as members of the general public involved in "pick-your-own", "U-Pick" or similar operations, cannot enter a treated area for 14 days after application of Imidan.

15.3.9 Stink Bugs (including Brown Marmorated Stink Bug)

• Biology & Cultural

[13.1] A number of native stink bug species (Brown, Dusky and Green Stink Bugs) can sometimes cause fruit damage in all tree fruits under conditions that are not fully understood. Adult feeding during bloom and shuck split can cause the fruit to abort, and feeding later in the summer can cause a deep catfacing injury such as that caused by tarnished plant bug, or depressed, dimpled, corky or water-soaked areas on the skin. All tree fruits are attacked, especially peaches and apples. Other species of stink bugs are predators. Elimination of alternate host broadleaf weeds, especially legumes, in the orchard will contribute to management efforts. If control is needed, insecticides should be timed to kill immigrating adults as they appear in the orchards to prevent feeding damage and subsequent mating and egglaying.

The brown marmorated stink bug is an invasive species from Asia that was first documented in Allentown, PA in 2001. It has caused extensive damage to apple and peach crops in the mid-Atlantic states in recent years. It has a wide host range and is more likely to reproduce in orchards as compared to native species. This insect has spread across a number of eastern US States, and now extends to the west coast as well. It was first documented in Connecticut in 2008. Although it can be found throughout Connecticut in and around structures, extensive monitoring efforts in 2011- 2013 resulted in few detections in agricultural crops; however, reports of sightings have been increasing. Refer to the reference materials list (17.4) at the end of this publication for fact sheets containing details on the biology and management of brown marmorated stink bug.

• Pesticide Application Notes

[13.2] Apply at first signs of infestation; BMSB are very mobile pests, and may reinfest the treated area quickly. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. *Danitol has a FIFRA Section 2(ee) registration for BMSB; the labeling must be in the possession of the user at the time of pesticide application. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and Voliam Flexi should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

15.3.10 Tarnished Plant Bug

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest. Satisfactory control requires adequate management of orchard weeds that attract this pest and act as alternate hosts.

• Monitoring & Forecasting

[14.1] Most catfacing injury is caused before shuck split. Later season feeding generally results in only minor surface scarring.

[14.2] Apply spray as insects or damage appears and if action threshold is reached.
Suggested action threshold: 3 bleeding sites/tree or 1-2% of fruit with new injury.

• Pesticide Application Notes

[14.3]At 10-14-day intervals as needed in midsummer. Do not apply Actara between the pre-bloom (swollen bud) and post bloom (petal fall) growth stages. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

15.3.11 Western Flower Thrips

• Biology & Cultural

Drought conditions and high temperatures may encourage damaging populations. Adults move from alternate weed or crop hosts to fruit just prior to and during harvest, feed on the fruit surface in protected sites, such as in the stem end, the suture, under leaves and branches, and between fruit. Feeding results in silver stippling or patches; injury is particularly obvious on highly colored varieties.

• Pesticide Application Notes

[15.1] In orchards with severe infestations, a petal fall application may be warranted against thrips feeding in fruit clusters. Control may be improved by addition of an adjuvant.

[15.2] An application immediately after harvest may prevent subsequent losses; however, an additional application may be needed if pressure is severe. Control with Entrust or Delegate may be improved by addition of an adjuvant. Note 14 day pre-harvest interval.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage, Voliam Flexi and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

15.4 Storage Rots

• Pesticide Application Notes

[16.1] A postharvest treatment with Scholar SC via dipping, flooders, T-jet, or similar system for control of storage rots is recommended for fruit coming from orchards where sporulating brown rot was observed, or when one hopes keep fruit in cold storage for a few days prior to sale. Holding tanks in postharvest treatment equipment must have excellent agitation to keep fungicides in suspension. Solutions must be replenished regularly as directed on the product label. Never expose treated fruit to direct sunlight. This will cause the fungicide to break down.

15.5 Growth Regulation of Apricots

Table 15.3.2. Plant Growth Regulator Use in Apricots

Refer to inside back cover for key to abbreviations and footnotes.

Timing	Product	Concentration	Rate of Formulated Product	Comments
Preharvest Fruit Drop Control				
1-2 weeks before anticipated harvest	ReTain	132 ppm	0.74 lb/acre or 333 g/acre (1 pouch)	Apply in sufficient water to ensure thorough but not excessive coverage. An organosilicone surfactant (12 oz/100 gal) should be used with ReTain.

FIGURE 16.1.1

GROWTH STAGES IN PLUM AND PRUNE

1. Dormant
2. Swollen bud
3 Bud burst
4. Green cluster
5. White bud
6. Bloom
7. Petal fall
8. Fruit set

16 Plums and Prunes

16.1 Insecticides and Fungicides for Plums and Prunes

See Sections 16.2, 16.3, and 16.4 for comments related to this table.

Table 16.1.1 Pesticide Spray Table – Plums and Prunes.

Refer to inside back cover for key to abbreviations and footnotes

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Bud Burst						
European red mite, European lecanium scale, San Jose scale	(§)oil	2 gal/100 gal		12	0	[8.2],[14.1]
	Centaur		34.5 oz/A	12	14	
White Bud to Petal Fall						
Black knot	Bravo Ultrex 82.5 WDG or Bravo Weather Stik 6F or other chlorothalonil formulations (see labels)	0.9-1.25 lb/100 gal 1.0-1.4 pt/100 gal	2.8-3.8 lb/A 3.1-4.1 pt/A	12 hr/ 7days (E)	SS	[1.1],[1.2] [1.3],[1.4]
	Topsin M 70WP/WSB or Topsin M 4.5F	5.3-8.0 oz/100 gal 6.7-10 fl oz/100 gal	1.0-1.5 lb/A 20-30 fl oz/A	48 48	1 1	[1.4]
Brown rot (blossom blight)	Bravo Weather Stik 6F or other chlorothalonil formulations (see labels)	1.0-1.4 pt/100 gal	3.1-4.1 pt/A	12 hr/ 7days (E)	SS	[2.1]
	Captan 50WP or Captan 80WDG or Captec 4L	2 lb/100 gal 1.25 lb/100 gal 1 qt/100 gal	6.0 lb/A 3.75 lb/A 3 qt/A	24 24 24	0 0 0	[2.2]
	Echo 720 6F or Echo 90DF	1.0-1.4 pt/100 gal 0.75-1.2 lb/100 gal	3.1-4.1 pt/A 2.25-3.5 lb/A	12hr/7 days (E)	SS	
	Elevate 50WDG		1.5 lb/A	12	0	
	Fontelis 1.67		14-20 fl oz/A	12	0	
	Gem 500SC		1.9-3.8 oz/A	12	1	[2.8]
	Inspire Super		16-20 fl oz/A	12	2	
	Merivon		4.0-6.7 fl oz/A	12	0	
	Meteor		1-2 pt/A	24	PF	
	Pristine 38WDG		10.5-14.5 oz/A	12	0	[2.4]
	Quash 50 WDG		2.5-3.5 oz/A	12	14	[2.6]
	Rally 40 WSP		2.5-6.0 oz/A	24	0	
	Scala 600SC		9.0-18.0 fl oz/A	12	2	
	Tilt 3.6EC		4.0 fl oz/A	12	0	[2.5]
	Sulfur 92WP	5-10 lb/100 gal		24	0	
	§Microthiol Disperss		10-20 lb/A	24	0	
Leaf spot	(See comments)					[1.4]
Shuck Split						
Brown rot, Black knot, Peach scab	Bravo Ultrex 82.5WDG or Bravo Weather Stik 6F or other chlorothalonil formulations (see labels)	0.9-1.25 lb/100 gal 1.0-1.4 pt/100 gal	2.8-3.8 lb/A 3.1-4.1 pt/A	12 hr/ 7days (E)	SS	[2.3],[3.1]
	Captan 50WP or Captec 4L	2 lb/100 gal 1 qt/100 gal	6.0 lb/A 3 qt/A	24 24	0 0	

Table 16.1.1 Pesticide Spray Table – Plums and Prunes.

Refer to inside back cover for key to abbreviations and footnotes

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Shuck Split (continued)						
Brown rot, Black knot, Peach scab *(continued)*	Topsin M 70WP/WSB	4 oz/100 gal		48	1	
	or Topsin M 4.5F	5 fl oz/100 gal		48	1	
	plus:					
	Captan 50WP	1.5 lb/100 gal		24	0	
	or Captec 4L	1.5 pt/100 gal		24	0	
	Fontelis 1.67		14-20 fl oz/A	12	0	
	Gem 500SC		1.9-3.8 oz/A	12	1	
	Inspire Super		16-20 fl oz/A	12	2	
	Merivon		4.0-6.7 fl oz/A	12	0	
	Quash 50WDG		2.5-3.5 oz/A	12	14	
European red mite, Twospotted spider mite	Acramite 50 WS		0.75-1.0 lb/A	12	3	[8.2]
	*Agri-Mek 0.15EC	2.5-5.0 fl oz/100 gal	10-20 fl oz/A	12	21	
	plus: oil					
	Envidor		16.0-18.0 fl oz/A	12	7	
	Nexter 75WS		4.4-10.7 oz/A	12	7	[8.2]
	Onager 1 EC		12-24 oz/A	12	7	
	Portal		2 pt/A	12	7	
	Savey 50DF		3.0-6.0 oz/A	12	28	
	*Vendex 50WP		1.0-2.0 lb/A	48	14	
Oriental fruit moth, Plum curculio	Actara		4.5-5.5 oz/A	12	14	[12.2]
	Altacor 35 WDG		3.0-4.5 oz/A	4	10	[11.2]
	*Asana 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	
	Assail 30 SG		5.3-8.0 oz/A	12	7	
	Avaunt 30 WDG		5.0-6.0 oz/A	12	14	
	§Aza-Direct		1.0-2.0 pt/A	4	0	
	or Azatin XL 3L		10-21 fl oz/A	4	0	
	*Baythroid XL 1EC					
	for oriental fruit moth:		2.0-2.4 fl oz/A	12	7	
	for plum curculio:		2.4-2.8 fl oz/A	12	7	
	Belt 4SC		3-4 fl oz/A	12	7	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25WG		6.0-7.0 oz/A	4	7	[12.4]
	§Entrust 80WP	0.4-0.8 oz/100 gal	1.25-2.5 oz/A	4	7	
	Imidan 70W	0.75-1.0 lb/100 gal	2.1-4.25 lb/A	7-14 days	7	[12.5]
	Intrepid 2F		10.0-16.0 fl oz/A	4	7	[11.2]
	Sevin XLR Plus, 4F		2-3 qt/A	12	3	
	§Surround 95WP		25-50 lb/A	4	0	[12.3]
	(§)Pheromone disruption for OFM:					
	Checkmate OFM-F		1.3-2.9 fl oz/A			[11.1]
	or §Checkmate OFM Dispenser		100-200 dispensers/A			
	or Isomate-M 100		100 ties/A			

Table 16.1.1 Pesticide Spray Table – Plums and Prunes.

Refer to inside back cover for key to abbreviations and footnotes

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Shuck Split (continued)						
Oriental fruit moth, Plum curculio *(continued)*	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Peachtree Borer, Lesser Peachtree Borer	(§)Pheromone disruption: Isomate PTB-Dual		150 ties/A			[10.1]
Additional Summer Sprays						
Black knot	Topsin M 70WSB/WP	5.3-8.0 oz/100 gal	1.0-1.5 lb/A	48	1	
	or Topsin M 4.5F	6.7-10 fl oz/100 gal	20-30 fl oz/A	48	1	
Brown rot	Captan 50WP	2.0 lb/100 gal	6.0 lb/A	24	0	[2.2]
	or Captec 4L	1 qt/100 gal	3 qt/A	24	0	
	Elevate 50WDG		1.5 lb/A	12	0	
	Fontelis 1.67		14-20 fl oz/A	12	0	
	Indar 2F		6.0 fl oz/A	12	0	
	Inspire Super		16-20 fl oz/A	12	2	
	Merivon		4.0-6.7 fl oz/A	12	0	
	Pristine 38WDG		10.5-14.5 oz/A	12	0	
	Quash		2.5-3.5 oz/A	12	14	
	Rally 40 WSP		2.5-6.0 oz/A	24	0	
	Sulfur 92WP	5-10 lb/100 gal		24	0	
	§Microthiol Disperss		10-20 lb/A	24	0	
	Tilt 3.6EC		4.0 fl oz/A	12	0	[2.5]
Apple maggot	Imidan 70W	0.75-1.0 lb/100 gal	2.1-4.25 lb/A	7-14 days	7	[6.2],[12.5]
	*Voliam Xpress		6-12 fl oz/A	24	14	[6.2]
European red mite, Twospotted spider mite	Acramite 50WS		0.75-1.0 lb/A	12	3	[8.2]
	Envidor		16.0-18.0 fl oz/A	12	7	
	Nexter 75WS		4.4-10.7 oz/A	12	7	
	Onager 1 EC		12-24 fl oz/A	12	7	
	Portal		2.0 pt/A	12	365	[8.3]
	Savey 50DF		3.0-6.0 oz/A	12	28	
	*Vendex 50WP		1.0-2.0 lb/A	48	14	
	Zeal 72 WS		2.0-3.0 oz/A	12	7	
Japanese beetle	Admire Pro		1.4-2.8 fl oz/A	12	7	[9.2]
	Assail 30 SG		5.3-8.0 oz/A	12	7	
	Sevin XLR Plus, 4F		2-3 qt/A	12	3	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	

Table 16.1.1 Pesticide Spray Table – Plums and Prunes.

Refer to inside back cover for key to abbreviations and footnotes

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Additional Summer Sprays (continued)						
Lecanium scale, San Jose scale	Admire Pro		1.4-2.8 fl oz/A	12	7	[7.1],[14.2]
	Centaur 0.7WDG		34.5 oz/A	12	14	
	Esteem 35WP		4.0-5.0 oz/A	12	14	[14.2]
	Movento 240SC		6.0-9.0 fl oz/A	24	7	
Lesser peachtree borer, Peachtree borer, American plum borer	*Asana 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	[10.2]
	*Baythroid XL 1EC					
	for lesser peachtree borer:		1.4-2.0 fl oz/A	12	7	
	for American plum borer:		2.4-2.8 fl oz/A	12	7	
	(§)Pheromone disruption:					
	Isomate PTB-Dual		150 ties/A			[10.1]
	*Proaxis 0.5CS		2.6-5.1 fl oz/A	24	14	
	*Warrior II		1.28-2.56 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	[10.2]
Oriental fruit moth	(§)Pheromone disruption:					[11.1]
	or Checkmate OFM-F		1.32-2.93 fl oz/A			
	or §Checkmate OFM dispensers		100-200 dispensers/A			
	or Isomate-M 100		100 ties/A			
	Altacor 35 WDG		3.0-4.5 oz/A	4	10	[11.2]
	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	
	Assail 30SG		5.3-8.0 oz/A	12	7	
	Avaunt 30 WDG		6.0 oz/A	12	14	
	*Baythroid XL 1EC		2.0-2.4 fl oz/A	12	7	
	Belt 4SC		3-4 fl oz/A	12	7	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25 WG		6.0-7.0 oz/A	4	7	
	§Entrust 80WP	0.4-0.8 oz/100 gal	1.25-2.5 oz/A	4	7	
	Imidan 70W	0.75-1.0 lb/100 gal	2.1-4.25 lb/A	7 -14 days	7	[12.5]
	Intrepid 2F		10.0-16.0 fl oz/A	4	7	
	*Proaxis 0.5CS		2.6-5.1 fl oz/A	24	14	
	Sevin XLR Plus, 4F		2-3 qt/A	12	3	
	*Warrior II		1.28-2.56 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Voliam Flexi WDG		4.0-7.0 oz/A	12	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Redbanded leafroller	*Baythroid XL 1EC		2.4-2.8 fl oz/A	12	7	[12.1]
	Belt 4SC		3-4 fl oz/A	12	7	

Table 16.1.1 Pesticide Spray Table – Plums and Prunes.

Refer to inside back cover for key to abbreviations and footnotes

Pest	Product	Amt/100 gal	Amt/A	REI (hrs)	PHI (days)	Comments (see text)
Additional Summer Sprays (continued)						
Redbanded leafroller (*continued*)	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25 WG		4.5-7.0 oz/A	4	7	
	§Entrust 80WP		1.25-2.5 oz/A	4	7	
	Imidan 70W	0.75-1.0 lb/100 gal	2.1-4.25 lb/A	7 -14 days	7	[12.5]
	The following pre-mix products are also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Voliam Xpress		6-12 fl oz/A	24	14	
Spotted wing Drosophila	*Asana XL 0.66EC	2.0-5.8 fl oz/100 gal	4.8-14.5 fl oz/A	12	14	
	Actara		4.5-5.5 oz/A	12	14	
	Admire Pro		1.4-2.8 oz/A	12	0	
	Assail	5.3-8 oz/100		12	7	
	*Baythroid XL 1 L		2.4-2.8fl oz/A	12	7	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	
	Delegate 25WG		4.5-7 oz/A	4	7	[15.3]
	*Diazinon AG500	1 pt/100 gal		96	21	
	§Entrust 80WP		1.25-2.5 oz/A	4	7	[15.3]
	Imidan 70W	0.75 lb/100 gal	2.13 lb/A	7-14 days	7	[15.4]
	Mustang Max		4 oz./A	12	14	
	Pyganic		1 pt- 2 qt/A	12	0	[15.3]
	Sevin XLR Plus		2-3 qts/A	12	3	
	The following pre-mix product is also labeled for use against this pest; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
Stink bugs, including Brown marmorated stink bug	Actara 25WDG		4.5-5.5 oz/A	12	14	[16.2]
	Assail 30SG		5.3-8.0 oz/A	12	7	
	*Danitol 2.4EC		10.7-21.3 fl oz/A	24	3	[16.2]
	*Warrior 1I CS		1.28-2.56 fl oz/A	24	14	
	The following pre-mix products are also labeled for use against these pests; however, for best effectiveness and insecticide resistance management, their use should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.					
	*Endigo ZC		5-5.5 fl oz/A	24	14	
	*Leverage 360		2.4-2.8 fl oz/A	12	7	
	Voliam Flexi		6-7 fl oz/A	12	14	
Control of Storage Disorders						
Storage rots	Scholar SC	16-32 fl oz/100 gal				[17.1]

16.2 Diseases

16.2.1 Bacterial Spot (*Xanthomonas arboricola* pv. *pruni*)

• Biology & Cultural

Bacterial spot can be devastating to plums and prunes. Plum or prune varieties developed in drier climates and then grown in the more humid climate of New England are the most likely to be susceptible. This disease will be more severe in the warmer southern portions of New England, in wet years, in orchards with lighter (sandy) soils, and in windy orchard sites. The bacterial spot pathogen, *Xanthomonas arboricola* pv. *pruni* infects leaf scars at leaf drop and overwinters in infected twigs. Bacteria populations subsequently multiply during warm weather and ooze out during spring rains. Immature tissues are less susceptible to the bacterial infection, and as such, infections will not begin until petal fall/shuck split. Early season (§)copper applications applied to manage bacterial blast are quite effective for controlling the bacterial spot populations, but also likely to induce phytotoxicity if one is not careful.

• Pesticide Application Notes

Unfortunately, there are no materials registered for bacterial spot on prunes and plums. Despite the effectiveness, do not make a dormant (§)copper application for bacterial spot. Copper applications to manage bacterial blast are still allowed whether or not the planting has bacterial spot.

16.2.2 Black Knot

• Biology & Cultural

[1.1] Fungicide sprays will be relatively ineffective in controlling black knot unless old knots are pruned and removed or burned, preferably before bud break. Make pruning cuts at least 6-8 inches below visible swellings. Destroy wild plum and cherry trees along fence rows, for these are major sources of black knot inoculum.

[1.2] The most important period for black knot sprays is from white bud through shuck split. Black knot infection periods require rain and are most likely at temperatures above 55° F; thus, sprays are most likely to be beneficial under these conditions.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this disease.

• Pesticide Application Notes

[1.3] Bravo is the most effective fungicide for black knot control. Topsin M is only moderately effective. Bravo is not labeled for use on plums after shuck split.

[1.4] If leaf spot has been a problem in previous years, include captan, sulfur, or Topsin M in each spray from petal fall until terminal growth stops. Pristine also controls leaf spot. A petal fall spray of Bravo is recommended if wet weather and inoculum availability favor black knot infection. This spray will also protect against early season brown rot infections of the green fruit.

[1.5] If black knot is present in the orchard or nearby, apply an appropriate fungicide in the first 2 cover sprays if weather conditions are favorable for infection (wet).

16.2.3 Brown Rot

• Biology & Cultural

[2.1] Blossom blight is most likely to be a problem when the weather is warm (above 60° F) and wet or when large numbers of fruit were not harvested the previous year. Blossom blight may also be a problem at lower temperatures if prolonged wetting periods occur. If these conditions do not occur, it is recommended that the white bud, bloom, and petal fall sprays be directed primarily at black knot. Bravo and Echo give superior control of black knot and will also control blossom blight.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this disease.

• Pesticide Application Notes

[2.2] Captan may cause injury on Stanley and Japanese-type plums if used repeatedly in early season sprays.

[2.3] Some plum cultivars are very susceptible to brown rot for the first few wk after setting; therefore, the shuck split and first cover sprays are important for control of this disease unless the weather is very dry. Do not apply Topsin M without captan.

[2.4] Spray intervals should be shortened during wet periods and the last 3 wk before harvest, because this is when fruit are most susceptible to infection. Pristine and Tilt are the best materials for brown rot control if high disease pressure develops near harvest, because of their partially systemic and antisporulant activities.

[2.5] Note the label warning that Tilt may affect the size and shape of "Stanley" plums.

[2.6] Do not apply Quash to "Stanley" type plums.

16.2.4 Peach Scab

• Biology & Cultural

Peach scab can infect Japanese plum fruit in southern New England if spring weather is warm and wet and no fungicides are applied at shuck split and first cover. The disease is more common following a year when spring frosts caused a crop failure, because trees grown for an entire summer without fungicides are more likely to carry peach scab infections the following year. Fungicides applied to control black knot are usually sufficient to control peach scab.

• Pesticide Application Notes

[3.1] Apply 2 or 3 sprays at 10-14-day intervals beginning at shuck split. Under light disease pressure, a single application of Bravo or Echo applied at shuck split may provide season-long control. Bravo and Echo cannot be applied after shuck split.

16.2.5 Perennial (cytospora, valsa) Canker

• Biology & Control

[4.1] Perennial canker can be serious on Japanese-type plums and some prune cultivars. Refer to the discussion on this disease under Peaches. Also, refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this disease.

16.2.6 Phytophthora Root and Crown Rots

• Biology & Control

[5.1] Although plum rootstocks are relatively resistant to these diseases, Japanese-type plums that are planted on peach rootstocks are at the same risk as peach and apricot trees. Refer to the section on this disease under Peaches.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this disease.

16.3 Insects and Mites

16.3.1 Apple Maggot

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring

[6.1] Suggested action threshold: 1 adult capture on yellow board or red sphere trap.

• Pesticide Application Notes

[6.2] Up to 3 sprays at 10-day intervals, beginning app. July 1 in southern New England. If Assail, Asana, Baythroid, Danitol or Warrior are used for other pests (e.g. oriental fruit moth, plum curculio), they should also control apple maggot.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

16.3.2 Brown Marmorated Stink Bug – refer to section on Stink bugs

16.3.3 European Fruit Lecanium Scale

• Pesticide Application Notes

[7.1] 1 spray at the end of crawler hatch (mid-June), about 16-20 days after the 2nd plum curculio spray. Admire Pro not labeled for Lecanium scale.

16.3.4 European Red Mite, Twospotted Spider Mite

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring

[8.1] Suggested action thresholds:
Bud Burst – 10% of spurs with eggs
Shuck Split and later – 6 motile forms/leaf.

• Pesticide Application Notes

[8.2] Apply oil to overwintering eggs. Apply acaricides when mites first surpass threshold; do not apply Acramite, Envidor, Onager or Savey more than once; or Nexter or *Vendex more than 2 times per season. Use lower rate of Nexter for European red mite, higher rate for twospotted spider mite (see label).

[8.3] Portal Has a supplemental label for stone fruits.

16.3.5 Japanese Beetle

• Biology & Cultural

[9.1] Adults emerge from the soil between early July and mid-August to feed on numerous trees and shrubs. In plum trees, beetles devour the tissue between the veins, leaving a lace-like skeleton, and also feed on the surface of the fruit. Severely injured leaves turn brown and often drop. Adults are most active during the warmest part of the day and prefer to feed on plants that are fully exposed to the sun.

• Pesticide Application Notes

[9.2] Although pheromone traps are available and can be hung in early July to detect the beetles' presence, they are generally NOT effective at trapping out the beetles. Fruit and foliage may be protected from damage by applying Admire Pro, Sevin, Assail, or *Leverage ; repeated applications may be required.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

16.3.6 Lesser Peachtree Borer, Peachtree Borer, American Plum Borer

• Biology & Cultural

Refer to the reference materials list at the end of this publication for Fact Sheets containing details on the biology and management of these pests. American plum borer can be a problem particularly in orchards adjacent to other stone fruit plantings.

• Biological & Non-chemical Control

[10.1] Hang (§)pheromone ties at shuck split before moth flight begins. Pruning should be done before hanging dispensers. Use Isomate PTB-Dual at a rate of 150 per acre. Use a higher rate (200-250/A) for outside edges of border blocks; areas that haven't been disrupted before and have high populations; and in blocks smaller than 5 acres. Isomate PTB-Dual is effective on both Peachtree Borer and Lesser Peachtree Borer.

• Pesticide Application Notes

[10.2] Up to 3 sprays of *Asana or *Warrior to trunk and scaffold limbs against larvae: June 1-10, July 7-15, and August 1-10. *Baythroid and *Leverage not labeled for peachtree borer.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

Suggested action threshold: 1st emergence of adults plus 8 days or 1-2 larvae or pupal cases/tree.

16.3.7 Oriental Fruit Moth

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Biological &Non-chemical Control

[11.1] (§)Pheromone disruption is economically justified if 2-3 sprays are normally applied, and if no other insecticide sprays are routinely needed for other pests after petal fall. For this reason, disruption may not be economical for the 1st brood, as plum curculio sprays at this time normally would also control oriental fruit moth. Pheromones should be applied in mid-June before initiation of the 2nd flight; the need for re-application depends on residual field life of specific formulations: Isomate-M 100 and §Checkmate OFM Dispenser, 90 days; Checkmate, OFM-F, 30 days. Insecticide sprays or a double rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

• Pesticide Application Notes

[11.2] Summer sprays should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45°F) after the first adult catch of the second brood, with a second application in 10-14 days. In high pressure blocks, a final spray should be applied 2 wk before harvest to control late season larvae. Avaunt will provide suppression only. Altacor will provide suppression only against plum curculio. Intrepid not effective on plum curculio.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

Suggested action threshold: Avg. of >10 adults/week caught per pheromone trap.

16.3.8 Plum Curculio

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring and Forecasting

Monitor for adults beginning at bloom using beating trays. Examine fruit, especially along border rows, beginning at shuck-split. Suggested threshold is 1-2 % new damage. Use degree day model to determine when immigration into orchard should be complete. This is at 308 DD (base 50°) from apple petal fall.

• Pesticide Application Notes

[12.1] Also effective against redbanded leafroller.

[12.2] Actara not effective on Oriental fruit moth. Do not apply Actara between the prebloom (swollen bud) and post bloom (petal fall) growth stages.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Leverage and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.3] Frequent applications (7-10-day intervals) of §Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth.

[12.4] Delegate is for plum curculio suppression only.

[12.5] Although the restricted entry interval (REI) is 7 days, hand harvesting is prohibited for 14 days after application. Persons not covered by the Worker Protection Standard (WPS), such as members of the general public involved in "pick-your-own", "U-Pick" or similar operations, cannot enter a treated area for 14 days after application of Imidan.

16.3.9 Redbanded Leafroller

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring

[13.1] Suggested action threshold: 10% infested terminals from petal fall to shucks off; 5% infested terminals in late August.

• Pesticide Application Notes

[13.2] Imidan applied as the 2nd plum curculio spray controls this pest. May also need a spray 3 wk before harvest.

For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo and *Voliam Xpress should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

16.3.10 Scales, including European Lecanium and San Jose Scale

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of San Jose scale.

• Pesticide Application Notes

[14.1] Apply (§)oil against overwintering stage.

[14.2] One application 4-6 weeks after shuck split against hatching crawlers. Movento must be used with a horticultural mineral oil or nonionic spray adjuvant.

16.3.11 Spotted Wing Drosophila

• Biology & Cultural

[15.1] This is an exotic species of vinegar fruit fly, a group normally attracted to damaged and rotting fruit. But in contrast to endemic Drosophila fruit flies, it has a serrated ovipositor and will lay eggs in intact ripening fruit on the tree and on the farmstand shelf.. It is also a pest of berry fruit crops. Originally known from Japan, it has been found throughout New England since 2011. Refer to the reference materials list (17.4) at the end of this publication for fact sheets containing details on the biology and management of this species.

• Monitoring

[15.2] Vinegar-baited traps are not effective as an indicator of first emergence. There is a baited trap that is more effective Standard Yeast Bait consisting of water+sugar+active dried yeast+unscented dishwasher soap. Inspect ripening fruit for larvae.

• Pesticide Application Notes

[15.3] Apply at first signs of adult activity when fruits are beginning to ripen. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. Pyganic can provide adult knockdown but has a very short residual of 0-2 days.

[15.4] Although the restricted entry interval (REI) is 7 days, hand harvesting is prohibited for 14 days after application.Persons not covered by the Worker Protection Standard (WPS), such as members of the general public involved in “pick-your-own”, “U-pick” or similar operations, cannot enter a treated area for 14 days after application of Imidan.

16.3.12 Stink Bugs (including Brown Marmorated Stink Bug)

• Biology & Cultural

[16.1] A number of native stink bug species (Brown, Dusky and Green Stink Bugs) can sometimes cause fruit damage in all tree fruits under conditions that are not fully understood. Adult feeding during bloom and shuck split can cause the fruit to abort, and feeding later in the summer can cause a deep catfacing injury such as that caused by tarnished plant bug, or depressed, dimpled, corky or water-soaked areas on the skin. All tree fruits are attacked, especially peaches and apples. Other species of stink bugs are predators. Elimination of alternate host broadleaf weeds, especially legumes, in the orchard will contribute to management efforts. If control is needed, insecticides should be timed to kill immigrating adults as they appear in the orchards to prevent feeding damage and subsequent mating and egglaying.

The brown marmorated stink bug is an invasive species from Asia that was first documented in Allentown, PA in 2001. It has caused extensive damage to apple and peach crops in the mid-Atlantic states in recent years. It has a wide host range and is more likely to reproduce in orchards as compared to native stink bug species. This insect has spread across a number of eastern US States, and now extends to the west coast as well. It was first documented in Connecticut in 2008. Although it can be found throughout Connecticut in and around structures,, extensive monitoring efforts in 2011 – 2013 resulted in few detections in agricultural crops; however, reports of sightings have been increasing. Refer to the reference materials list (17.4) at the end of this publication for fact sheets containing details on the biology and management of brown marmorated stink bug.

• Pesticide Application Notes

[16.2] Apply at first signs of infestation; BMSB are very mobile pests, and may reinfest the treated area quickly. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations. *Danitol has a FIFRA Section 2(ee) registration for BMSB; the labeling must be in the possession of the user at the time of pesticide application. For best effectiveness and insecticide resistance management, the use of pre-mixes such as *Endigo, *Leverage and Voliam Flexi should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

16.4 Storage Rots

[17.1] A postharvest treatment with Scholar SC via dipping, flooders, T-jet, or similar system for control of storage rots is recommended for fruit coming from orchards

where sporulating brown rot was observed, or when one hopes keep fruit in cold storage for a few days prior to sale. Holding tanks in postharvest treatment equipment must have excellent agitation to keep fungicides in suspension. Solutions must be replenished regularly as directed on the product label. Never expose treated fruit to direct sunlight. This will cause the fungicide to break down.

16.5 Growth Regulation of Plums and Prunes

Table 16.5.1. Plant Growth Regulator Use in Plums and Prunes

Refer to inside back cover for key to abbreviations and footnotes.

Timing	Product	Concentration	Rate of Formulated Product	Comments
Preharvest Fruit Drop Control				
1-2 weeks before anticipated harvest	ReTain	132 ppm	333 g/acre (1 pouch) (12 oz/100 gal)	Apply in sufficient water to ensure thorough but not excessive coverage. An organosilicone surfactant (12 oz/100gal) should be used with ReTain.

17 Appendices

17.1 Pesticide Data

Table 17.1.1 Common names, product names, formulations, and days-to-harvest for pesticides used on tree fruits.

Common Names/ Products Formulations	DAYS TO HARVEST (A)					
	Apples	*Apricots*	*Cherries*	*Peaches*	*Pears*	*Plums*
Insecticides and Acaricides						
*abamectin/*avermectin						
*Agri-Mek, *Temprano 0.15EC	28	—	—	—	28	21
*Abba 0.15EC, *Gladiator	28	—	—	—	28	21
acequinocyl						
Kanemite 15SC	14	—	—	—	14	—
acetamiprid						
Assail 30SG	7	7	7	7	7	7
(§)azadirachtin						
§Neemix 4.5L, §Aza-Direct 1.2L, Azatin XL 0.27EC	0	0	0	0	0	0
*azinphos-methyl						
*Guthion 50WS	14(A)	—	15	—	14	—
bifenzate						
Acramite 50WS	7	3	3	3	7	3
*bifenthrin						
*Bifenture 2EC, *Brigade 10WS, 2 EC,*Fanfare 2EC	—	—	—	—	14	—
§Bt (*Bacillus thuringiensis*)						
§Deliver 18WG	0	0	0	0	0	0
§Dipel 10.3 DF	0	0	0	0	0	0
§Biobit HP	0	0	0	0	0	0
§Javelin WG	0	0	0	0	0	0
§Agree 3.8 WS	0	—	—	0	0	0
buprofezin						
Centaur WDG	14	14	14	14	14	14
buprofezin & flubendiamide						
Tourismo	14	14	14	14	14	14
Carbaryl						
Sevin 4F, 4EC	3	3	3	3	3	3
chlorantraniliprole						
Altacor 35WDG	5	10	10	10	5	10
chlorantraniliprole & thiamethoxam						
Voliam Flexi WDG	35	14	14	14	35	14
chlorantraniliprole & cyhalothrin						
Voliam Xpress WDG	21	14	14	14	35 (60 with adjuvant)	14
chlorpyrifos						
Lorsban Advanced	PB/28(A)	—	21	14	PB	PB
*Lorsban 4EC	PB/28(A)	—	21	14	PB	PB
Lorsban 75WG	PB/28(A)	—	14 or 21(C)	14	PB	PB
clofentezine						
Apollo 4SC	45	21	21	21	21	—
clothianidin						
Clutch 50 WDG	7	—	—	—	7	—
Belay 2.1	7	—	—	21	7	—

Table 17.1.1 Common names, product names, formulations, and days-to-harvest for pesticides used on tree fruits.

Common Names/ Products Formulations	DAYS TO HARVEST (A)					
	Apples	*Apricots*	*Cherries*	*Peaches*	*Pears*	*Plums*
Insecticides and Acaricides (continued)						
cyfluthrin						
*Baythroid XL 1E, 2EC, *Leverage 2.7SE	7	7	7	7	7	7
diazinon						
*Diazinon 50WP, AG600	21/PF(A)	21	21	21	21	21
deltamethrin						
*Battalion 1.5 EC, *Battalion 0.2 EC *Delta Gold 1.56 EC	21	—	—	—	21	—
dimethoate						
Dimethoate 400, 4EC	—	—	—	—	28	—
emamectin benzoate						
*Proclaim 5SG	14	—	—	—	14	—
endosulfan						
*Thionex 50WP	21	—				—
*Thionex 3EC	21	—				—
esfenvalerate						
*Asana XL 0.66EC	21	14	14	14	28	14
etoxazole						
Zeal 72WS	14	7	7	7	14	7
fenbutatin-oxide, hexakis						
*Vendex 50WP	14	—	14	14	14	14
fenpropathrin						
*Danito1 2.4EC	14	3	3	3	14	3
fenpyroximate						
Portal 0.4EC	14	7	7	7	14	7
flonicamid						
Beleaf 50SG	21	14	14	14	21	14
flubendiamide						
Belt SC	14	7	7	7	14	7
gamma-cyhalothrin						
*Proaxis 0.5CS	21	14	14	14	21	14
§granulosis virus						
§Carpovirusine 0.99SC	0	—	—	—	0	—
§Cyd-X 0.06SC	0	—	—	—	0	0
hexythiazox						
Savey 50DF	28	28	28	28	28	28
Onager 1 EC	28	7	7	7	28	7
imidacloprid						
Admire Pro	7	0	7	0	7	7
*Leverage 2.7SE	7	7	7	7	7	7
indoxacarb						
Avaunt 30 WDG	14	14	14	14	28	14
§kaolin						
§Surround 95WP	0	0	0	0	0	0
lambda-cyhalothrin						
*Lambda-Cy 1CS, *Taiga-Z 1CS, *Warrior 1CS, *Warrior II 2.08CS	21	14	14	14	21	14
*Endigo ZC	35	14	14	14	35	14

Table 17.1.1 Common names, product names, formulations, and days-to-harvest for pesticides used on tree fruits.

Common Names/ Products Formulations	DAYS TO HARVEST (A)					
	Apples	*Apricots*	*Cherries*	*Peaches*	*Pears*	*Plums*
Insecticides and Acaricides (continued)						
malathion						
Malathion 57EC, 5EC	—	6	3	7	—	—
methidathion						
*Supracide 2EC, 25WP	PB	PB	PB	PB	PB	PB
methomyl						
*Lannate 2.4L, 90SP	14	—	—	4	7	—
methoxyfenozide						
Intrepid 2F	14	—	—	—	14	—
novaluron						
Rimon 0.83 EC	14	8	—	8	—	8
oxamyl						
*Vydate 2L	14	—	—	—	14	—
permethrin						
*Ambush 25WP,*Perm-Up 3.2EC	PF	—	3	14	PB	—
*Pounce 3.2EC, 25WP	PF	—	3	14	PB	—
(§)oil						
JMS Stylet Oil, §Omni Oil 6E, (§)Purespray Spray Oil	0	0	0	0	0	0
phosmet						
Imidan 70WS	7	14	7 (C)	14	7	7
potassium fatty acids						
§Des-X, §M-Pede	0	0	0	0	0	0
See Des-X label about possible phytotoxicity after fruit formation on pears, cherries, and smooth-skinned stone fruit.						
(§)pyrethrin/rotenone						
§PyGanic 1.4 EC	0	0	0	0	0	0
Pyrenone 6.0% EC	0	0	0	0	0	0
pyridaben						
Nexter 75WS	25	PH	PH	7	7	7
pyriproxyfen						
Esteem 35WP	45	14	14	14	45	14
rynaxypyr (see chlorantraniliprole)						
spinetoram						
Delegate 25WG	7	14	7	1	7	7
(§)spinosad						
§Entrust 80WP	7	14	7	14	7	7
§GF-120	0	0	0	0	0	0
spirodiclofen						
Envidor 2 SC	7	7	7	7	7	7
spirotetramat						
Movento 240SC	7	7	7	7	7	7
thiacloprid						
Calypso 4F	30	—	—	—	30	—
thiamethoxam						
Actara 25WDG	14/35	14	14	14	14/35	14
zeta cypermethrin						
*Mustang Max EC	14	14	14	14	14	14

Table 17.1.1 Common names, product names, formulations, and days-to-harvest for pesticides used on tree fruits.

Common Names/ Products Formulations	DAYS TO HARVEST (A)					
	Apples	*Apricots*	*Cherries*	*Peaches*	*Pears*	*Plums*
Fungicides and Bactericides						
azoxystrobin Abound 2.08F	—	0	0	0	—	0
§*Bacillus subtilis* §Serenade ASO	0	0	0	0	0	0
captan Captan 50WP, 80WDG, Captec 4L	0	0	0	0	—	0
chlorothalonil Bravo Weather Stik, Ultrex Echo 720, 90DF, Chloronil 720, Concorde, Equus, Applause DF, 720	—	SS	SS	SS	—	SS
(§)copper hydroxide Kocide 2000, 4.5LF, 101, DF §Champ Formula-2. §NuCop 50DF	HIG	BL	BL,PH (C)	BL	BL	BL
copper oxychloride sulfate C-O-C-S WDG	GT	PF	PF,PH (C)	BL,PF	BL	BK,PF
copper sulfate Cuprofix Ultra Disperss 40DF, Basicop	2C	BL	BL, PH	SS	BL	BL
cyprodinil Vangard WG	0	2	2(C)	2	0	2
DCNA Botran 75WP	—	10	10(D)	10	—	BL
difenoconazole Inspire Super MP	14	2	2(C)	2	14	2
dodine Syllit 65WP, FL	7	—	7, PH	15	7	—
fenarimol Vintage 1SC	30	—	0	—	30	—
fenbuconazole Indar 2F	14	0	0	0	—	0
fenhexamid Elevate 50WDG	—	0	0	0	0	0
ferbam Ferbam Granuflo	7	—	-	21	7	—
fluopyram + pyrimethanil (Luna Tranquility) [a]	72	—	—	—	—	—
fluopyram + trifloxystrobin (Luna Sensation) [a]	14	—	1	—	—	—
flutriafol (Topguard)	14	7	7	7	7	7
fluxapyroxad + pyraclostrobin (Merivon) [a]	0	0	0	0	0	0
fosetyl-Al Aliette WDG	14	(B)	(B)	(B)	14	(B)

Table 17.1.1 Common names, product names, formulations, and days-to-harvest for pesticides used on tree fruits.

Common Names/ Products Formulations	DAYS TO HARVEST (A)					
	Apples	*Apricots*	*Cherries*	*Peaches*	*Pears*	*Plums*
Fungicides and Bactericides(continued)						
§hydrogen dioxide (hydrogen peroxide)						
§OxiDate	0	0	0	0	0	0
iprodione						
Rovral 50WP, 4 Flowable, Iprodione 4L, AG	—	PF	PF	PF	—	PF
kresoxim-methyl						
Sovran 50WG	30	—	—	—	30	—
(§)lime sulfur						
Allpro Lime Sulfur, §Rex lime sulfur solution, Miller Lime Sulfur Solution, Sulforix Lime Sulfur	0	—	0	0	0	0
mancozeb						
Manzate Max Penncozeb 75DF	BL,77(A)	—	—	—	BL,77(A)	—
mancozeb + copper hydroxide						
ManKocide	BL	—	—	—	BL	—
mefanoxam						
Ridomil Gold SL	0	0	0	0	0	0
metiram						
Polyram 80WP	BL,77(A)	—	—	—	—	—
myclobutanil						
Rally 40WSP	14	0	0	0	—	0
(§)oxytetracycline						
§Mycoshield 17WP, Fireline 17WP	60	—	—	21	60	—
Pantoea agglomerans strain E325						
§Bloomtime Biological FD	PF	—	—	—	PF	—
penthiopyrad (Fontelis)	28	—	0	0	28	0
phosphite products						
Agri-fos, Fungi-Phite, Phostrol Topaz	0	0	0	0	0	0
prohexadione calcium						
Apogee 27.5DF	45	—	—	—	—	—
propiconazole						
Orbit 3.6EC, Tilt	—	0	0	0	—	0
pyraclostrobin						
Cabrio EG	0	-	0	-	-	-
pyraclostrobin + boscalid						
Pristine 38WDG	0	0	0	0	0	0
pyrimethanil						
Scala	72	2	—	2	72	2
quinoxyfen						
Quintec	-	—	7	7	7	7
(§)streptomycin						
§Agri-Mycin 17WP,Firewall 17WP, Streptrol 17WP, Agricultural streptomycin 17WP	50	—	—	—	30	—

Table 17.1.1 Common names, product names, formulations, and days-to-harvest for pesticides used on tree fruits.

Common Names/ Products Formulations	DAYS TO HARVEST (A)					
	Apples	*Apricots*	*Cherries*	*Peaches*	*Pears*	*Plums*
Fungicides and Bactericides(continued)						
(§)sulfur						
§Kumulus DF, § Microthiol Disperss, Wettable sulfur Thiolux Jet	PH	—	0	0	PH	0
tebuconazole						
Elite 45WSP	—	—	0	0	—	—
Tebuzol 45DF	75	0	0	0	75	0
tebuconazole + trifloxystrobin						
Adament 50WG	75	1	1	1	75	1
thiophanate-methyl						
Topsin M WSB, 70WP	(A)	1	1	1	1	1
Topsin 4.5L	(A)	1	1	1	—	1
T-methyl 70W WSB	1	1	1	1	1	1
thiram						
Thiram Granuflo	—	—	—	7	—	—
triadimefon						
Triadimefon 50DF, Bayleton	45	—	—	—	45	—
trifloxystrobin						
Flint	14	—	—	—	14	—
Gem 500 SC	—	1	1	1	—	1
triflumizole						
Procure 50WS	14	—	1	—	14	—
ziram						
Ziram 76DF	14	30	14	14	14	—

Key:
BL Do not apply beyond bloom.
GT Do not apply beyond green tip.
HIG Do not apply beyond 1/2-in green.
PB Prebloom applications only.
PF Do not apply beyond petal fall.
PH Postharvest applications allowed.
SS Do not apply beyond shuck split.
2C Do not apply after 2d cover spray.
(A) If more than one value is given, depends on rate, method and/or number of applications; check label.
(B) Nonbearing trees only.
(C) Tart cherries only.
(D) Sweet cherries only
— Not registered for use on crop.
***** Restricted-use pesticide; may be purchased and used only by certified applicators, or used by someone under the supervision of a certified applicator.
§ Potentially acceptable in certified organic pograms
(§) Not all formulations of the active ingredient are acceptable in certified organic programs.

Table 17.1.2. Common names, product names, formulations, and days-to-harvest for growth regulators.

Common Name/ Product Name	Formulation	EPA Reg. No.	Crop	Preharvest Interval
Amid-Thin W naphthalene-acetamide	8.4 WP	5481-426	Apple, pear	—
Apogee prohexadione calcium	27.5% DF	7969-188	Apple	45 days
Ethrel ethephon	2 lb/gal	264-267	Apple, cherries	7 days

Table 17.1.2. Common names, product names, formulations, and days-to-harvest for growth regulators.

Common Name/ Product Name	Formulation	EPA Reg. No.	Crop	Preharvest Interval
Exilis Plus cytokinin	2.0% liquid	62097-9	Apple	86 days
Fruitone L naphthalene-acetic acid	3.5% liquid	5481-47	Apple. Pear	2 days
Fruitone N naphthalene-acetic acid	3.1%	5481-427	Apple, pear	2 days
MaxCel cytokinin	1.9%	73049-407	Apple	86 days
Novagib gibberellin	1.0% liquid	62097-7	Apple	—
Perlan cytokinin+gibberellin	1.8% + 1.8% liquid	62097-6	Apple	—
PoMaxa Naphthaleneacetic acid	3.1%	73049-487	Apple, pear	7 days
§ProGibb gibberellic acid	4% liquid	73049-15	cherries	0 days
§ProGibb Plus 2X gibberellic acid	20% SP	73049-16	Sweet cherry	0 days
§ProVide 10 SG gibberellin	10% SG	73049-409	Apple	—
Promalin cytokinin+gibberellin	1.8% + 1.8% liquid	73049-41	Apple, pear, sweet cherry	—
ReTain AVG	15% SP	73049-45	Apple, pear	7 days
RiteSize cytokinin+gibberellin	1.8% + 0.18% liquid	55146-86	Apple	—
RiteWay cytokinin 6-BA	1.9% liquid	71368-60	Apple	86 days
Tre-Hold RTU naphthalene-acetic acid	1.15%	5481-452	Apple, pear, nectarine	—
Typy cytokinin+gibberellin	1.8% + 1.8% liquid	55146-78	Apple	—
TypRus gibberellin 4+7	2.0% liquid	55146-85	Apple	—

— Preharvest interval information not provided on label.
§Potentially acceptable in certified organic programs

17.2 EPA numbers and worker protection standard re-entry and personal protective equipment (PPE) guidelines.

Worker Notification: Under most circumstances, worker employers must make sure that workers are notified about areas where pesticide applications are taking place or where restricted-entry intervals are in effect. Some pesticide labels require you to notify workers BOTH orally AND with signs posted at entrances to the treated area. Unless the pesticide labeling requires both types of notification, notify workers EITHER orally OR by the posting of warning signs at entrances to treated areas. You must inform workers which method of notification is being used. For details on notification requirements both for these products and those not represented below, refer to the product label and the Worker Protection Standard, 40 CFR part 170. NOTE: Every attempt has been made to keep this table up-to-date and accurate, however, for your and your workers safety always consult the label if in doubt about required PPE and othe details about Agricultural Use Requirements undet the Worker Protection Standard.

Table 17.2.1 Insecticides and acaricides

Product	EPA Reg. No.	Common Name	REI (hrs)	Applicator PPE	Early Entry PPE
*Abba 0.1EC	66222-139	abamectin	12	dfghij	dfghj
Acramite 50WS	400-503	bifenazate	12	ac	cfk
Actara	100-938	thiamethoxam	12	acf	cfk
Admire Pro 4.6SC	264-827	imidacloprid	12	acf	cfk
§Agree WG	70051-47	Bt	4	abcp	bck
*Agri-Mek 0.15EC	100-898	abamectin	12	dfghij	dfghj
Altacor 35WDG	352-730	chlorantraniliprole, rynaxypyr	4	ac	ac
Apollo 4SC	66222-47	clofentezine	12	acf	cfk
*Asana XL 0.66EC	352-515	esfenvalerate	12	acfh	cfhk
Assail 30SG	8033-36-70506	acetamiprid	12	abcj	bck
Avaunt 30WDG	352-597	indoxacarb	12	abc	beg
§Aza-Direct 1.2L	71908-1-10163	azadirachtin	4	abc	bck
Azatin XL 0.27EC	70051-27-59807	azadirachtin	4	acfh	cfhk
*Battalion 0.2EC	264-1007-66330	deltamethrin	12	dfghij	dfghj
*Battalion 1.5 EC	66330-374	deltamethrin	12	dfghij	dfghj
*Baythroid XL 1EC	264-840	beta-cyfluthrin	12	acfh	cfhk
Beleaf 50SG	71512-10-279	flonicamid	12	abc	bck
Belay	59639-150	clothianidin	12	acf	cfk
Belt SC	264-1025	flubendiamide	12	acf	cfk
*Bifenture EC	70506-57	bifenthrin	12	acfh	cfk
§Biobit HP	73049-54	Bt	4	abc	bck
Biobit XL 2.1FC	73049-46	Bt	4	abc	bck
*Brigade 10WS	279-3108	bifenthrin	12	abc	bck
*Brigade 2EC	279-3313	bifenthrin	12	acf	cfk
Calypso 4F	264-806	thiacloprid	12	acf	cfk
§Carpovirusine 0.99SC	66330-55	granulosis virus	4	acfhlo	achf
Centaur WDG	71711-21	buprofezin	12	abc	beg
Checkmate CM-F 14.3S	56336-37	pheromone	4	abcj	bcd
Checkmate CM-OFM Duel	56336-49	pheromone	0	b	–
Checkmate OFM-F 24.6S	56336-24	pheromone	0	abc	–
Clutch 50 WDG	59639-152	clothianidin	12	abc	bck
§Cyd-X 0.06SC	70051-44	granulosis virus	4	ac	bck
*Danitol 2.4EC	59639-35	fenpropathrin	24	acfh	cfhk
Delegate 25WG	62719-541	spinetoram	4	ac	cfk
§Deliver 18WG	70051-69	Bt	4	abc	bck
*Delta Gold 1.5 EC	264-1011-1381	deltamethrin	12	dfghij	dfghj
§Des-X	67702-22-70051	potassium fatty acids	12	dfghij	

Table 17.2.1 Insecticides and acaricides

Product	EPA Reg. No.	Common Name	REI (hrs)	Applicator PPE	Early Entry PPE
*Diazinon 50W	66222-10	diazinon	96	abc	bcjk
Dimate 4EC	51036-110-9779	dimethoate	48	afghjl	fghjk
Dimethoate 4EC	19713-231	dimethoate	48	fghjk	fghjk
Dimethoate 400	34704-207	dimethoate	10 days	acfil	efgj
§Dipel DF	73049-39	Bt	4	abcp	bck
*Endigo ZC	100-1276	lambda-cyhalothrin, thiamethoxam	24	dfgij	dfgj
§Entrust 80WP	62719-282	spinosad	4	ac	bck
Envidor 2SC	264-831	spirodiclofen	12	abc	abc
Esteem 35WP	59639-115	pyriproxyfen	12	ac	bce
*Fanfare 2EC	66222-99	bifenthrin	12	acfh	cfk
§GF-120	62719-498	spinosad	4	ac	bck
*Guthion 50WS	66222-162	azinphos-methyl	14-15 days (E)	efghijm	efghj
Imidan 70-W	10163-169	phosmet	3-7 days (E)	abcjl	bcjk
Intrepid 2F	62719-442	methoxyfenozide	4	abc	beg
§Isomate-C TT	53575-25	pheromone	0	b	—-
§Isomate-CM/OFM TT	53575-30	pheromone	0	b	—
Isomate PTB Dual	53575-43	pheromone	0	b	—
Isomate-M 100	53575-19	pheromone	0	b	—
§Javelin 7.5WDG	70051-66	Bt	4	abcp	bck
JMS Stylet Oil	65564-1	paraffinic oil	12	acf	cfk
Kanemite 15SC	66330-38	acequinocyl	12	acf	cfk
Kelthane 50WSP	62719-414	dicofol	48	bcehijl	bchk
§Kumulus 80DF	51036-352	sulfur	24	abfh	bchk
*Lambda-Cy 1EC	70506-121	lambda-cyhalothrin	24	acfh	acf
*Lannate 90SP	352-342	methomyl	48-96(E)	acfhlq	cfhk
*Lannate LV 2.4L	352-384	methomyl	48-96(E)	acfhilq	cfhk
*Leverage 2.7SE	264-770	imidacloprid/cyfluthrin	12	dfghi	fghk
*Leverage 360	2645-1104	imidacloprid/ beta-cyfluthrin	12	acf	cfk
Lorsban Advanced	62719-591	chlorpyrifos	96	dfgijlq	dfgj
Lorsban 75WG	62719-301	chlorpyrifos	96	dfgijlq	dfgj
Malathion 57EC	34704-108	malathion	12	acfh	cfhk
Malathion 5EC	19713-217	malathion	12	acf	cfk
Movento 240SC	264-1050	spirotetramat	24	acfh	acfh
§M-Pede 49L	53219-6	insecticidal soap	12	ac	bck
*Mustang Max EC	279-3327	zeta-cypermethrin	12	acfh	cfk
§Neemix	70051-9	azadirachtin	12	acfh	cfhk
Nexter 75WS	7969-106	pyridaben	12	abchjl	bchjkl
§Omni Spray Oil 6E	5905-368	mineral oil	12	acf	cfk
Onager 1EC	10163-277	hexythiazox	12	abc	abc
*Perm-Up 3.2EC	70506-9	permethrin	12	acfh	cef
Portal 0.4EC	71711-19	fenpyroximate	12	acfhj	dfghij
*Pounce 25 WP	279-3051	permethrin	12	abc	bck
*Proaxis 0.5CS	74921-3-34704	gamma-cyhalothrin	24	acfh	cfk
*Proclaim 5SG	100-904	emamectin benzoate	12 or 48 (E)	acef	cfhk
Provado 1.6F	264-763	imidacloprid	12	acf	cfk
Purespray Spray Oil	69526-5	petroleum oil	4	acf	cef
§Purespray Green	69526-9	mineral oil	4	acf	cfk

Table 17.2.1 Insecticides and acaricides

Product	EPA Reg. No.	Common Name	REI (hrs)	Applicator PPE	Early Entry PPE
§PyGanic 1.4EC	1021-1771	pyrethrins	12	acf	cfk
Pyrenone	432-1033	pyrethrins/PBO	12	acf	cfk
Rimon 0.83EC	66222-35-400	novaluron	12	acfh	cefh
Savey 50DF	10163-250	hexythiazox	12	abc	abc
Sevin XLR Plus	264-333	carbaryl	12	acfj	cfjk
Sevin 4F	264-349	carbaryl.	12	acfj	cfjk
Sherpa	34704-983	imidacloprid	12	acf	cfk
SPLAT Cydia	80286-3	pheromone	4	acfh	afhk
SPLAT OFM 30M-1	80286-1	pheromone	4	acfh	afhk
*Supracide 25W	10163-244	methidathion	72	abclq	bck
§Surround WP	70060-14	kaolin	4	aclo	ac
*Taiga Z 1CS	100-1112-1381	lambda-cyhalothrin	24	acfh	cfk
*Temprano 0.15EC	67760-71-400	abamectin	12	acfh	dfgh
*Thionex 3EC	66222-63	endosulfan	7 days	acfhijm	cfhk
*Thionex 50W	66222-62	endosulfan	20 days	acfhijm	cfhk
Tourismo	71711-33	buprofezin & flubendiamide	12	abcj	cfghj
§Trilogy	70051-2	neem extract	4	acf	cfk
*Vendex 50WP	1812-413	hexakis	48	dfghijq	cfhk
§Virosoft CP4	72898-4	granulosis virus	4	abch	bchk
Voliam Flexi	100-1319	thiamethoxam/ chlorantraniliprole	12	acf	cfk
*Voliam Xpress EC	100-1320	lambda-cyhalothrin/ chlorantraniliprole	24	acf	cfk
*Vydate 2L	352-372	oxamyl	48	dfghijm	dfghj
*Warrior II 2.08CS	100-1295	lambda-cyhalothrin	24	acfh	cfk
Zeal 72WS	59639-138	etoxazole	12	acf	acf

Table 17.2.2 Fungicides and batericides

Product	EPA Reg. No.	Common Name	REI (hrs)	Applicator PPE	Early Entry PPE
Abound 2.08F	100-1098	azoxystrobin	4	acf	cfk
Adament 50WG	264-1052	trifloxystrobin	12	acf	cfk
Ag Streptomycin	66222-121	streptomycin	12	acfo	efgo
§Agri-Mycin 17WP	55146-96	streptomycin	12	acf	efg
Agri-fos	71962-1	phosphite	4	abch	bcdh
Aliette WDG	264-516	fosetyl-Al	12	abch	bchk
Allpro Lime Sulfur	769-558	lime sulfur	48	efghijl	efghj
Apogee 27.5%	7969-188	prohexadione calcium	12	acf	cfk
Applause 720	50534-188	chlorothalonil	12	acfhl	cfhk
Bac-Master	55146-80-5481	streptomycin	12	abcl	fchk
Bayleton 50DF	264-737-5481	triadimefon	12	acfj	cfk
Bloomtime Biological FD	71975-1	*Pantoea agglomerans strain E325*	4	abco	bck
Botran 75W	10163-189	dichloronitroaniline	12	ac	bck
Bravo Weather Stik	50534-188-100	chlorothalonil	12	acf	cfhk
Bravo Ultrex	50534-201-100	chlorothalonil	12	dfghijl	dfghj
Cabrio EG	7969-187	pyraclostrobin	12	acf	cfk
Captan 50WP	66330-234	captan	24(E)	achilo	cfhk
Captan 80WDG	66222-58-66330	captan	24(E)	acfhio	cfhk

Table 17.2.2 Fungicides and batericides

Product	EPA Reg. No.	Common Name	REI (hrs)	Applicator PPE	Early Entry PPE
Captec 4L	66330-239	captan	24(E)	acfih	cfhk
Champ Formula-2 4.6F	55146-64	copper hydroxide	24(E)	acfh	cfhk
Chloronil 720	50534-188-100	chlorothalonil	12	acf	cfhk
C-O-C-S WDG	34704-326	copper oxychloride & basic copper sulfate	24	acfh	cfhk
Concorde	72167-24-1812	chlorothalonil	12	acfh	cfhk
Cuprofix Ultra 40 Disperss	70506-201	basic copper sulfate	48	ac	cfk
Dithane Rainshield DF	62719-402	mancozeb	24	acf	cfk
Dithane F-45 Rainshield	62719-396	mancozeb	24	cefhi	cef
Dithane M45	62719-387	mancozeb	24	cefhi	cef
Echo 720	60063-7	chlorothalonil	12(E)	acfhm	cfhk
Echo 90DF	60063-10	chlorothalonil	12(E)	acfhm	bchk
Elevate 50WDG	66330-35	fenhexamid	12	acf	cfk
Elite 45WP	264-749	tebuconazole	12	acfh	acfh
Equus 500ZN	72167-27-66222	chlorothalonil	12	acfh	cfhk
Ferbam Granuflo	45728-7	ferbam	24	acfhjl	cfhjk
Fireline	80990-1	oxytetracycline HCl	12	acfh	cfhk
Firewall 17WP	80990-4-82695	streptomycin	12	acfq	cfe
Flint	264-777	trifloxystrobin	12	acf	cfk
Fontelis	352-834	Penthiopyrad	12	ac	cdef
Fungi-Phite	83472-1	phosphite	4	abch	bchk
GEM 500 SC	264-826	trifloxystrobin	12	acf	cfk
Indar 2F	62719-416	enbuconazole	12	acfj	cfk
Inspire Super	100-1317	difenoconazole & cyprodinil	12	acf	cfk
Iprodione 4L AG	51036-340	iprodione	24	acefjl	cef
JMS Stylet Oil	65564-1	Paraffinic oil	4	acf	cfk
Kocide 3000	352-662	copper hydroxide	48	acfh	cfhk
§Kumulus DF	51036-352	sulfur	24	acfh	cfhk
Luna Sensation	264-1090	fluopyram + trifloxystrobin	12	acf	cef
Luna Tranquility	264-1085	pyrimethanil + fluopyram	12	acf	cef
*Manzate 75DF	1812-414-352	mancozeb	24	cefhi	cef
Manzate Max	1812-416	mancozeb	24	cefhi	bceh
ManKocide	1812-360	mancozeb + copper hydroxide	24	cefhi	cefh
Merivon	7969-310	pyraclostrobin + fluxapyroxad	12	acf	cdef
Mertect 340-F	100-889	thiabendazole	12	ac	cfk
§Microthiol Disperss	70506-187	sulfur	24	acf	cfhk
Miller Lime Sulfur	66196-2-72	lime sulfur	48	efghijl	efghj
§Mycoshield 17WP	55146-97	oxytetracycline HCl	12	acfh	cfhk
No Scald-DPA-23	2792-45	diphenylamine	psthvst	acf	—
§NuCop 50DF	45002-4	copper hydroxide	24	acfh	cfhk
§OxiDate	70299-2	hydrogen dioxide	1	eg	bck
Penbotec 400SC	43813-32-64864	pyrimethanil	psthvst	acf	—
Penncozeb 75DF	70506-185	mancozeb	24	cefhi	cef
Penncozeb 4FL	70506-194	mancozeb	24	cefhi	cef
Phostrol	55146-83	phosphite	4	acfh	cfhk
Polyram 80DF	7969-105-34704	metiram	24	cefhi	cef

Table 17.2.2 Fungicides and batericides

Product	EPA Reg. No.	Common Name	REI (hrs)	Applicator PPE	Early Entry PPE
Pristine 38WDG	7969-199	pyraclostrobin/boscalid	12	acf	cfk
Procure 50WS	400-431	triflumazole	12	acf	cfk
Quash	59639-147	metconazole	12	acf	cfk
Quintec	62719-375	quinoxyfen	12	acf	cfk
Rally 40WSP	62719-410	myclobutanil	24	acfh	cfhk
§Rex Lime Sulfur Solution	71096-6	lime sulfur	48	efghijl	efghj
Ridomil Gold EC	100-801	mefanoxam	48	acf	cfk
Rovral 50WP	264-453	iprodione	24	efgijl	cfk
Rovral 4 Flowable	264-482	iprodione	24	acf	cfk
Scala	264-788	pyrimethanil	12	acf	ack
Scholar	100-969	fludioxonil	psthvst	acf	—
Scholar SC	100-1242	fludioxonil	psthvst	acf	—
§Serenade ASO	69592-12	*Bacillus subtilis*	4	abco	abc
Sovran 50WDG	7969-154	kresoxim-methyl	12	acf	cfk
Streptrol	55146-80	streptomycin	4	acfl	cef
Sulforix Lime Sulfur	66196-3-72	lime sulfur	48	efghijl	efghj
Syllit FL	55260-6	dodine	48	acfhij	efghj
T-methyl 70W WSB	66330-301	thiophanate-methyl	48(E)	acf	efgj
Tebuzol 45DF	70506-113	tebuconazole	(E)	acfh	acfh
Thiolux Jet	100-1138	sulfur	24	acfh	efg
Thiophanate Methyl 85WDG	72167-10-66222	thiophanate-methyl	12(E)	acf	cfk
Thiram Granuflo	45728-21	thiram	24	acfj	cfk
Tilt	100-617	propiconazole	12	acfh	cfhk
Topsin M 70WP	73545-11-70506	thiophanate-methyl	48	acefgi	efgi
Topsin M WSB	73545-16-70506	thiophanate-methyl	48	acefgi	efgj
Topsin M 4.5FL	73545-13-70506	thiophanate-methyl	48	acefgi	efgj
Triadimefon 50DF	264-737-45728	triadimefon	12	acfjo	cfjk
§Trilogy	70051-2	neem extract	4	acf	cfk
Vangard WG	100-828	cyprodinil	12	acf	cfk
Vintage SC	10163-275	fenarimol	24	dfghij	dfghj
Wettable sulfur	5905-289	sulfur	24	acf	cfk
Ziram 76DF	4581-140-82695	ziram	48	abchl	bchk

Table 17.2.3 Growth Regulators

Product	EPA Reg. No.	Common Name	REI (hrs)	Applicator PPE	Early Entry PPE
Amid-Thin W	5481-426	NAD	48	abc	bck
Apogee	7969-188	prohexadione Ca	12	afc	cfk
Ethrel	264-267	ethephon	48	acfh	efghj
Exilis Plus	62097-9-82917	BA	12	acfhi	abch
Fruitone L	5481-541	NAA	48	acf	cdefh
Maxcel	73049-407	BA	12	acf	cfk
Novagib	62097-7-82917	GA_{4+7}	4	acfhij	abch
Perlan	62097-6-82917	GA_{4+7} + BA	4	acfhi	abch
§Pro-Gibb 4%	73049-15	GA_3	12	acfh	cfhk
§Pro-Gibb Plus 2X	73049-16	GA_3	4	abc	bck
Pro-Vide PGR	73049-3	GA_{4+7}	12	acfh	cfhk
§Pro-Vide 10 SG	73049-409	GA_{4+7}	12	acfh	cfhk
Promalin	73049-41	GA_{4+7} + BA	4	abch	bck
ReTain	73049-45	AVG	12	abc	bck

Table 17.2.3 Growth Regulators

Product	EPA Reg. No.	Common Name	REI (hrs)	Applicator PPE	Early Entry PPE
RiteSize	55146-86	BA + GA_{4+7}	12	ach	bchk
RiteWay	71368-60	BA	12	acfh	cfhk
Tre-Hold RTU	5481-452	NAA	12	acfh	cfhk
Typrus	55146-85	GA_{4+7}	24	acfh	cdfh
Typy	55146-78	BA + GA_{4+7}	24	dfghim	abch

Key:

a..... Long-sleeved shirt & long pants
b..... Waterproof gloves
c..... Shoes plus socks
d..... Coveralls over short-sleeved shirt & short pants
e..... Coveralls over long-sleeved shirt & long pants
f ..... Chemical-resistant gloves; refer to label for specifics
g..... Chemical-resistant footwear & socks
h..... Protective eyewear
i ..... Chemical-resistant apron when cleaning equipment, mixing or loading
j ..... Chemical-resistant headgear for overhead exposure
k..... Coveralls
l ..... Dust/mist filtering respirator (MSHA/NIOSH approval no. prefix TC-21C)
m ..... Respirator with either an organic vapor-removing cartridge with a pre-filter approved for pesticides (MSHA/NIOSH approval no. prefix TC-23C) or a canister for pesticides (MSHA/NIOSH approval no. prefix TC-14G)
n .....Face shield for mixing and loading
o .....Dust/mist filtering respirator (NIOSH approved) with any N, R, P or HE filter
p .....Dust/mist filtering respirator meeting NIOSH standards of at least N-95, R-95, and P-95
q .....NIOSH approved respirator with any R, P, or HE filter

PPE .....Personal protective equipment
REI.....Re-entry interval
(E) .....Refer to label for details of restricted entry interval
psthvst ....Post-harvest use only
§ .....Potentially acceptable in certified organic programs
* .....Restricted-use pesticide; may be purchased and used only by certified applicators, or used by someone under the supervision of a certified applicator.

17.3 Spray Mixture Compatibility Notes

Read the label for specific crops or situations. Compatibilities may be changed by certain adjuvants, different formulations, combinations of more than two materials, and environmental factors such as temperature and humidity.

- Unless otherwise noted on the label, use soon after mixing, preferably in systems with continuous agitation.
- Physical compatibility: Although there may be no chemical incompatibility between the active ingredients of 2 given pesticides, some formulations of these products may not be physically compatible. This is particularly true when mixing at high concentrations and when mixing wettable powders with emulsifiable concentrates. It is recommended that a small batch of a proposed mixture be prepared before making tank combinations, to check for unacceptable physical reactions.

17.3.1 Suggested Mixing Sequence

Always mix different spray materials in the following order, starting with:

1. water soluble bags (WS)
2. water dispersible granules and dry flowables (WDG, DF)
3. wettable powders (WP)
4. liquid flowables (L, F, FC)
5. sprayable concentrates (S, SC, LC)
6. emulsifiable concentrates (EC)
7. surfactants, oils, and adjuvants Do not add oils, surfactants, or emulsifiable concentrates prior to dry formulations, or lumping may occur.

17.4. Tree Fruit Reference Materials.

Univ. of Massachusetts Fact Sheets

Online at: **extension.umass.edu/fruitadvisor/fact-sheets**

F-101R	Controlling Growth of Apple Trees
F-114R	Limb Positioning
F-116R	Maintaining a Balance Between the Top and Bottom of Apple Trees
F-118R	Thinning Apples Chemically
F-119R	Foliar Calcium Sprays for Apples
F-124	Nutrient Recommendations for Apples
F-126	Prebloom Nutrient Applications for Apple Trees
F-127R	Apogee – A New Growth Retardant for Apples
F-128	Expansion of the Apple Harvest Season
F-129A	Late-season "Rescue" Thinning with Ethephon
F-130	Apple Tree Pruning and Training (English & Spanish)
F-131	Enhancing Return Bloom of Apple
F-133	An Annual Fireblight Management Program
	Predicting Delicious Storage Scald
F-200	Peach Leaf Curl
	Block-specific Spray Calibration Worksheet
	Dogwood Borer in Dwarf Apples
	Reducing Apple Scab Risks and Saving Scab Sprays

Univ. Maine Publications

Orchard Fruit Pest Management - applicator training manual	
Planting and Early Care of Fruit Trees	**www.umext.maine.edu/onlinepubs/htmpubs/2411.htm**
Renovating Old Apple Trees	**www.umext.maine.edu/onlinepubs/htmpubs/2409.htm**

Univ. Vermont Fact Sheets

Online at: **orchard.uvm.edu/**

- IPM 'Quick' Summary for Monitoring Apple Arthropod Pests
- IPM Checklist for Vermont
- Key Arthropods and Diseases Affecting Apples: A Synopsis
- Apple Orchard Information for Beginners

Newsletters & Periodicals

Healthy Fruit Newsletter (UMass)	**extension.umass.edu/fruitadvisor/publications/healthy-fruit**
Fruit Notes (UMass)	**umassfruitnotes.com**
Apple Pest Report Newsletter (UMaine)	**pmo.umext.maine.edu/apple/AppPestReport.html**
Apple IPM News (UVM)	**orchard.uvm.edu/uvmapple/pest/**

Websites

- NEWA, current weather and pest forecast information, **newa.cornell.edu/**
- Pesticide labels and MSDS sheets for most registered pesticides: **www.cdms.net/manuf/manuf.asp** [NOTE: The labels at this site may or may not contain state-specific restrictions.] Also appleipm.com
- PRONewEngland: **pronewengland.org** Links to university, government, private sector pest management contacts, state pesticide registrations, fact sheets, and other onine pest management information for the six New England states.
- Rhode Island Apple IPM: **www.uri.edu/research/ipm**
- Rhode Island Fruit Growers website: **www.rifruitgrowers.org**
- Rhode Island product registration: **state.ceris.purdue.edu/htm/ri.htm**
- UMaine Apple IPM: **pmo.umext.maine.edu/apple/** Links to fact sheets, apple pest report newsletter, and updated weather-driven pest phenology models of use to commercial and hobbyist apple growers in Maine.
- Maine State Pomological Society **www.maineapples.org** Apple lore, orchard locations in Maine.
- UMass Fruit Advisor: umassfruit.com Provides resources for commercial tree- and small-fruit growers, including access to archives of *Healthy Fruit*, *Berry Notes*, and *Fruit Notes*, various fact sheets, videos, and other useful information for fruit growers.
- UConn IPM: **www.ipm.uconn.edu** Provides timely information on fruit pests and other fruit topics including meeting announcements and the online version of Crop Talk, a newsletter for commercial fruit and vegetable growers.
- Univ. Vermont's OrganicA: **www.uvm.edu/organica/** A resource for organic apple production in New England.

- Univ. Vermont's Apple Program: **orchard.uvm.edu** A website for commercial apple growers in Vermont.
- For listing of New York State research and extension publications: **www.nysaes.cornell.edu/hp/publications.html**
- Up-to-date listing of maximum residue levels (MRLs; i.e., pesticide residue tolerances) for countries that import U.S. fruits and vegetables; **mrldatabase.com**
- For listing and purchase of PALS Publishing publications: **palspublishing.cals.cornell.edu**
- Northeastern IPM Center Tree Fruit IPM Working Group: **www.northeastipm.org/working-groups/tree-fruit**

Cornell Tree Fruit IPM Fact Sheets

Online at: **www.nysipm.cornell.edu/factsheets/treefruit/**

A series of fact sheets developed for insect and disease pests of tree-fruit crops. These outline the biology, monitoring, and management of various pests and include color photographs to aid in identification.

Insect IPM Fact Sheets

102GFSTF-I1	Pear Psylla. 1978.
102GFSTF-I2	Codling Moth. 1996.
102GFSTF-I3	Plum Curculio. 1980.
102GFSTF-I4	Green Fruitworm. 1980.
102GFSTF-I5	Obliquebanded Leafroller. 1980.
102GFSTF-I6	Peachtree Borer. 1980.
102GFSTF-I8	Apple Maggot. 1991.
102GFSTF-I9	Spotted Tentiform Leafminer. 1980.
102GFSTF-I10	European Red Mite. 1980.
102GFSTF-I11	Rosy Apple Aphid. 1980.
102GFSTF-I12	San Jose Scale. 1980.
102GFSTF-I13	White Apple Leafhopper. 1980.
102GFSTF-I14	Dogwood Borer. 1985.
102GFSTF-I15	Cherry Fruit Fly & Black Cherry Fruit Fly. 1988.
102GFSTF-I16	Woolly Apple Aphid. 1988.
102GFSTF-I17	Oriental Fruit Moth. 1988.
102GFSTF-I18	Beneficial Insects. 1989.
102GFSTF-I19	Redbanded Leafroller. 1989.
102GFSTF-I20	European Apple Sawfly. 1991.
102GFSTF-I21	Tarnished Plant Bug. 1991.
102GFSTF-I22	Comstock Mealybug. 1991.
102GFSTF-I23	Predatory Mites. 1995.
102GFSTF-I24	American Plum Borer. 1997.
102GFSTF-I25	Phytophagous Mirid Bugs. 1998.
102GFSTF-I26	Apple-Boring Beetles. 1999.

Disease IPM Fact Sheets

102GFSTF-D3	Fire Blight. 1994.
102GFSTF-D4	Powdery Mildew of Apple. 2004.
102GFSTF-D5	Cedar Apple Rust. 1981.
102GFSTF-D6	Black Knot of Plum. 1992.
102GFSTF-D7	Phytophthora Root and Crown Rots. 1992.
102GFSTF-D8	Cherry Leaf Spot. 1993.
102GFSTF-D9	Apple Scab. 1993.
102GFSTF-D10	Brown Rot of Stone Fruits. 1993.
102GFSTF-D11	Sooty Blotch and Flyspeck. 1994.
102GFSTF-D12	Perennial Canker. 1995.

Mammal IPM Fact Sheets

102GFSTF-M1	Meadow Vole and Pine Vole. 1988.

Cornell Extension Bulletins

IB 219	Orchard Nutrition Management. 1991. **hdl.handle.net/1813/3305**
IB 221	Predicting Harvest Date for Apples. 1992. **hdl.handle.net/1813/3299**
IPM207	Apple IPM. 1999. **nysipm.cornell.edu/publications/apple_man**

Cornell's Scaffolds Newsletter

Online at: **www.nysaes.cornell.edu/ent/scaffolds/**

Cornell Food and Life Sciences Bulletins

Online at: **www.nysaes.cornell.edu/pubs/fls/**

FLS 50	Green Fruitworms. 1974.
FLS 58	Growth Stages in Fruit Trees - From Dormant to Fruit Set. 1976.
FLS 92	Biology and Control of Cytospora Fungi in Peach Plantings. 1982.
FLS 95	Blister Spot of Apple. 1982.
FLS 108	Diagnostic Keys for Diseases of Apple, Peach and Cherry. 1984.
FLS 116	Chemical Thinning of Apples. 1986.
FLS 117	Peach and Nectarine Varieties in New York State. 1986.
FLS 118	Preventing Decomposition of Agricultural Chemicals by Alkaline Hydrolysis in the Spray Tank. 1986.
FLS 123	Basing European Red Mite Control Decisions on a Census of Mites Can Save Control Costs. 1988.
FLS 124	Insects Associated with Apple in the Mid-Atlantic States. 1988.
FLS 127	Sweet and Tart Cherry Varieties: Descriptions and Cultural Recommendations. 1989.
FLS 128	Effects of Ground Cover Manipulations on Pest and Predator Mite Populations on Apple in Eastern NY. 1989.
FLS 142	Fruit Pest Events and Phenological Development According to Accumulated Heat Units. 1993.
FLS 143	Sampling Second Generation Spotted Tentiform Leafminer. 1993.
FLS 158	New York Integrated Fruit Production Protocol for Apples. 2006.

PALS Publishing Publications (palspublishing.cals.cornell.edu)

NRAES-169 Tree Fruit Field Guide to Insect, Mite and Disease Pests and Natural Enemies of Eastern North America. 2006.

Brown Marmorated Stink Bug Fact Sheets and Links

Eastern NY Brown Marmorated Stink Bug Project: hudsonvf.cce.cornell.edu/bmsb1.html

Maryland: www.hgic.umd.edu/content/brownstinkbug.cfm

New Jersey: njaes.rutgers.edu/stinkbug/

Northeastern IPM Center: www.northeastipm.org/working-groups/bmsb-working-group/bmsb-information/

Pennsylvania: ento.psu.edu/extension/factsheets/brown-marmorated-stink-bug

USDA with cooperators Stop BMSB www.stopbmsb.org

UMass Brown Marmorated Stink Bug: ID and Biology, Monitoring, Management
https://extension.umass.edu/fruitadvisor/brown-marmorated-stink-bug

Spotted Wing Drosophila Fact Sheets and Links

Identifying *Drosophila suzukii* - Oregon Department of Agriculture
www.oregon.gov/ODA/PLANT/docs/pdf/ippm_d_suzukii_id_guide10.pdf?ga=t

How to Identify the Spotted Wing Drosophila Fly - Oregon State University (video)
www.youtube.com/watch?v=fxHhMRh9gnI

Recognizing Fruit Damaged by Spotted Wing Drosophila (SWD), *Drosophila suzukii*
www.ars.usda.gov/SP2UserFiles/person/41853/PDF/articlesandinfo/Damage by SWD_2.pdf

UMass Spotted Wing Drosophila: extension.umass.edu/fruitadvisor/spotted-wing-drosophila

Recognize Fruit Damage from Spotted Wing Drosophila (SWD) - Oregon State University
horticulture.oregonstate.edu/system/files/em9021.pdf

Getting Ready for Spotted Wing Drosophila: Understanding Risks for Small Fruit Crops and Current Management Options - (Webcast with Dr. Greg Loeb, Cornell University)
breeze.cce.cornell.edu/p65wch1dipm

Spotted Wing Drosophila - Michigan State University
www.ipm.msu.edu/swd.htm

Spotted Wing Drosophila: A New Threat To Tender Fruit And Berry Crops – OMAFRA
www.omafra.gov.on.ca/english/crops/facts/pest-alert-swd.htm#id

Spotted Wing Drosophila - Oregon State University
horticulture.oregonstate.edu/group/spotted-wing-drosophila
www.ipm.ucdavis.edu/IPMPROJECT/workshop-spottedwing_drosophila.html
swd.hort.oregonstate.edu

17.5 Diagnostic and Analytical Services

To submit samples for insect or disease diagnosis or plant identification, contact:

UConn Home & Garden Education Center
Ratcliffe Hicks Building, Room 4
1380 Storrs Rd., Unit 4115
Storrs, CT 06269-4115
(860)486-6271 or toll-free 1-877-486-6271
www.ladybug.uconn.edu

Plant Disease Information Office
The Connecticut Agricultural Experiment Station
123 Huntington Street, P.O. Box 1106
New Haven, CT 06504
(203) 974-8601
www.ct.gov/caes/pdio

UMaine Coop. Ext. Insect & Plant Disease Diagnostic Lab
Pest Management Office
491 College Avenue
Orono, ME 04473
Insect Inquiries: 207-581-2963
Disease Inquiries: 207-581-3883
umaine.edu/ipm/ipddl/

UMass Plant Diagnostic Lab
101 University Drive, Suite A7
Amherst, MA 01002
413-545-3208
ag.umass.edu/diagnostics

UNH Cooperative Extension Insect Identification
G28 Spaulding Hall
38 Academic Way
Durham, NH 03824
603-862-3200
extension.unh.edu/Agric/AGPDTS/ArthroID.htm

UNH Cooperative Extension Plant Diagnostic Lab
G37 Spaulding Hall
38 Academic Way
Durham, NH 03824
603-862-3200; FAX 603-862-2717
extension.unh.edu/Agric/AGPDTS/PlantH.htm

URI Plant Clinic
3 East Alumni Ave.
Cooperative Extension Education Center
Kingston, RI 02881
401-874-2900
www.uri.edu/ce/ceec/plantclinic.html

UVM Plant Diagnostic Clinic
201 Jeffords Hall
63 Carrigan Dr.
University of Vermont
Burlington, VT 05405
802-656-0493
www.pss.uvm.edu/pd/pdc

To submit soil or leaf tissue nutrient analysis samples, contact:

Connecticut Agricultural Experiment Station
Slate Laboratory
P.O. Box 1106
New Haven, CT 06504
203-974-8521
www.caes.state.ct.us/Soiloffice/soiltesting.htm

UConn Soil Nutrient Analysis Laboratory
6 Sherman Place, U-102
University of Connecticut
Storrs, CT 06269-5102
860-486-4274
www.soiltest.uconn.edu

UMaine Analytical Laboratory
Maine Soil Testing Service
5722 Deering Hall
University of Maine
Orono, ME 04469-5722
207-581-3591 or 207-581-2945
anlab.umesci.maine.edu/

UMass Soil & Tissue Testing Laboratory
West Experiment Station
682 North Pleasant Street
University of Massachusetts
Amherst, MA 01003
413-545-2311
soiltest.umass.edu

UNH Cooperative Extension Soil Testing Program
Spaulding Life Science Center, Room G28
38 Academic Way
Durham, NH 03824
603-862-3200
extension.unh.edu/Agric/AGPDTS/SoilTest.htm

UVM Agriculture and Environmental Testing Laboratory
262 Jeffords Hall
63 Carrigan Drive
Burlington, VT 05405
802-656-3030
www.uvm.edu/pss/ag_testing/

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Cheryl Smith Spaulding Hall, UNH 38 College Road Durham, NH 03824	**Plant Health**	603-862-3841 cheryl.smith@unh.edu
RHODE ISLAND		
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VERMONT		
Terence Bradshaw Dept. of Plant and Soil Science University of Vermont Burlington, VT	**Tree fruit culture, management, and IPM**	802-922-2591 tbradsha@uvm.edu
Ann Hazelrigg Dept. of Plant and Soil Science University of Vermont Burlington, VT	**Pesticide Applicator Training**	802-656-0493 Ann.Hazelrigg@uvm.edu