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 6.1.2, 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							Relative Toxicity to Beneficials				
Fungicide	**Fungicide Family/ FRAC code‡**	**Scab**	**Powdery Mildew**	**Cedar Apple Rust**	**Black/ white rot**	**Sooty Blotch/ Fly speck**	**Bitter Rot**	**Mite Suppres-sion (a)**	**Bees**	**Af**	**Tp**	**Sp**	**Aa**
captan[j]	Phthalimide/ M4	4	0		1	3	2[e]	3[e]	L	L	L	—	L
cyprodinil (Vanguard)	Anilinopyrimidine/9	2[g]	1		0	0	0	0	L	-–	—	—	—
dodine (Syllit)	Guanidine/M7	2[b,c]	0	1	1	1	0	0	L	L[f]	L[f]	—	L
Fenarimol (Rubigan)[g]	DMI (SI)/3	4[c]	4	4	0	0	0		L	L	L	—	—
fenbuconazole (Indar)	DMI (SI)/3	4[c]	4	4	0	0	0		L	L	L	—	—
ferbam (Ferbam)	Dithiocarbamate/ M3	2	0	2	1	2	1	0	L	—	—	—	—
kresoxim-methyl (Sovran)	Strobilurin (QoI)/11	4	3	2	3	4	2	0	L	L	L	—	—
mancozeb (Dithane, Manzate, Penncozeb,)	Dithiocarbamate/ M3	3[d]	0	4	3	4	4	0	L	M-H[h]	M-H[h]	—	—
maneb (Manex, Maneb)	Dithiocarbamate/ M3	3[d]	0	4	3	4	4	0	L	M-H[h]	M-H[h]	—	—
metiram (Polyram)	Dithiocarbamate/M3	3[d]	0	4	3	4	4	0	L	—	—	—	—
myclobutanil (Nova, Rally)[g]	DMI (SI)/3	4[c]	4	4	0	0	0	—	L	L[I]	L[I]	—	—
pyraclostrobin + boscalid (Pristine)	Strobilurin (QoI)/11 + carboxamide	4	3	2	3	4	3	—	L	—	—	—	—
pyrimethanil (Scala)[g]	Anilinopyrimidine/9	2[g]	—	0	0	0	0	—	—	—	—	—	—
§sulfur	Inorganic/M2	2	2	0	1	1	–	0	L	L[f]	L[f]	—	—
thiophanate-methyl (Topsin M)	Benzimidazole/M1	2[b,c]	2[c]	0	4	4	1	2	L	L[I]	L[I]	—	—
Thiram [k]	Dithiocarbamate/M3	2	0	2	1	2	1	0	L	L[I]		—	—
trifloxystrobin (Flint)	Strobilurin (QoI)/ 11	4[c]	3	2	3	4	2	0	L	L	L	—	—
triflumizole (*Procure)[g]	DMI (SI)/3	4	4	4	0	0	0	—	L	—	—	—	—
Ziram	Dithiocarbamate/M3	2	0	2	1	3	1	—	L	M-H[h]	M-H[h	—	—

Key to control ratings: — = Unknown or does not apply **0** = none, **1** = slight, **2** = fair, **3** = good, **4** = excellent

(a) These indicate the degree of mite suppression of the product when used on a full-season schedule.
(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) Information derived from 24-hr slide dip tests conducted at the New York State Agricultural Experiment Station.
(g) Activity of these materials is highly rate-dependent. Stated efficacies assume a rate of 9 fl oz/A for Rubigan 1E, 5 oz/A for Nova or Rally 40WP, 6 oz/A Rally 40WSP, 9 oz/A for Procure 50WS, 5oz/A for Vangard, and 10 oz/A for Scala.
(h) Low to moderate impact from several early season (through 1C) applications; moderate to high impact from summer applications.
(i) This information is derived from application field tests conducted at the New York State Agricultural Experiment Station.
(j) 24hr REI for some formulations (generally more recent labels).
(k) Apples are no longer included on the most recent labels.
§ potentially acceptable in certified organic programs.
‡ The Fungicide Resistance Action Committee (FRAC: http://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.

Key to beneficials:
Bees = honeybees
Af = *Amblyseius fallacis*, a predatory mite found throughout New York State
Tp = *Typhlodromus pyri*, a predatory mite found mostly in Western New York
Sp = *Stethorus punctum*, a ladybird beetle predator of mites
Aa = *Aphidoletes aphidimyza*, a cecidomyiid predator of aphids

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.

(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. Characteristics of apple scab fungicides.

Fungicide and Rate/100 Gal (assuming 300 gpa for standard trees)	Protection	Retention	Redistribution	After-Infection Activity (hr)	Pre-symptom	Post-symptom
captan 50WP, 2 lb	VG	VG	G	18-24	none	none
cyprodinil (Vangard) 75WG, 1.67 oz	G	G	?	48-72	none	none
dodine (Syllit) [1] 3.4 FL, 12 oz	VG	VG	G	18-24	E	VG
fenarimol (Rubigan) 1EC, 3-4 fl oz [1]	F	VG	P	72-96	E	G-VG
fenbuconazole (Indar) 2F, 2-2.7 fl oz	F	VG	P	72-96	E	G-VG
ferbam, 2 lb	G	G	G	15-20	none	none
§liquid lime sulfur, 1.5-2 gal	F	F-G	F-G	72-96	none	F
kresoxim-methyl (Sovran) 50WP, 1.33 oz	VG	E	G	48-72[2]	none	G
mancozeb 75DF, 80WP, 2 lb	VG	VG	G	18-24	none	none
metiram (Polyram) 80WP, 2 lb	VG	VG	G	18-24	none	none
myclobutanil (Nova) [1] 40WP, 2 oz	F	VG	P	72-96	E	G-VG
pyrimethanil (Scala) 600SC, 3.3 oz	G	G	?	48-72	none	none
§sulfur, 5 lb actual	F	F-G	F-G	none	none	none
thiram 75WDG, 1 1/2 lb [3]	F-G	F-G	F	15-20	none	none
thiophanate-methyl [1] (Topsin M) 70WP, 6 oz	F	G	P-F	18-24	E	VG
trifloxystrobin (Flint) 50WP, 0.67 oz	VG	E	G	48-72[2]	none	G
triflumizole (Procure) [1] 50WS, 2.5 oz	F	VG	P	72-96	E	G-VG
Ziram 76WDG, 76DF, 1 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 DMI-resistant populations of apple scab.
[3] Apples are not included on the most recent label.
§ potentially acceptable in certified organic programs.
Key: **P** = poor, **F** = fair, **G** = good, **VG** = very good, **E** = excellent.

6.2 Notes On Apple Scab Management

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

i. High levels of carry-over inoculum are present in leaf litter in the orchard.
ii. Weather conditions favor ascospore infections between green tip and bloom.
iii. 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.

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) sometime after winter 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, and 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.

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.

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.

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.

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.

Seasonal ascospore maturity and discharge. Ascospore maturity can be 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, ascospore maturity advances in response to 18 degree-days over that period. The cumulative percentage of matured 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).

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.

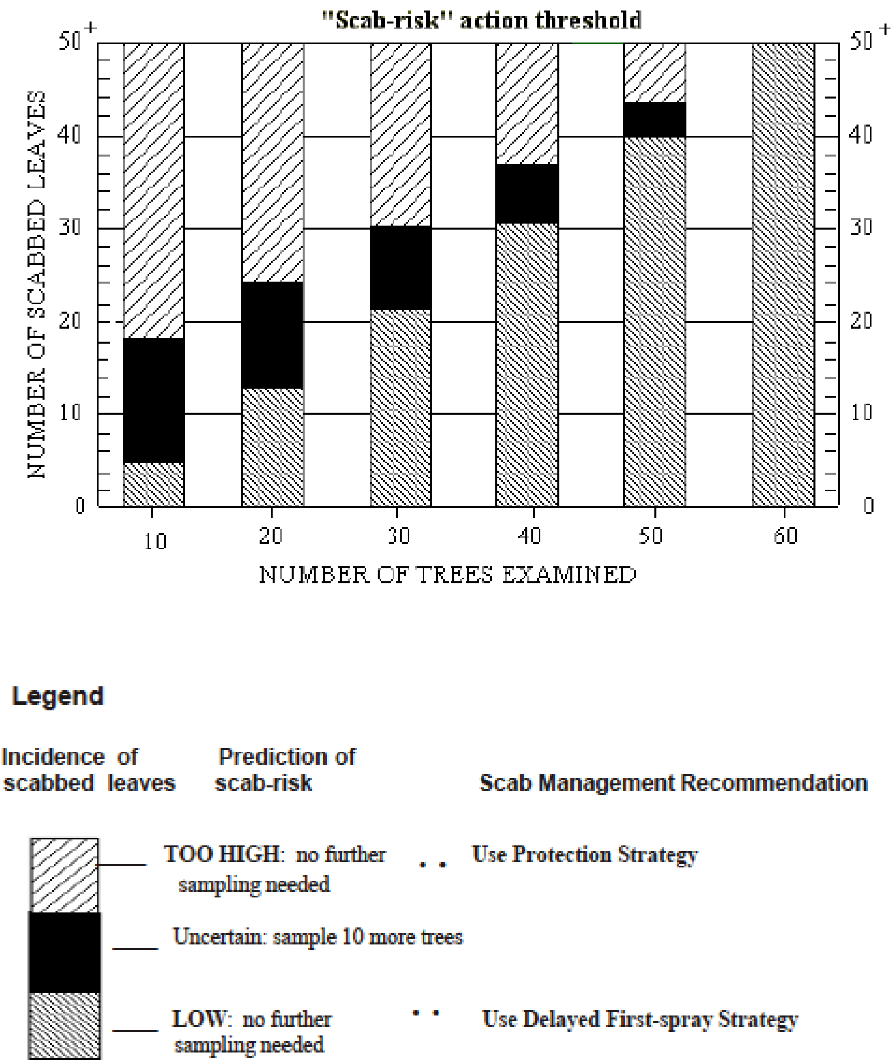

Figure 6.2.1. Sequential sampling chart for determining level of scab risk in an orchard block. Use this chart if sanitation practices will NOT be considered.

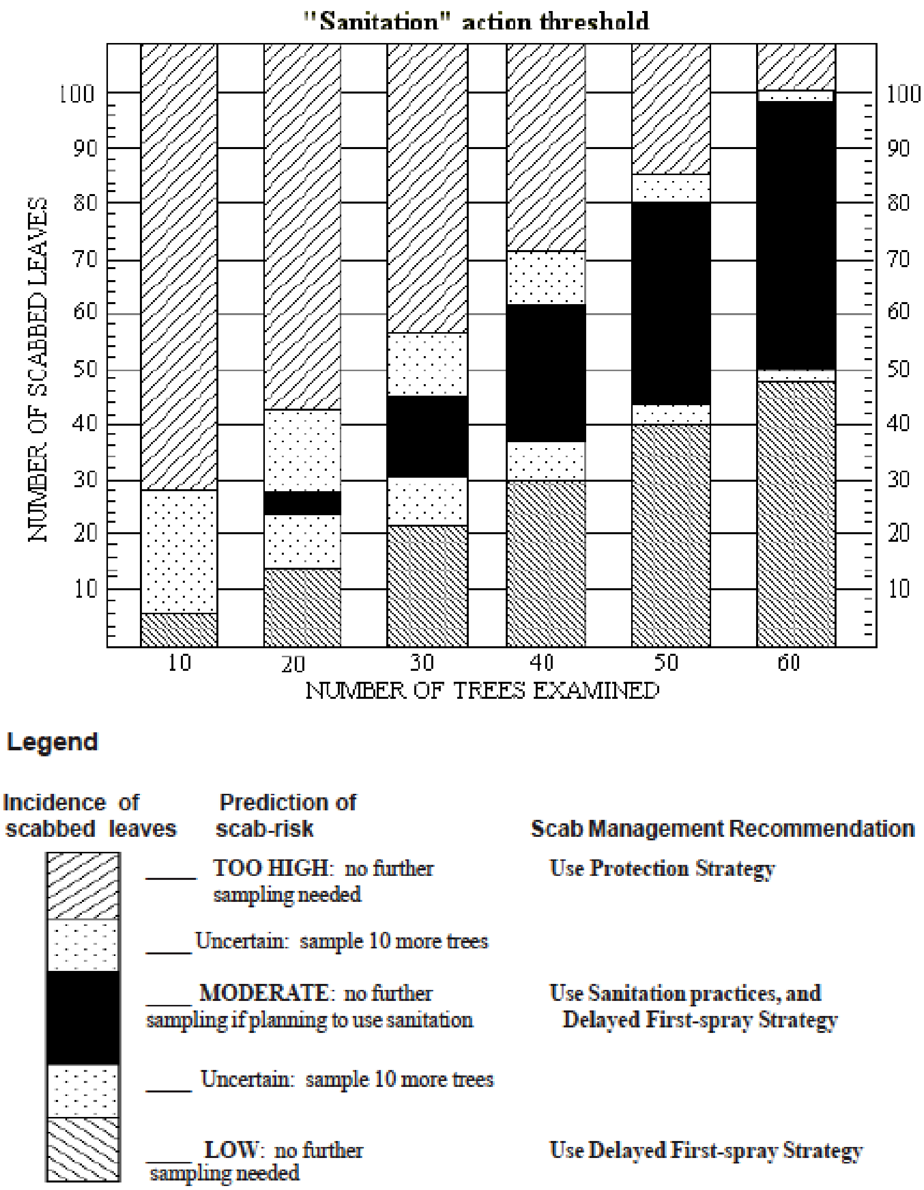

Figure 6.2.2. Sequential sampling chart for determining level of scab risk in an orchard block when sanitation practices will be considered.

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 [3]	Cumulative ascospores matured (%)	90% Confidence interval for estimate [4]
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

[3] 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.

[4] 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.

		Registered for use on:				*Control of*						
						Brown Rot						
Fungicide	**Fungicide Family/FRAC code‡**	**Apricot**	**Cherry**	**Peach**	**Plum**	**Blossom Blight**	**Fruit Rot**	**Cherry Leaf Spot**	**Powdery Mildew**	**Black Knot**	**Peach Leaf Curl**	**Peach Scab**
Abound [a]	Strobilurin(QoI)/11	+	+	+	+	3	3	3	4	—	—	3
Applause 720 [f]	Chloronitrile/M5	+	+	+	+	—	—	4[g]	0	4[g]	4[g]	4[g]
Botran [c]	Chlorophenyl/14	+	+	+	+	2[g]	2	—	—	—	—	
Bravo [f]	Chloronitrile/M5	+	+	+	+	3	—	4[g]	0	4[g]	4[g]	4[g]
Concorde [f]	Chloronitrile/M5	+	+	+	+	3	—	4[g]	0	—	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
Nova	DMI (SI)/3	+	+	+	+	2[h]	1[h]	4[h]	4	—	—	—
Orbit	DMI (SI)/3	+	+	+	+	4[h]	4[g] [h]	3[h]	3	—	—	—
Pristine	Strobilurin(QoI)/11	+	+	+	+	4	4	4	4	—	—	—
*Procure	DMI (SI)/3	—	+	—	—	1	—	3[h]	4	—	—	—
Rovral, Iprodione	Dicarboximide/2	+	+	+	+	4	—	2	0	—	—	—
Rubigan	DMI (SI)/3	—	+	—	—	—	—	3[h]	3	—	—	—
Scala	Anilino-pyrimidines/9	+	—	+	+	3	1	—	—	—	—	—
§Sulfur	Inorganic/M2	+	+	+	+	2	1	1	2	0	—	3
Syllit	Guanidine/M7	—	+	+	—	—	1[g]	2	0	—	—	—
Thiram	Dithiocarbamate/M3	—	—	+	—	1	1	—	—	—	3	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 or 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 in NY, 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.

§ Potentially acceptable in certified organic programs.

‡ The Fungicide Resistance Action Committee (FRAC: http://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 [a].

	Degree of Infection		
Average Temp (˚F)	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

[a] 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.

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