

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 if present in sufficient numbers 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 should 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 evolved to overcome this resistance. 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.

However, overapplication of sulfur or lime sulfur fungicides to manage apple scab and other diseases should be avoided because those materials have significant negative impacts associated with their use. Both sulfur and lime sulfur have been shown to reduce net photosynthesis in trees following application, which may reduce tree growth, fruit set, crop yield, and fruit size. Both materials also have been shown to reduce populations of predaceous mites, e.g. and fruit size. Both materials also have been shown to reduce populations of predaceous mites, e.g. *T. pyri*, which contribute to biological management of phytophagous (i.e. plant-feeding) mite species. Finally, both sulfur and lime sulfur may impact fruit finish, especially when applied prior to hot weather greater than 85°F.

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. It is therefore important to use the best sprayer on the farm for applications of organic materials, keeping in mind that most certifiers require a

dedicated sprayer that is not also used to apply materials that are incompatible with organic certification in non-organic blocks. 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, 6.1.3, 7.1.1 7.1.2, and 7.1.4). 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 effective for controlling rust diseases on apples. [Note: Rust diseases in organic apple orchards can be minimized if eastern red cedars and ornamental junipers 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.

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. Caution should be used when applying liquid lime sulfur, because it is extremely caustic and an eye and respiratory irritant. Care should also be taken to thoroughly clean spray equipment after use because the material is corrosive to steel and other sprayer materials. 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.

Note: both sulfur and lime sulfur are phytotoxic if applied within 7-10 days of horticultural oil.

Copper fungicides (Champ, Nu Cop) also control many tree fruit diseases, but copper causes phytotoxicity under certain conditions. When applied in a full-orchard spray between silver tip and ¼” green tip, copper is effective in reducing overwintering fire blight inoculum and provides control of apple scab for about seven days following treatment. 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 X₂) are available and labeled for use during the summer against multiple diseases including Brooks 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 partial control of fire blight when applied to blossoms prior to or immediately after (i.e. within 24 hours) an infection period. Serenade should be applied as a preventive and can be applied up to and including the day of harvest.

Extract of *Reynoutria sachalinensis* (Regalia) is a plant defense promoter with translaminar but not systemic activity, and therefore must be applied preventatively on a 10-14 day schedule. It is not effective against apple scab, but is labeled for fire blight suppression and management of sooty blotch, fly speck, and powdery mildew. Research on

its effectiveness against these diseases is limited in New England, so its use is not recommended beyond trial applications at this time.

***Bacillus amyloqueliciens* strain D747** (Double Nickel 55, Double Nickel LC) is a biofungicide labeled for fire blight, sooty blotch, flyspeck, and summer rots and suppression of apple scab on pome fruit. Preliminary research has shown good efficacy against the shoot stage of fire blight when combined with low-rate copper products such as Cueva or Badge X₂ in summer sprays. Caution is advised, however, regarding fruit finish problems that may result from this treatment. Field data on efficacy against other diseases is limited, so trial use only is recommended at this time.

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 formerly used for control of fire blight of apples and pears, but its use in certified-organic production systems has been disallowed beginning October 2014. Older recommendations for the use of streptomycin to manage fire blight should be ignored.

Fire blight management in organic orchards may be challenging in orchards with susceptible cultivars and a history of the disease given the removal of streptomycin from the approved materials list. Growers are encouraged to adopt an integrated fire blight management program in organic orchards, including: 1) use of cultivars with reduced susceptibility to the disease; 2) conservative application of nitrogen fertilizers to reduce excessive, succulent growth that is more susceptible to infection; 3) aggressive removal of fire blight cankers in winter; 4) application of fixed copper between silver tip and ¼” green

tip to all orchard blocks and varieties; 5) use of disease modeling software (i.e. Maryblyt™ or Cougarblight, also available through NEWA (newa.cornell.edu)) to predict infections; 6) application of lime sulfur or biocontrol materials (e.g., Serenade, Bloomtime Biological) during bloom when infections are predicted; and 7) frequent removal of diseased tissue during dry weather in summer. More information on non-antibiotic management of fire blight may be found at: <https://www.youtube.com/watch?v=NuKxKCWKI28>.

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 phytophagous mite populations. To be effective, Surround 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. Application to manage plum curculio should begin in late bloom to prevent colonizing of trees by migrating adults.

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 within four hours following application. 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 contribute to management of 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 an active ingredient derived from fermentation of a naturally occurring soil bacteria. Entrust is an organically accepted formulation that can provide good control of codling moth, leafrollers, 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.

Pyrethrum (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 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, Dex-X) 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, Madex HP). 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 and Madex HP only) plums. Madex HP is also registered for use against oriental fruit moth. 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.

***Burkholderia rinojensis* metabolites** (Venerate XC) is labeled for control of pear psyllid and plum curculio and suppression of stink bugs on apple; as well as lepidoptera and plum curculio control and aphid, mealybug, mite, stink bug, thrips, and whitefly suppression on stone fruit. Field research trials are lacking however for these uses of this product, so use beyond trial applications is not recommended.

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 (Berkett et al., 2013).

2.5 Organic Apple Production Resources:

New England Resources:

- Organic Apple Production Basics:
http://www.uvm.edu/~fruit/?Page=treefruit/tf_organicbasics.html&SM=tf_submenu.html
- An Organic IPM Checklist for Vermont:
http://www.uvm.edu/~fruit/?Page=treefruit/tf_ipm/OrganicIPMchecklist.html&SM=tf_submenu.html Practical Guide for Organic Apple Production:
http://www.uvm.edu/~fruit/?Page=treefruit/tf_organicbasics/PracticalGuideOrganic/PracticalGuideOrganic.html&SM=tf_submenu.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

References

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- 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.