



# 2014 Midwest Tree Fruit Spray Guide

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# 2014 Midwest Tree Fruit Spray Guide

This publication is one of a series of publications for fruit growers in the Midwest developed by the Midwest Fruit Workers Group. Other publications include the *Midwest Small Fruit Pest Management Handbook*, *Midwest Commercial Small Fruit and Grape Spray Guide*, and *Midwest Tree Fruit Pest Management Handbook*. Contact your local Cooperative Extension office for information on these publications.

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The Midwest Tree Fruit Pest Management Handbook is a companion publication to this spray guide that contains further information on pesticide safety, sprayer calibration, tree fruit diseases and insect pests, pesticide characteristics, growth regulators and spray adjuvants, and other related topics. Copies of this publication are available from your state extension service.

## **Foreword**

Commercial fruit production has become a highly skilled technological profession. Concerns for residues, operator risks, and the environment dictate that all fruit growers exercise extreme caution in the use of all pesticides and, indeed, all chemicals. The EPA has designated a number of fruit pesticides as "restricted-use." Record-keeping and worker protection requirements have changed dramatically since 1994. Consult the Pesticide Applicator Training program or local extension office for more information.

Growers who wish to use restricted-use materials must be certified as "private applicators." Certification requires that applicators understand: labels and labeling; safety factors; potential environmental concerns, identification of common pests; knowledge of pesticides and their usage; proper equipment use; and applicable state and federal regulations. Contact your local extension office for information about certification training programs.

Pest management recommendations provide up-to-date information on pesticides and their applicability to your problem. We suggest that you use this information to set up your own spray program. You should include space for records in the program, such as materials used; date of application; stage of growth; and weather. In case of questions, nothing beats a good set of records, and records are required for restricted-use pesticides.

## **Fruit Grower Newsletters**

### **ILLINOIS**

University of Illinois Extension publishes *The Illinois Fruit & Vegetable News*. This newsletter covers production practices and insect and disease management. It is available at [www.ipm.illinois.edu/ifvn](http://www.ipm.illinois.edu/ifvn). For information, or to order, contact Rick Weinzierl, Department of Crop Sciences, University of Illinois, AW-101 Turner Hall, 1102 S. Goodwin Avenue, Urbana, IL 61801; phone: 217) 244-2126; email: [weinzier@illinois.edu](mailto:weinzier@illinois.edu).

### **INDIANA**

Purdue Extension offers *Fact for Fancy Fruit*, a fruit grower newsletter issued at frequent intervals during the fruit season to Indiana growers by first class mail for \$15 a year. This service supplies timely information on disease and insect activity throughout the state, cultural information, and announcements of upcoming meetings. The newsletter also is available free at [www.hort.purdue.edu/fff](http://www.hort.purdue.edu/fff) and through email.

To receive the paper copy, send your name, address, and present fruit interests along with a check for \$15 made out to Purdue University, to *Facts for Fancy Fruit*, Department of Horticulture and Landscape Architecture, 625 Agricultural Mall Drive, Purdue University, West Lafayette, IN 47907-2010.

### **IOWA**

Iowa State University Extension and Outreach publishes a free monthly small fruit and vegetable newsletter. Topics covered include production practices, seasonal issues including weather, insect, disease, and weed management strategies, as well as upcoming events. For more information, contact Joe Hannan, Commercial Horticulture Field Specialist, at (515) 993-4281 or [jmhannan@iastate.edu](mailto:jmhannan@iastate.edu).

### **KENTUCKY**

A Cooperative Extension newsletter, *Kentucky Fruit Facts*, is issued monthly to all Kentucky growers at no cost. This service supplies timely information on disease and insect activity throughout the state, as well as cultural information. To obtain this service, send your name and address to: *Kentucky Fruit Facts*, c/o John Strang, Department of Horticulture, N-318 Ag Sci Building North, University of Kentucky, Lexington, KY 40546-0091; phone (859)257-5685; fax: (859) 257-2859; email: [jstrang@uky.edu](mailto:jstrang@uky.edu). *Kentucky Fruit Facts* is also available at [www.uky.edu/hort/documents-list-fruit-facts](http://www.uky.edu/hort/documents-list-fruit-facts).

### **Management Tips for Safety**

1. Maintain accurate spray records. Show application rates, pesticides used, total gallonage, stage of plant development, and weather data.
2. Be prepared to show your records to the EPA or state agency inspectors.
3. Do not contaminate forage crops or pastures.
4. Prevent excess drift.
5. Do not allow animals to graze in orchards.
6. Maintain equipment in top condition.
7. Protect children, pets, livestock, and your environment from pesticides in any form.
8. Inform all workers of re-entry restrictions and other safety information.
9. Comply with the Right-To-Know Law. Have complete product labels readily available for workers. Have the Material Safety Data Sheet for each product available for workers to see, and for rescue or fire personnel to use in case of emergency.
10. Provide pesticide safety training for pesticide handlers and other workers to comply with Worker Protection Standards.
11. Regularly inspect and maintain personal protective equipment used when applying pesticides.

### **Handling Pesticides**

1. Know the pesticide toxicity and act accordingly.
2. When mixing pesticides, do not breathe the dust, powder, or vapor. Always mix outdoors.
3. Use an adequate respirator and protective clothing, especially when mixing pesticides. The necessary protective equipment is listed on the pesticide label. Suitable respirators should be available from your pesticide dealer.
4. Do not smoke, eat, or drink when handling or applying pesticides.
5. Stay out of drift from spray or dust.
6. Rinse out liquid containers with water at least three times, and pour into spray tank as it is being filled. Punch holes in metal and plastic containers and crush. Dispose of all pesticide containers in accordance with the pesticide label directions and as allowed by state and local authorities. Do not re-use pesticide containers.
7. Have a "buddy" around when using toxic organophosphates or carbamates, just in case.
8. For maximum safety, get a blood test to determine the cholinesterase level for each worker before the spraying season and periodically during the season. This will allow you to monitor the cholinesterase level in those people using insecticides and can help prevent overexposure.
9. Consult a doctor immediately if the following symptoms develop while spraying: blurred vision, nausea, headache, chest pain, weakness, diarrhea, or cramps.
10. Wash hands thoroughly before eating or smoking.
11. Bathe and change clothes daily.
12. Always store pesticides in their original marked container.
13. Always store pesticides under lock and key. Keep children away.
14. Follow all label instructions carefully.
15. Always use an anti-siphon device when filling spray tank from a domestic water source.

The label is the law: Read and follow all label instructions carefully.

### Dilute Spraying

The object of spraying is to uniformly distribute a fungicide, insecticide, miticide, or growth regulator over all parts of the tree. Pesticide recommendations are based on the amount of dilute spray needed to wet trees thoroughly. In a standard apple or pear orchard, with trees approximately 20 ft tall, 22 ft wide, and set on rows 35 ft apart, 400 gal water/acre is a standard dilute spray for fungicide and insecticide application. Recommendations are made per 100 gal or per acre. Dilute is considered 1x concentration. For cherry, peach, and plum, 300 gal water/acre is the standard dilute spray volume for full-size trees.

Table 1 lists the gallons of dilute spray per acre required to provide equivalent coverage for mature trees of different sizes and spacings.

Growth regulators may be applied by high-volume handgun or air-blast sprayers, in either dilute or low-volume applications. Low-volume application may be more risky because any mistakes in concentration are magnified.

Read the growth regulator label for suggestions on application methods. Some labels suggest dilute sprays with full coverage and others suggest a specific amount of chemical in a specific amount of water per acre.

### Low-volume Spraying

Low-volume, or concentrate, spraying refers to the use of less water per acre to apply pesticides. In low-volume spraying, the volume of water applied per acre is reduced in proportion to the increased concentration used. So, if a 3x concentration is used, apply only one-third the water per acre that would be used in dilute spraying.

Low-volume sprays must be applied with air-blast sprayers that use high-velocity airstream to distribute the spray mixture. Most conventional air-blast sprayers can be used to apply spray mixtures up to 6x concentration. Sprayers specifically designed for ultra low-volume applications should be used for applications at 10x or greater.

Using low-volume sprays requires less labor, less water, less time, and fewer refills than 1x or dilute mixtures. However, savings in gallonage and application costs decrease most rapidly down to about 50 gallons of water per acre. Below that, the savings may not be worth the additional risk of improper application and problems with wind.

Table 1.

Gallonage of dilute spray per acre required to provide equivalent coverage for mature trees of different sizes and spacing.

Distance Between Rows (feet)	Tree Height (feet)	Tree Width (feet)	Maximum Tree Volume/Acre (1000 cu ft <sup>a</sup> )	Maximum Dilute Spray (gallons/acre <sup>b</sup> )
30	20	15	436	300
26	16	12	354	225
24	14	10	254	180
22	14	10	272	200
20	12	10	261	185
18	10	10	242	175
16	8	8	174	125
14	6	6	149	105
12	6	6	131	90

<sup>a</sup> Maximum tree volume/acre = tree width x tree height x running feet or row per acre.

Running feet of row per acre = 43560 divided by the distance between rows.

<sup>b</sup> Minimum dilute gallons per acre = approximately 0.7 gallon /1,000 cubic feet of tree volume.

Table 2 illustrates an 80 percent savings of water at 5x, but only an additional 10 percent savings by increasing the concentrate to 10x. At concentrations of 5x or higher, one can reduce the mixing rate by 20 to 25 percent and achieve the same control. This is because sprays are no longer being applied to run-off.

Following are some precautions in the use of low-volume pesticide or growth regulator applications:

1. Use extreme care in calibrating the sprayer and maintaining a constant sprayer speed. As gallonage is decreased, errors become much more critical.

2. Choose calm, yet good drying conditions for spraying. This may mean spraying at night or early in the morning. Good coverage cannot be achieved when winds are over 5 miles per hour.
3. Prune trees to a very open canopy for spray penetration. Spray droplets will not penetrate large, thick trees.
4. Choose pesticide formulations that will mix satisfactorily. Pay careful attention to increased operator hazards and drift problems.

Table 2. Gallons of spray per acre (approximate) for various concentrates.

	1x	2x	3x	4x	5x	6x	7x	8x	9x	10x
Apples	400	200	132	100	80	64	56	48	44	40
Peaches	300	150	100	75	60	50	45	38	33	30
Percent water savings over dilute		50%	67%	75%	80%	84%	86%	88%	89%	90%
Greatest savings						Diminished savings				

### Tree Row Volume Spraying

Tree row volume (TRV) is a method of determining the dilute (1x) volume of a spray solution necessary to cover the entire tree surface. This is an objective method of determining the differences in spray volume required for different tree sizes and ages.

With the TRV method, the volume of dilute spray needed per acre can be easily calculated for each orchard based on tree age, size, amount of pruning, and row spacing.

To determine the TRV, the between-row spacing, maximum tree height, and cross-row limb spread of trees must be accurately measured. See the step-by-step procedure below.

The TRV method also can be used to determine the pesticide rate for an orchard. Calculate the TRV gallonage for the orchard. Multiply this gallonage by the recommended dilute pesticide rate for dilute application.

For example, a fungicide is recommended at 2 lb/100 gal and is to be applied in an orchard with a TRV gallonage base of 400 gal/acre. Therefore, the per acre rate for this pesticide is:

$$2 \text{ lb}/100 \text{ gal} \times 400 \text{ gal}/\text{acre} = 8 \text{ lb}/\text{acre}.$$

To determine the rate of fungicide or insecticide per acre when using the low-volume spraying method (3x or greater), first calculate the dilute TRV gallonage. Multiply this concentrate gallonage by 0.75 to obtain a concentrate TRV gallonage. Multiply this concentrate gallonage by the recommended dilute pesticide rate per 100 gallons to determine the rate of pesticide per acre for concentration application.

For example, a fungicide is recommended at 2 lb/100 gal and is to be applied at 5x in an orchard with a TRV gallonage base of 400 gal/acre. The rate of pesticide per acre is calculated as:

$$(\text{TRV gallonage})$$

$$\times (0.75)$$

$$\times \text{dilute pesticide rate}/100 \text{ gal}$$

$$= \text{concentrate pesticide application rate}/\text{acre}$$

$$400 \text{ gal}/\text{acre} \times 0.75 \times 2 \text{ lb}/100 \text{ gal} = 6.0 \text{ lb}/\text{acre}$$

If the TRV base gallonage is less than 200 gal/acre, use 200 gal to compute the pesticide application rate.

### Fungicide Resistance Alert

The development of strains of the apple scab fungus with resistance to the sterol inhibiting or DMI fungicides (Rally, Indar, Inspire Super, Bayleton, Elite, Orbit, Procure, and Vintage) has become a serious problem in the last few years in several regions of the Midwest. Five orchards tested for resistance in Ohio in 2005 and two orchards in Wisconsin all had very high levels of resistance (DMIs would not provide adequate scab control).

There is no reason to assume that the situation is different across the Midwest where these fungicides have been used for the past several years. In orchards where resistance is a problem, growers have been forced to go back to using a standard protectant program for scab control.

If you have not been achieving good scab control in your orchard, or you suspect that you may have resistance, you should use a standard protectant program for scab control.

**Step 1**

Calculate feet row/acre

$$\frac{43,560 \text{ sq ft/acre}}{\text{between row spacing (ft)}} = \text{feet of row/acre}$$

**Step 2**

Calculate cubic feet of TRV/acre.

Feet of row/acre (from Step 1)

x tree height (ft)

x cross-row limb spread (ft)

= cu ft of TRV/acre

**Step 3**

Select density factors from Table 3.

Select the density factor that best indicates the canopy density of each separate orchard or block.

**Step 4**

Calculate TRV gallonage/acre

cu ft of TRV/acre tree density

(from Step 2) x (from Step 3)

1,000

= gallons of dilute solution applied per acre

= TRV gal/acre

**EXAMPLE**

An orchard has rows spaced 20 feet apart, tree height is 14 ft and the cross-row limb spread is 12 ft. The tree density is 0.85.

**Step 1**

$$43,560 \text{ square ft/acre} / 20 \text{ ft}$$

$$= 2,178 \text{ feet of row/acre}$$

**Step 2**

$$2,178 \times 14 \text{ ft} \times 12 \text{ ft}$$

$$= 365,904 \text{ cubic feet of TRV/acre}$$

**Step 3**

Density has been given as 0.85.

**Step 4**

$$(365,904 \times 0.85) / 1,000$$

$$= 311 \text{ TRV gallons/acre}$$

For additional information on calculating TRV gal/acre refer to the Ohio State Extension Bulletin 892 *Orchard Spray Rates: How to Determine the Amount of Pesticide and Water to Use in Your Orchard* by C. Welty.

Table 3. Determining density factors using tree density estimates.

0.70 gal/1,000 cubic feet	Trees extremely open	light visible through entire tree, less than 15 scaffold limbs per tree, young trees
0.75 gal/1,000 cubic feet	Trees very open	18 to 21 scaffold limbs per tree, light penetration throughout the tree, healthy spurs within the tree canopy
0.80 gal/1,000 cubic feet	Trees well pruned	adequate light in trees for healthy spurs throughout trunk and scaffold limbs, many holes in foliage where light can be seen through tree
0.85 gal/1,000 cubic feet	Trees moderately well pruned	reasonable spur population within canopy, tree thick enough that light cannot be seen through the tree
0.90 gal/1,000 cubic feet	Trees minimally pruned	spurs inside canopy are weak due to limited light, very few holes where light can be seen through the tree
1.00 gal/1,000 cubic feet	Trees unpruned	extremely thick, no light visible anywhere through tree canopy, trees more than 20 feet high

**Spray Tank pH**

Several pesticides break down rapidly in alkaline water. In a matter of hours (or in extreme instances only minutes), 50 percent or more of the active ingredient may be hydrolyzed to yield a less active compound. Captan, Carzol, Dimethoate, Imidan, Kelthane, and Malathion are examples of compounds that are especially vulnerable to alkaline hydrolysis. To ensure the maximum effectiveness of pesticide applications, check the pH of spray mixes in the spray tank and add buffering agents, if necessary, to adjust the pH to neutral (7). Buffercide, Buffer-X, Unifilm B, and LI 700 Acidiphactant are examples of such buffering agents.

**Pesticide Compatibility**

Pesticide compatibility in the spray tank is usually not a problem with newer pesticides. Compatibility of some materials may depend upon solvents and emulsifiers used by the manufacturer. Emulsifiable concentrate formulations are more likely to cause compatibility problems than wettable powders. If wettable powders are mixed with emulsifiable concentrates, incompatibility may result. Compatibility problems are often noted with lime, copper (Bordeaux),

or oil products are used in a mix. Be aware of spray tank pH as noted above.

Read the comments section in this spray guide for notes on compatibility problems and read the pesticide label before tank mixing products.

**Standard Protectant Program****versus Extended Protectant Program**

The standard protectant program requires that fungicide application begin at green tip and the interval between sprays should not exceed 7 days through primary scab season (green tip through first or second cover). This is in contrast to the extended protectant program (see page 8) that could be used when a sterol inhibiting fungicide in combination with an effective protectant fungicide could be applied on a 10-day or longer interval.

The loss of the curative activity from the sterol inhibitors means we must rely primarily on fungicides with protectant activity. The strobilurin fungicides (Sovran and Flint) have limited curative activity (possibly 48 hr) and cannot be used effectively in an extended protectant program. In addition, we may be experiencing reduced sensitivity and eventual resistance in the scab fungus to the strobilurins.

# APPLE

## APPLE DORMANT TO SILVERTIP

Apply before growth starts in spring and when temperatures are above 45°F.

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Fire blight	Fixed copper fungicides (Copper hydroxide) (Copper oxychloride) (Basic copper sulfate) (Bordeaux mixture)		If fire blight was severe last year, fixed copper spray at silver tip is suggested. Do not apply copper after ¼-inch green leaf stage or when drying conditions are cool and slow because severe injury can occur. Many fixed copper fungicides are registered for use on apple. Fixed coppers can be mixed with oil. <b>However, never combine copper sulfate alone with dormant oil.</b>
Crown rot (collar rot)	Ridomil Gold SL Aliette 80 WP Phosphorous Acid		Refer to crown rot section on page 20 for fungicide use recommendations.

## APPLE GREEN TIP

If using a protectant fungicide program, begin sprays at green tip and repeat every seven days through second cover.

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
<sup>1</sup> Primary scab Protectant program	<sup>2</sup> Captan 50 WP <sup>3</sup> Syllit 3.4 F Ziram 76 DF <sup>4</sup> Mancozeb 75 DF <sup>4</sup> Polyram 80 DF <sup>5</sup> Vangard 75 WG <sup>5</sup> Scala 5 SC <sup>6</sup> Sanitation methods for apple scab	6 lb 1.5–3 pt 6–8 lb 6 lb 6 lb 5 oz 7–10 fl oz	<sup>1</sup> See note on page 5 on fungicide resistance. <sup>2</sup> See note on Captan on page 23. <sup>3</sup> If Syllit (Cyprex) has a long history of use in your orchard, fungicide resistance may be a problem. <sup>4</sup> See note on Mancozeb and Polyram on (Restrictions on EBDC Products) page 20. <sup>5</sup> Vangard and Scala are most effective at temperatures below 70°F. <sup>6</sup> See note on important sanitation methods to aid in control of apple scab on page 22.  <b>Fungicide Resistance Management:</b> The strobiliurin fungicides (Sovran, Cabrio, Pristine, and Flint); the sterol inhibiting fungicides (Rally, Vintage, Indar, Inspire Super MP, Topguard, and Procure); and the new succinate dehydrogenase inhibiting fungicides (Fontelis, Luna Sensation, LunaTranquility, and Merivon) all are at high risk for the development of resistance in fungi that cause many of the major fruit diseases, such as apple scab, powdery mildews, and brown rot. Each of these groups of fungicide has a different chemical mode of action for controlling fungi. To aid in limiting the potential for fungicide resistance development, do not make more than four applications of any fungicide within each group per season. In addition, do not make more than two sequential applications of any fungicide within each group without alternating to a fungicide within a different group of chemistry. Many plant pathologists in the Midwest recommend alternating to a group of different chemistry after one application of a fungicide within each group of chemistry. For example: two applications of Sovan (a strobiliurin fungicide) alternated with two applications of Inspire Super MP (a sterol inhibiting fungicide) alternated with two applications of Fontelis (a succinate dehydrogenase inhibiting fungicide). See note on fungicide resistance management on page 23.

## APPLE GREEN TIP CONTINUED

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
San Jose scale, European red mite eggs, aphid eggs	Superior oil <b>plus one of the following</b> Lorsban Advanced 4 E Lorsban 50W Lorsban 75 WG Supracide 25 WP Supracide 2 E Diazinon AG 600 WBC	2%  0.5–4 pt 3 lb 2–2.67 lb 4–12 lb 8–12 pt See label.	<p><b>Apply oil when temperature is above 40°F; never during freezing weather.</b> Check label for fungicide/oil compatibility. Oil is most effective when sprayed dilute under calm conditions to assure thorough coverage of all woody tissue.</p> <p>Where San Jose scale is a main target of oil sprays, the best timing for application is at green tip. Wait until half-inch green or pink if European red mite or rosy apple aphid is the primary target. Although Lorsban, Supracide, and Diazinon are labeled for use with oil to increase scale control, trials have shown that oil alone results in greater than 98 percent control of scales if coverage is thorough. Adding an insecticide does improve aphid control.</p> <p>Put pheromone traps in place now to monitor adult leafminer activity.</p>

## APPLE HALF-INCH GREEN

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Primary scab	Same as for green tip		Esteem controls scale anytime between half-inch green and second cover. When used at half-inch green it also controls rosy apple aphid.
San Jose scale Rosy apple aphid	Same as for green tip <b>or</b> Esteem 35 WP Centaur 70 WDG	4–5 oz 34.5 oz	When used at pink it also controls leafminer. The minimum rate is effective when used pre-bloom, but the maximum rate is needed if application is delayed until the crawler stage in early summer.
European red mite eggs	Superior oil	2%	
Spotted tentiform leafminer, adults	Vydate L Endosulfan 3 EC	2–4 pt 3.33 qt	Delaying oil application until this time will give better control of mites than earlier applications.
			Control of spotted tentiform leafminer adults at half-inch green may be improved by spraying in the evening when moths are most active, but killing spotted tentiform leafminer adults at half-inch green is not as effective as killing hatching eggs at petal fall. The pyrethroids Ambush, Asana, Baythroid, Danitol, Mustang Max, Pounce, Proaxis, Renounce, Voliam Xpress, and Warrior also are labeled for control of adult spotted tentiform leafminers but are not recommended because they kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pests.

## APPLE TIGHT CLUSTER 7 days after half-inch green

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
<sup>1</sup> Scab only Protectant program 7-day interval	<sup>3</sup> Captan 50 WP Ziram 76 DF <sup>4</sup> Mancozeb 75 DF <sup>4</sup> Polyram 80 DF Vanguard 75 WG Scala 5 SC	6 lb 6–8 lb 6 lb 6 lb 5 oz 7–10 fl oz	<sup>1</sup> See comments on fungicide resistance on page 5. <sup>2</sup> Growers using an Extended Protectant program should use an SI fungicide (Rally, Rubigan, Indar, Inspire Super, or Procure) in combination (tank-mixed) with a protectant fungicide such as Captan, Mancozeb, Polyram, or Ziram through the period from at least tight cluster to second cover. With a 10-day spray interval, this should result in no more than four applications during this period.
Scab, rust, and powdery mildew	Bayleton 50WP <sup>5</sup> Rally WSP	2–8 oz 5–8 oz	The strobilurin fungicides (Sovran, Cabrio, Flint, and Pristine) and the succinate dehydrogenase inhibiting fungicides (Fontelis, Luna Sensation, Luna Tranquility, and Merivon) are sometimes recommended for use alone. However, due to the risks of resistance development in the scab fungus, they should be tank-mixed with a protectant fungicide as well.
<sup>1</sup> Protectant program 7-day interval	Procure 50 WP <sup>6</sup> Indar 2 F <sup>8</sup> Topguard Sovran 50 WG <sup>7</sup> Flint 50 WG <sup>7</sup> Cabrio 20 EC Pristine 38 WG <sup>9</sup> Inspire Super Fontelis <sup>10</sup> Luna Sensation <sup>11</sup> Luna Tranquility <sup>12</sup> Merivon <b>plus</b> <sup>3</sup> Captan 50 WP <sup>4</sup> Mancozeb 75 DF <sup>4</sup> Polyram 80 Ziram 76 DF	12–16 oz 6–8 fl oz 8–13 oz 4–6.4 oz 2–2.5 oz 12 oz 14.5–18.5 oz 12 fl oz 16–20 fl oz 4–5.8 fl oz 11.2–16 fl oz 4–5.5 fl oz 6 lb 3 lb 3 lb 6–8 lb	<sup>3</sup> See note on Captan on page 23. <sup>4</sup> See note on Mancozeb and Polyram on page 16. <sup>5</sup> Nova fungicide has been renamed Rally. <sup>6</sup> Indar also is available as a 75 WSP. <sup>7</sup> To avoid damage on leaves and fruit, do not apply Flint with an organo-silicate surfactant. Cabrio is not registered for rust control. <sup>8</sup> Topguard is a sterol-inhibiting fungicide and should not be used alone in orchards with scab resistance to the sterol inhibiting fungicides. The label states use 13 oz for scab and 8–12 oz for powdery mildew and rusts. <sup>9</sup> Inspire Super is a package mix of cyprodinil (Vanguard) and difenoconazole. Inspire Super has replaced Inspire Super MP. <sup>10</sup> Luna Sensation is a mixture of two fungicides (fluopyram and trifloxystrobin [Flint]). For powdery mildew control, it should be used at 5–5.8 fl oz per acre. <sup>11</sup> Luna Tranquility is a combination of two fungicides (fluopyram and pyrimethanil). <sup>12</sup> Merivon is a combination of two fungicides (fluxapyroxad and pyraclostrobin [Cabrio]).
			<b>Fungicide Resistance Management:</b> See notes on pages 5 and 23.

**APPLE PINK** 7–10 days after tight cluster

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
<sup>1</sup> Scab, rust, and powdery mildew	Same as for tight cluster		<sup>1</sup> A critical time for control for scab, rust, and powdery mildew.
<sup>2</sup> Rosy apple aphid	Lorsban 4E Lorsban 50 W Lorsban 75 WG Endosulfan 3 EC Assail 30 SG Calypso 4 F Vydate 2 L Beleaf 50 SG Belay 2.13 SC Closer 2SC	1.5–4 pt 3 lb 2–2.67 lb 3.33 qt 2.5–4 oz 2–4 fl oz 4–8 pt 2–2.8 fl oz 4–6 fl oz 1.5–2.75 fl oz	<sup>1</sup> Rust diseases need to be controlled with sprays at regular intervals from pink through the second cover spray. Rally, Bayleton, Rubigan, Indar, Inspire Super, Procure, Mancozeb, Polyram, Ziram, Flint, Sovran, and Pristine will control rust; Topsin-M and Captan will not. See green tip comments regarding primary scab fungicides.
Spotted tentiform leafminer	Same as half inch green <b>or</b> Carzol SP Calypso 4 F Assail 30SG Intrepid 2F Altacor 35 WDG Esteem 35WP	1–1.25 lb 2–4 fl oz 2.5 oz 8–12 fl oz 2.5–4.0 oz 3–5 oz	<sup>2</sup> Scout for curled leaves at early pink. Apply aphicide at pink if any curled leaves with rosy apple aphid inside are found.
Tarnished plant bug and stink bugs	Endosulfan as listed for tentiform leafminer at half-inch green <b>or</b> Avaunt 30 WDG Calypso 4 F Lannate SP Lannate LV Beleaf 50 SG Belay 2.13 SC Ambush Asana XL 0.66 EC Baythroid XL 1 EC Danitol 2.4 EC Mustang Max 0.8 EC Pounce 25 WP Proaxis 0.5 EC Renounce 20 WP Warrior 1 CS Closer 2 SC	5–6 oz 2–4 fl oz 0.5–1 lb 1.5–3 pt 2–2.8 fl oz 6–12 fl oz 6.4–25.6 oz 4.8–14.5 fl oz 2–2.4 fl oz 10.7–21.3 fl oz 1.28–4 fl oz 6.4–16 oz 2.6–5.1 fl oz 2.5–3 oz 2.6–5.1 fl oz 2.75–5.75 fl oz	Use of the pyrethroids Ambush, Asana, Baythroid, Danitol, Mustang Max, Pounce, Proaxis, Renounce, and Warrior will kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pests. Use these pyrethroid insecticides only if the potential for plant bug and stink bug damage is high. Closer for plant bugs only.
San Jose scale			Put pheromone traps in place now to monitor adult scale activity; crawlers are expected 4 to 6 weeks after adult emergence.
Nutrient level	Solubor (boron) <b>and/or</b> Feed grade urea (nitrogen)	2 lb 3 lb	Add Solubor to pesticide spray; check compatibility before adding. Urea can be added to pesticide sprays when needed.

**APPLE BLOOM** 7–10 days after pink

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Scab, rust, and powdery mildew	Same as for tight cluster		
Fire blight (blossom blight)	Streptomycin 17 WP  <b>OR</b> Streptomycin 17 WP <b>plus</b> *Regulaid **See note on Mycoshield	1.5 lb  1 lb  1 pt	Start fire blight sprays at the first sign of open blossoms. Repeat sprays at 4- to 5-day intervals through bloom and petal fall on susceptible varieties. A minimum of two applications is necessary to provide control. If warm, wet weather occurs, it is critical that sprays are applied on a tight schedule using a maximum strength of 100 ppm (8 oz per 100 gal) of streptomycin. Growers can improve timing and confidence in using streptomycin with assistance from a disease warning system such as MARYBLYT. Streptomycin is not recommended for use after petal fall.  *Do not concentrate Regulaid.  **Mycoshield (oxytetracycline) is now labeled for use on apple, but it is not as effective for fire blight control as streptomycin. Unless streptomycin resistance has been confirmed in your orchard, streptomycin is the material of choice for fire blight control.
Fire blight (shoot blight)	<i>Growth regulator</i> Apogee 27.5 W <b>plus</b> *Regulaid		Consider using Apogee to reduce the threat of shoot blight on vigorous trees of susceptible varieties that have nearly filled their space. See comments on pages 20–21.
Insects or mites	SAVE THE BEES! Do not use insecticides or miticides.		
Codling moth (monitoring)	Pheromone traps	1 per 10 acres, minimum of 2 per block	Put out pheromone traps now to monitor adult codling moth activity. See page 21 for information on how to use traps to determine optimal timing of insecticides.
Codling moth (control)	Isomate-C Plus  Isomate-CM Flex  Isomate-CM/OFM TT	400 dispensers/acre  200–400 dispensers/acre  200–400 dispensers/acre	See section on mating disruption on page 21. Additional products and formulations also are available.  Isomate CM/OFM TT also controls Oriental fruit moth.
Red Delicious shape	Promalin		Apply in early bloom when most of the king flowers are open and before petals fall from the king flowers. Promalin can cause fruit thinning if guidelines for time of application are not followed.

**APPLE PETAL FALL** 7–10 days after bloom

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Scab, rust, and powdery mildew	Same as for tight cluster (page 9)		
Fire blight	Same for bloom (page 10)		Continue sprays on susceptible varieties until all petals have fallen.
Plum curculio, leafrollers, oriental fruit moth	Imidan 70 W Avaunt 30 WDG	2.1–5.3 lb 5–6 oz	Peak hatch of redbanded leafroller usually coincides with petal fall. Control at this time helps prevent late-season problems. If plum curculio pressure has been severe and Imidan is applied to control it, use 5.3 lb per acre.
Leafrollers	Products listed above for three species combined <b>or</b>  Intrepid 2 F Confirm 2 F Entrust 80 WP Entrust 2 SC Proclaim 5SG Rimon 0.83 EC Altacor 35 WDG Delegate 25 WG Belt 4 SC	8–16 fl oz 20 fl oz 2–3 oz 6–10 fl oz 3.2–4.8 oz 20–50 fl oz 2.5–4.5 oz 4.5–7 oz 3–5 fl oz	The pyrethroids Asana, Baythroid, Danitol, Leverage, Mustang Max, Pounce, Proaxis, Renounce, and Warrior also are labeled for control of these insects but are not recommended because they kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pest mites.
Plum curculio	Products listed above for three species combined <b>or</b>  Calypso 4 F Assail 30 SG Actara 25 WDG Surround Belay 2.13 SC	4–8 fl oz 8 oz 4.5–5.5 oz 25–50 lb 6 fl oz	
Oriental fruit moth	Products listed above for three species combined <b>or</b>  Assail 30 SG Calypso 4 F Intrepid 2 F Entrust 80 WP Entrust 2 SC Rimon 0.83 EC Altacor 35 WDG Delegate 25 WG Belt 4 SC Belay 2.13 SC	5–8 oz 4–8 fl oz 12–16 fl oz 2–3 oz 6–10 fl oz 20–40 fl oz 2.5–4.5 oz 4.5–7 oz 3–5 oz 6–12 fl oz	Oriental fruit moth is not present in many Midwestern apple orchards.

## APPLE PETAL FALL continued

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Spotted tentiform leafminer (larvae), white apple leafhopper, aphids	Admire Pro 4.6 EC Assail 30 SG Calypso 4 F Actara 25 WDG Endosulfan 3 EC Lannate LV Lannate 90 SP Belay 2.13SC	1.4–2.8 fl oz 2.5–4 oz 2–4 fl oz 4.5–5.5 oz 3.33 qt 3 pt 1 lb 4–6 fl oz	Use Admire as soon as pollination is complete but after bees are no longer foraging. The pyrethroids Asana, Baythroid, Danitol, Leverage, Mustang Max, Proaxis, Renounce, and Warrior also are labeled for control of these insects at petal fall but are not recommended because they kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pest mites. Lannate also kills predaceous mites and can trigger pest mite outbreaks.
Spotted tentiform leafminer (larvae)	Products listed above for three pests combined <b>or</b> Agri-Mek 0.15 EC Entrust 80 WP Entrust 2 SC Esteem 35 WP Carzol 92 SP Rimon 0.83EC Altacor 35 WDG Delegate 25 WG Belt 4SC	10–20 fl oz 1.5–3 oz 4–10 fl oz 3–5 oz 1–1.25 lb 15–40 fl oz 2.5–4.5 oz 4.5–7 oz 3–5 oz	Treat if mines average two or more per leaf and larvae are still in the initial sap-feeding stage on the underside of the leaves. Apply Agri-Mek with horticultural oil or a penetrating surfactant.
White apple leafhopper	Products listed above for three pests combined <b>or</b> Carzol SP Portal 0.4 EC Agri-Mek 0.15 EC Centaur 70 WDG Closer 2 SC	0.5–1 lb 1–2 pt 10–20 fl oz 9–12 oz 1.5–2.75 fl oz	White apple leafhopper nymphs begin hatching at tight cluster and feed on the underside of apple leaves. The presence of leafhopper nymphs, their cast skins, and the white feeding marks (stippling) on leaves indicate possible need for control. Management is needed at petal fall if the average number of nymphs is one or more per leaf.
Aphids	Products listed above for three pests combined <b>or</b> Esteem 35 WP Beleaf 50 SG Movento 2 SC Closer 2 SC	3–5 oz 2–2.8 oz 6–9 fl oz 1.5–2.75 fl oz	Rosy apple aphid is best treated at pink, but there is some chance to control it at petal fall if infestations develop.  Movento is toxic to honey bees and can be used only after petal fall.

## APPLE PETAL FALL continued

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Mites	Apollo 4 SC Savey 50 DF Agri-Mek 0.15 EC Nexter 75 WP Portal 0.4 EC Carzol 92 SP Acramite 50 WS Zeal 72 WP Envidor 2 SC Kanemite 15 SC Onager 1 EC Oil	4–8 fl oz 3–6 oz 10 fl oz 4.4–5.2 oz 1–2 pt 1–1.25 lb 0.75–1 lb 2–3 oz 16–18 fl oz 21–31 fl oz 12–24 fl oz 0.5–1%	For Nexter, use low rate for European red mite or high rate for twospotted mite. For Acramite use low rate for twospotted mite or high rate for European red mite. AgriMek is most effective if applied before leaves harden off.  Do not use oil if Captan is used for disease control or if temperature exceeds 90°F. See comments on oil on page 23.
For thinning summer varieties	Refer to section on thinning (p. 52)		
Nutrient level	Solubor (boron) <b>and/or</b> Feed grade urea	4 lb  8 lb	May be added to insecticide/fungicide spray solutions, but check for compatibility, order of mixing, etc.

## APPLE FIRST AND SECOND COVER 7–10 days after petal fall and 7–10 days later

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Scab and fruit rots	<sup>1</sup> Captan 50 WP or Ziram 76 DF or Mancozeb 75 DF or Polyram 80 DF <b>or</b> <sup>2</sup> Topsin-M 70 WSB <b>plus</b> Captan 50 WP or Mancozeb 75 DF or Polyram 80 DF or Ziram 76 DF	6 lb 6–8 lb 3 lb 3 lb 1–1.5 lb 4 lb 3 lb 3 lb 6–8 lb	<sup>1</sup> See note on Captan on page 23.  <sup>2</sup> Topsin-M 70 WSB may cause scarf skin on Rome apples, if applied within a 4-week period following petal fall. Topsin-M should not be used for scab control due to the development of resistance. Topsin-M is excellent for control of some fruit rots.  <sup>3</sup> Bayleton is not effective for scab control.  <sup>4</sup> The sterol inhibiting fungicides do not provide adequate control of fruit scab when applied alone. They should be combined with a protectant fungicide.
Scab, rust, powdery mildew, fruit rots, sooty blotch, and flyspeck	<sup>3</sup> Bayleton 50 WP <sup>4</sup> Rally 40 WP <sup>4</sup> Procure 50 WP <sup>5</sup> Inspire Super Indar 2F Topguard Sovran 50 WG Flint 50 WG Pristine 38 WG Fontelis Luna Sensation Luna Tranquility Merivon <b>plus</b> Captan 50 WP <b>or</b> <sup>6</sup> Mancozeb 75 DF <b>or</b> <sup>6</sup> Polyram 80 DF <b>or</b> Ziram 76 DF	2–8 oz 5–8 oz 12–16 oz 12 fl oz 6–8 lb 8–13 oz 4–6.4 oz 2–2.5 oz 14.5–18.5 oz 16–20 fl oz 4–5.8 fl oz 11.2–16 fl oz 4–5.5 fl oz 6 lb 3 lb 3 lb 6–8 lb	<sup>5</sup> See note on Inspire Super MP on page 9.  <sup>6</sup> See note on Mancozeb and Polyram on page 16.  Sprays after second cover for powdery mildew control should be based on previous field history and orchard scouting.  <b>Fungicide Resistance Management:</b> See comments on page 23.

## APPLE FIRST AND SECOND COVER CONTINUED

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Codling moth, oriental fruit moth	Imidan, Assail, or Calypso as listed at petal fall for plum curculio (page 12) <b>or</b> Rimon 0.83 EC Cyd-X Cyd-X HP Madex HP Virossoft CP4 Carpovirusine	20–40 fl oz 1–6 fl oz 0.5–3 fl oz 0.5–3 fl oz 3.2 fl oz 6.8–13.5 fl oz	Codling moth control should be initiated at first or second cover based on timing of capture in pheromone traps. See product labels for specific recommendations; timing ranges from 50–250 degree days after biofix; see summary on page 21. Virus products (Cyd-X, Virossoft, Carpovirusine) are for codling moth only. Madex is also for Oriental fruit moth. Virus products should be applied at weekly intervals.
	Confirm 2F Intrepid 2F Altacor 35 WDG Belt 4 SC Delegate 25 WG	20 fl oz 12–16 fl oz 2.5–4.5 oz 3–5 fl oz 4.5–7 fl oz	Confirm is not labeled for oriental fruit moth.
Plum curculio	Imidan, Avaunt, Actara, Calypso, or Surround as listed at petal fall (page 12)		Timing for plum curculio usually extends through first cover.
Leafrollers	Imidan, Altacor, Delegate, Entrust, Confirm, Intrepid, or Rimon as listed at petal fall (page 12)		
Mites	Same as for mites at petal fall (page 14) except do not use Carzol.		See miticide section on page 46.
San Jose scale (crawlers)	Diazinon AG 600 WBC  Esteem 35W Admire Pro 4.6 F Assail 30 SG Centaur 70 WDG Movento 2 SC	12.75 fl oz/ 100 gallons  4–5 oz 2.8 fl oz 8 oz 34.5 oz 6–9 fl oz	San Jose scale “crawlers” may be present by second or third cover.  Esteem controls scale anytime between half-inch green and second cover. When used at half-inch green it also controls rosy apple aphid. When used at pink it also controls leafminer. The minimum rate is effective when used pre-bloom, but the maximum rate is needed if application is delayed until the crawler stage in early summer.

## APPLE FIRST AND SECOND COVER CONTINUED

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Green apple aphid	Same as for aphids at petal fall (page 13)		Do not use the AG 600 formulation of Diazinon after petal fall. Treat green apple aphid when numerous, but before excessive terminal leaf curling and honeydew deposits are observed.
Excess crop	Refer to section on chemical thinning (page 54)		
Cork spot, bitter pit, and Jonathan spot	Calcium chloride	8 lb	Start calcium chloride sprays in the first or second cover. Do not reapply calcium chloride anytime during the growing season if rain has not washed off residue from previous calcium spray. Do not exceed 4 pounds per acre for low volume spray.

### Note on Mancozeb and Polyram (EBDC Products)

Mancozeb and Polyram cannot be used past bloom at the 6 lb per acre rate; however, the permissible 3 lb per acre rate may not be sufficient under heavy scab pressure. If sterol inhibiting (SI) fungicides (Nova, Rubigan, Indar, Inspire Super, or Procure) are used in an extended protectant program for primary scab control (tight cluster to second cover), the last spray containing the SI fungicide is a "transition spray," where you are moving from the use of the SI fungicide to protectant fungicides for control of summer diseases and secondary scab. This "transition spray" should contain the full label rate of a protectant fungicide in combination with the SI fungicide. If growers choose to use Mancozeb or Polyram, no more than 3 lb per acre can be used at this time. This rate may be too low, especially under heavy scab disease pressure. In situations such as this, growers should consider the use of Captan, which can be applied at higher rates in the "transition spray." Do not apply Mancozeb or Polyram within 77 days of harvest.

## APPLE THIRD COVER 10 days after second cover

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Scab, fruit rots, sooty blotch, and flyspeck	<sup>1</sup> Captan 50 WP Ziram 76 DF Topsin-M 70 WSB plus <sup>1</sup> Captan 50 WP or Ziram 76 DF Sovran 50 WG Flint 50 WG Pristine 38 WG Luna Sensation Merivon	6 lb 6-8 lb 1-1.5 lb 6 lb 6-8 lb 4-6.4 oz 2-2.5 oz 14.5-18.5 oz 4-5.8 fl oz 4-5.5 fl oz	<sup>1</sup> See note on Captan on page 23. The strobilurin fungicides (Sovran, Flint and Pristine) are very effective for control of most summer fruit rots as well as sooty blotch and flyspeck. Topsin-M is also highly effective for prevention of sooty blotch and flyspeck. However, excessive use of Topsin-M may result in a buildup of resistant strains of the apple scab fungus and/or increased mite injury due to the adverse effect of this fungicide on predatory mites.
Sooty blotch and flyspeck only	<sup>2</sup> ProPhyt (phosphorous acid) plus Captan 50 W	4-6 pt 6 lb	<sup>2</sup> In recent research, ProPhyt plus Captan has provided control of sooty blotch and flyspeck equal to that of Captan plus Topsin-M.
Codling moth, leafrollers, oriental fruit moth	Same as for first and second cover (page 15)		
White apple leafhopper	Same as for petal fall (page 13)		

## APPLE THIRD COVER CONTINUED

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Apple maggot	Imidan 70 WP Sevin XLR(4L) Calypso 4 F Assail 30 SG Entrust 80 WP Entrust 2 SC Admire Pro 4.6 EC Altacor 35 WDG Belay 2.13 SC	2.1–5.3 lb 1.5–3 qt 4–8 fl oz 8 oz 2–3 oz 6–10 fl oz 2.8 fl oz 2.5–4.5 oz 6 fl oz	Apple maggot flies generally begin emerging from the soil about mid-June. Monitor for the first appearance of flies each year with a detailed examination of fruit and leaves in the center of trees, the use of yellow sticky board traps baited with an attractant, by hanging red or green spheres coated with a sticky substance in trees, or with a combination of all three methods. Continue applications until late September or as long as flies are present. The pyrethroids Asana, Baythroid, Danitol, Leverage, Mustang Max, Proaxis, Renounce, and Warrior also are labeled for control of these insects at petal fall but are not recommended because they kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pest mites. Sevin also kills predaceous mites and can trigger pest mite outbreaks.
Aphids	Same as for petal fall (page 13)		
Mites	Same as for first cover (page 15) <b>or</b> Vydate L	2–4 pt	Refer to miticide section on page 22. Vydate can cause fruit thinning if used within 30 days of bloom. Agri-Mek is not as effective once leaves harden off.
San Jose scale crawlers (if present)	Same as for first cover (page 15)		
Cork spot, bitter pit, and Jonathan spot	Same as for first cover (page 16)		

**APPLE SUMMER COVER SPRAYS** Depending on rainfall, apply at intervals of 10 to 14 days.

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Scab, fruit rots, *sooty blotch, and flyspeck	Same as third cover (page 16)		See comments under third cover regarding late season use of Topsin-M. Check preharvest interval and re-entry restrictions of various materials before making the final application.  *The use of a spreader-sticker adjuvant in the last one or two sprays for sooty blotch and flyspeck may improve the level of control. Do not use Flint in combination with organosilicate surfactants.
Codling moth	Same as first and second cover (page 15)		Apply Intrepid or Confirm at the initiation of egg hatch for the second generation, 1200 degree days after biofix.
Apple maggot	Same as third cover (page 17)		
Mites	Same as third cover (page 17)		Refer to the miticides on page 21.
Leafhoppers	Same as third cover (page 16)		
Spotted tentiform leafminer	Same as petal fall (page 13) except do not use Ambush or Pounce <b>or</b> Vydate 2L	2–4 pt	Treatment is recommended if there is an average of more than two miners per leaf from petal fall to mid-summer, and more than three miners per leaf for the late-summer third generation. Vydate may cause fruit thinning if used within 30 days of bloom.
Leafrollers	Same as for first and second cover (page 14) <b>or</b> <i>Bacillus thuringiensis</i> (Agree, Dipel, Deliver, and others)		<i>Bacillus thuringiensis</i> sprays will kill only caterpillar larvae that ingest residues. Reapply at 4- to 5-day intervals; thorough coverage is essential.
Japanese beetle	Imidan 70 WP Sevin XLR (4 L) Neemix 4.5 Assail 30 SG Danitol 2.4 EC Warrior 1 CS Proaxis 0.5 EC Mustang Max 0.8 EC	2.1–5.3 lb 1.5–3 qt 7–16 fl oz 5–8 oz 16–21.3 fl oz 2.5–5.1 fl oz 2.5–5.1 fl oz 1.28–4 fl oz	Sevin and the pyrethroids Danitol, Warrior, Proaxis, and Mustang Max kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pest mites.
Woolly apple aphid	Diazinon AG 600 WBC Endosulfan 3 EC Admire Pro 4.6 F Movento 2 SC Beleaf 50 SG Closer 2 SC	See label. 3.33 qt 7–10.5 fl oz 6–9 fl oz 2–2.8 fl oz 2.75–5.75 fl oz	To control woolly apple aphid, apply Admire Pro 4.6 F through drip, trickle, or similar irrigation method into the root zone.
Aphids	Same as petal fall (page 13)		
Cork spot, bitter pit, and Jonathan spot	Same as first cover (page 16)		During August and September, the rate for calcium chloride may be increased to 3 lb/100 gal or 12 lb/acre.

# Efficacy of Selected Insecticides and Acaricides Against Apple Insects and Mites

Products <sup>1</sup>	Mode of Action Group (IRAC)	Predator Mites	Coddling Moth	Plum Curculio	Apple Maggot	Oriental Fruit Moth	Redbanded Leafroller	Oblique Banded Leafroller	Plant Bugs	Periodical Cicada	Rosy Apple Aphid	Green Aphids	Woolly Apple Aphids	Leafhoppers	Spotted Tentiform Leafminer Adults	Spotted Tentiform Leafminer Larvae	Japanese Beetle	San Jose Scale	European Red Mite	Twospotted Mite	Apple Rust Mite
<b>Organophosphates</b>																					
Diazinon	1 B	ST		F	I	G	I	F	I	I	M	G	I	I	M	I	I	I	I	I	I
Imidan	1 B	ST			I	M	G	I	I	I	M	G	I	I	M	I	I	I	I	I	I
Lorsban	1 B	MT																			
Supracide	1 B	MT																			
<b>Neonicotinoids</b>																					
Actara	4 A	MT																			
Admire	4 A	MT																			
Assail	4 A	ST																			
Belay	4 A	MT																			
Calypso	4 A	MT																			
Closer	4 C	-																			
<b>Insect Growth Regulators</b>																					
Centaur	16	ST																			
Confirm	18 A	ST																			
Esteem	7 C	ST																			
Intrepid	18 A	ST																			
Neemix, AzaDirect	18 B	ST																			
Rimon	15	ST																			
<b>Pyrethroids</b>																					
Asana	3	HT																			
Baythroid	3	HT																			
Danitol	3	HT																			
Permethrin	3	HT																			
Proaxis	3	HT																			
Warrior	3	HT																			
<b>Carbamates</b>																					
Carzol	1 A	HT																			
Lannate	1 A	HT																			
Sevin	1 A	HT																			
Vydate	1 A	HT																			
<b>Other</b>																					
Altacor	28	ST																			
Avaunt	22	MT																			
Belt	28	ST																			
B.T. (Dipel, etc.)	11 B2	NT																			
Cyd-X, Virosoft	-	NT																			
Delegate	5	MT																			
Endosulfan, Thionex	2 A	ST																			
Movento	23	-																			
Proclaim	6	-																			
Entrust	5	ST																			
Surround	-	MT																			
<b>Miticides</b>																					
Acramite	25	ST																			
Agri-Mek	6	MT																			
Apollo	10 A	ST																			
Dicofol	-	HT																			
Envendor	23	MT																			
Kanemite	20 B	ST																			
Nexter	21	HT																			
Portal	21	MT																			
Savey	10 A	ST																			
Vendex	12 B	ST																			
Zeal	10 B	MT																			

= unknown or doesn't apply P = poor F = fair G = good E = excellent ST = slightly toxic MT = moderately toxic HT = highly toxic NT = not toxic

<sup>1</sup>See list of generic products on page 49.

## Special Problems and Pests of Apple

For more detailed information on disease and insect control and integrated pest management (IPM), growers should obtain a copy of the *Midwest Tree Fruit Pest Management Handbook*. The handbook should be used in conjunction with this spray guide and can be obtained from your state cooperative extension service.

### Crown Rot (Collar Rot) of Apple

Ridomil Gold SL is labeled for use on bearing apple trees. Applications should be made before symptoms appear, especially in areas of the orchard where water drainage is poor. Ridomil Gold SL will not revitalize trees showing moderate to severe crown rot symptoms. Mix 0.5 pint of Ridomil Gold SL with 100 gal of water. Apply the amount of diluted mixture indicated in the table below, around the trunk of each tree. Applications should be made in early spring before growth starts, and in the fall after harvest and before the ground freezes. On new plantings, delay the first application until 2 weeks after planting. To determine trunk diameter, measure the trunk 12 inches above soil line.

Trunk Diameter	Quarts of Diluted Mixture/Tree
< 1 inch	1 quart
1–3 inches	2 quarts
3–5 inches	3 quarts
> 5 inches	4 quarts

#### Notes

- (1) Do not dip roots of trees; spray bare roots with solutions containing Ridomil Gold SL.
- (2) Do not graze in or feed cover crops from treated orchards. Illegal residues may occur.

Aliette 80 WDG (Fosetyl-Al) is registered as a foliar spray for control of collar and root rot on apples and pears. Under moderate disease pressure, apply Aliette three or four times at 5 lb/100 gal on a 60-day spray interval, or six to eight times at 2.5 lb/100 gal on a 30-day schedule. Make the first application in the spring after sufficient foliage is present to absorb the chemical. Do not apply more than 5 lb of Aliette per acre per application. Do not exceed 20 lb of Aliette per acre per season. Nursery tree resets and new plantings should be treated after leaf emergence. Do not apply within 2–3 weeks of leaf color change in the fall. Foliage must be green and living for Aliette to be taken up and transported to the roots. Read the label.

### Phosphorous Acid (Phosphonates and Phosphites)

Several products containing phosphorous acid have been registered for use as nutritional supplements and "plant conditioners." Several of these products also are registered for use as fungicides for control of root and collar rot, caused by *Phytophthora* spp., on apple, pear, and stone fruit. Some of these products are currently labeled for control of apple scab and sooty blotch and flyspeck. Brand names for these products include Agri-Fos, ProPhyt, Phostrol, and Topaz. Several other

products also may be available or introduced in the near future. Phosphorous acid is the active ingredient for these products and this is essentially the same active ingredient as in the fungicide Aliette, which has been registered for use on tree fruit for many years. These materials are applied as a foliar spray. The active ingredient is highly systemic and moves down the tree from the leaves into the crown and roots. See the label for current use recommendations.

### Restrictions on EBDC Products

Users should carefully read, understand, and follow all restrictions prior to using EBDC products. EBDC products have two rate recommendations, depending upon how you choose to use the fungicides. Label recommendations for Mancozeb are identical for apples and pears. The following information is taken from the label:

**1. Pre-Bloom Use.** Begin applications at  $\frac{1}{4}$ - to  $\frac{1}{2}$ -inch green tip and continue on a 7- to 10-day schedule through bloom. DO NOT: (1) apply more than 6 lb Mancozeb per acre per application; (2) apply more than 24 lb of Mancozeb or Polyram per acre, per year; (3) apply after bloom.

### 2. Extended Application Schedule or Use in Tank

**Mixtures.** Begin applications at  $\frac{1}{4}$ - to  $\frac{1}{2}$ -inch green tip and continue applications on a 7- to 10-day schedule through the second cover spray. DO NOT: (1) apply more than 3 lb per acre per application; (2) apply within 77 days of harvest; (3) apply more than 21 lb of Mancozeb or Polyram per acre per year. **DO NOT combine or integrate the two treatment schedules.**

### Management of Shoot Blight Phase of Fire Blight with Apogee

**with Apogee.** Apogee (prohexadione calcium) inhibits gibberellin biosynthesis, resulting in an early cessation of terminal growth. Shoots with inhibited growth are less susceptible to fire blight. Consider using Apogee to reduce the threat of shoot blight on vigorous trees of susceptible varieties that have nearly filled their tree space. Apogee only decreases host susceptibility; it does not affect the pathogen directly. Apogee is not a substitute for streptomycin for blossom blight control during bloom. If needed, Apogee can be combined with streptomycin in one of the bloom sprays.

**Timing.** Apogee 27.5 W should be applied at full bloom to early petal fall on the king blooms for maximum effectiveness. Apogee is considerably less effective if applied too late. The decrease in blight susceptibility will not occur until about 10 to 14 days after application.

**Application rate and number.** A rate of 36 to 48 oz of Apogee 27.5 W per acre is recommended for trees that require 300 to 400 gallons of dilute spray per acre, respectively, or 12 oz per 100 gallons of dilute spray. The effectiveness of lower per acre rates for blight control drops off quickly.

In the Midwest, two applications of Apogee at 10 to 12 oz per 100 gal should be sufficient for preventing fire blight spread in the summer, but overly vigorous trees may need a third application (see label).

**Additives.** The nonionic surfactant Regulaid should be used with Apogee. Follow the manufacturer's rate recommendations. If Apogee is applied in hard water (water that contains high levels of calcium carbonate), 1 lb of spray-grade ammonium sulfate should be used for each pound of Apogee.

**Comments.** Growth control with Apogee is not concentration dependent. There is no difference in shoot growth control between dilute and concentrate sprays, provided the total amount of chemical per acre is the same. The level of growth control with Apogee is rate dependent. The greatest and quickest reduction is obtained at the recommended rate, and the effect on growth declines as the rate is reduced.

#### **Insecticide Resistance in Codling Moth Populations**

Codling moth populations that are suspected or confirmed to be resistant to certain insecticides have been reported from several states, including those covered by this spray guide. The resistance traits of populations differ among orchards and regions, so resistance may account for control failures in some orchards even though the same insecticides may provide effective control at another location.

Resistance is not the only cause for control failures, so growers are always urged to consider whether or not inadequate rates, inadequate spray volume, spray timing, or wash-off due to rainfall may have contributed to poor control. Where these factors do not appear to provide an explanation for control failures, then resistance, particularly to the organophosphates (Guthion, Imidan, Diazinon), may be the reason, and switching to other insecticides is recommended. Where control programs have been effective and resistance does not seem to be a problem, rotating among insecticides with different modes of action is recommended to delay development of resistance. (See mode of action groups on page 19.)

Populations that are resistant to the organophosphates exhibit resistance to all the organophosphates that are labeled for codling moth control in apples (Diazinon, Imidan, and Guthion), so switching among these insecticides offers no benefit. Laboratory research and field observations have shown that organophosphate-resistant codling moth populations also are less susceptible to some pyrethroids, so switching to Pounce (or other permethrin formulations), Asana, Warrior, Dantol, Baythroid, or Proaxis may not provide adequate control. The neonicotinoids Assail, Calypso, and Clutch, as well as the insect growth regulator Rimon, are effective against organophosphate-resistant codling moth populations. Growers are urged to consult with their state extension specialists in entomology to plan

effective season-long programs that make the best use of available products within the label-specified limits and restrictions for each.

#### **Mating Disruption for Codling Moth Control**

Isomate C-Plus, No-Mate CM, and CheckMate CM dispensers are registered for control of codling moth. They dispense the sex attractant of the codling moth and are designed to prevent male moths from locating females for mating. Sprayable formulations also are available. This strategy, termed mating disruption, is most likely to succeed in blocks of at least 5 acres where initial populations of codling moth are low. If mating disruption is used for codling moth control in smaller blocks or where infestations are greater, border sprays, or at least one or two cover sprays, also will be necessary. Controlling codling moth by mating disruption will not control other insect pests that are controlled by cover sprays (plum curculio and apple maggots, for example).

#### **Apple Borers**

The dogwood borer and American plum borer are caterpillars that attack burrknot tissue on apple trunks. Flat-headed and round-headed apple borers are beetle larvae that attack tree trunks, often in association with mechanical or other injury or generally weakened trees. Any of these borers can be treated with Lorsban Advanced at a rate of 1.5 qt per 100 gallons of spray, Lorsban 50 W at a rate of 3 lb per acre or Lorsban 4E at a rate of 1.5 qt per 100 gallons of spray no later than 28 days before harvest. For dogwood borer, the best insecticide timing is at peak egg hatch, which is in late June in the central Midwest. For American plum borer, the best timing is at petal fall. For flat-headed and round-headed apple borers, apply insecticide in the spring. Apply borer sprays to the lower 4 feet of the trunk and lower branches, soaking the bark. DO NOT apply Lorsban to the fruit or foliage. Only one application of Lorsban of any formulation is allowed each year. Do not use for borers if already used pre-bloom.

#### **Periodical Cicadas**

Periodical cicadas are orange to black, about 1½ inches long, with black transparent wings, and appear from May to July. Annual or dog-day cicadas are larger, green to black, and appear each year from July to September. Ordinarily, annual cicadas do not cause much damage. Cicada males announce their presence to the voiceless females by making a continuous, high-pitched shrill sound. Vibrating membranes on the underside of the first abdominal segment produce the sound.

The total life cycle of the periodical cicada takes either 13 or 17 years. Otherwise, the two types have similar habits. The adult females lay eggs in rows in pockets that they cut in small branches and twigs of trees with their long, knife-like egg layer. Each female will make five to 20 of these pockets, laying 24 to 28 eggs in two rows in each pocket. The eggs hatch in six or seven weeks; the

newly hatched nymphs fall to the ground and burrow until they find suitable roots, usually 1½ to 2 feet beneath the soil. With their sucking mouthparts, they immediately begin to suck juices from the roots.

During the spring of the 13th or 17th year, depending on which brood is involved, the cicadas burrow upward until they are about 1 inch below the soil surface. When the proper night comes, they leave the ground in large numbers and head for the nearest upright object, preferably a tree. The nymph attaches itself firmly to this object. By splitting its skin down the middle of the back, it emerges as a winged adult. At first, the adults are soft and white, but they become harder and darker as the tissues dry. Mating takes place within a few weeks and eggs are laid for the next brood.

There are 17 broods of the 17-year race (I–XVII) and 13 broods (XVIII–XXX) of the 13-year race. Each year, somewhere in the United States, at least one of these broods emerges. But any one brood will emerge only once every 13 or 17 years. Contact your extension office for information on broods and emergence in your area.

Females prefer oak, hickory, apple, peach, and pear trees and grape vines for laying eggs. Damage occurs when the females make slits in branches and twigs in which to deposit the eggs. These small twigs and branches turn brown and die, sometimes breaking off. The damage may be severe in newly planted orchards or on new plants of shade trees or shrubs. Heavy populations of nymphs in the soil also may affect the growth and vigor of certain trees.

You can prevent egg-laying damage by cicadas on young fruit and ornamental trees by covering the tree with a protective netting, such as cheesecloth. Cover the tree and tie the netting to the trunk below the lower branches. Remove the covering when egg-laying is over. If netting is not an option, you may apply insecticides when egg-laying begins and repeat 7 to 10 days later. Pyrethroids are recommended to control periodical cicada, but these applications may lead to mite outbreaks.

#### Brown Marmorated Stink Bug

A new invasive species of stink bug, the brown marmorated stink bug, is spreading across the Midwest from the east. Where this species has become established, it occurs in greater number and causes greater damage to fruit crops than other stink bug species. Of the insecticides listed on page 10 for the control of plant bugs and stink bugs, Actara, Baythroid, Belay, Danitol, Endosulfan, and Lannate have been effective against this species in early trials in the eastern United States. For information on the identification of this insect, see [http://www.ncipmc.org/alerts/stinkbug\\_alert.pdf](http://www.ncipmc.org/alerts/stinkbug_alert.pdf). If you suspect this insect is present in your orchard, contact your state extension specialist in entomology.

#### Miticides for Apple

The following miticides are registered for use on apples. Refer to product label for registered uses, amount of use, harvest restrictions, and remarks for use on other crops.

Brand Name	Rate Per Acre	Days to Harvest	MOA <sup>f</sup> Group
"Superior oil"	2%	before pink	
Acramite 50 WS	0.75–1 lb	7	UN
AgriMek 0.15 EC <sup>a</sup>	10 fl oz	28	6
Apollo 4 SC	4–8 fl oz	45	10A
Carzol 92 SP	1–1.25 lb	by petal fall	1A
Dicofol 4E	6 pt	7	UN
Envidor 2 SC	16–18 fl oz	7	23
Kanemite 15 SC	21–31 fl oz	14	20B
M-Pede <sup>b, c</sup>	1.2 gal	++	
Nexter 75 WP <sup>d</sup>	4.4–10.67 oz	25	21
Onager 1 EC	12–24 oz	28	10A
Portal 0.4 EC	1–2 pt	14	21
Savay 50 DF	3 oz	28	10A
Summer oils <sup>b</sup>	1–2 gal	++	
Vendex 50 W	1–2 lb	14	12B
Vydate L <sup>e</sup>	2–4 pt	14	1A
Zeal 72 WP	2–3 oz	14	10B

<sup>++</sup>Apply before waxy bloom forms on fruit.

<sup>a</sup> Apply within 2 weeks after petal fall.

<sup>b</sup> Do not use with Captan, Sevin, or other sulfur-containing products. Do not apply when temperatures exceed 90° F.

<sup>c</sup> Not very effective alone. Enhances efficacy of other miticides.

<sup>d</sup> Allow at least 30 days between sequential applications.

<sup>e</sup> Vydate may cause fruit thinning if used within 30 days of bloom.

<sup>f</sup> MOA is mode of action classification; for resistance management, it is best to rotate to products from a different group.

#### Sanitation Methods to Aid in Apple Scab Control

Especially in years following seasons when a high incidence of apple scab has developed in the orchard, the following sanitation methods can reduce the amount of apple scab inoculum (ascospores) by as much as 50%. Apple scab overwinters only in fallen leaves. The application of 5% urea (40 lbs per acre in 100 gallons of water) to the orchard floor provides nitrogen to help microorganisms decompose leaves, killing the overwintering apple scab fungus. Flail mowing the orchard also has been reported to reduce apple scab inoculum by as much as 50%. Flail mowing or nitrogen application can be performed in the fall, and/or in the spring. Each method has been reported to reduce the number of scab ascospores by as much as 50%; however, the combined effects of each method are not additive. If both methods are used, the level of ascospore reduction probably will

<b>Timing of First<sup>a</sup> Insecticide Spray for Codling Moth Control on Apple and Pear</b>	
Degree-days (base 50°F) after biofix <sup>b</sup>	Insecticide Products
50–75	Dimilin Rimon
100–200	Intrepid Confirm
150–250	Calypso Altacor Assail Belay Delegate
250	Imidan Avaunt Pyrethroids (Asana, Baythroid, Danitol, Mustang Max, Proaxis, Renounce, Warrior) Virus (Cyd-X, Carpovirusine, Virosoft CP4)

<sup>a</sup> A second spray should be made 10–14 days later.

<sup>b</sup> Biofix is defined as the date on which pheromone traps detect sustained flight of moths.

not exceed 50%. Be sure to recognize that urea provides nitrogen, and modify fertilization appropriately.

#### Notes on Soaps and Horticultural Oils

SunSpray UFO (UFO = “ultrafine” oil), Saf-T-Side, and M-Pede (a potassium salt of fatty acids, previously called an insecticidal soap) are relatively new insecticides that may be used in certified organic production systems. Summer oils and M-Pede are only effective against insects contacted by sprays at the time of application. These sprays provide no residual control. Many questions about the efficacy of these insecticides remain, and their use should be considered experimental. Nonetheless, they appear to be useful in certain situations.

A summer oil alone, at a concentration of 1 to 2 percent by volume, provides some control of mites and aphids (rosy apple aphid, apple grain aphid, green apple aphid, and spirea aphid). Limited observations suggest that aphid control is likely to be greatest if oil is applied when clusters are at the 0.25 inch green stage. M-Pede alone reduces mite, aphid, pear psylla, and white apple leaf-hopper populations, but control may not be satisfactory or long-lasting unless multiple sprays are applied. Unlike oils, M-Pede is not ovicidal. If applied alone, a summer oil is likely to be more effective for aphid and (especially) mite control than M-Pede. Data from Michigan indicate that adding M-Pede at 2 percent by volume to full-rate sprays of Vendex, Kelthane, and presumably other miticides, greatly enhances the control they provide.

Phytotoxicity, leaf drop, and fruit blemishes should be major concerns when deciding to use summer oil or soap. To prevent damage to foliage or fruits, never use a summer oil with Captan, Sevin, or other sulfur-

containing pesticides. Allow at least 14 days between applications of sulfur-containing compounds and the use of a summer oil. Do not apply oils if temperatures exceed 90°F or drying conditions are poor. Because of concerns about fruit russetting, some authorities suggest that insecticidal soaps should be used only in non-bearing orchards. Oils and soaps must be mixed at the proper dilution (1 to 2 percent); concentrated sprays will be less effective and more phytotoxic. Deposits of large droplets or the coalescing of droplets on fruit or foliage also increases the likelihood of leaf damage and fruit blemishes.

#### Fungicide Resistance Management

Many of our most effective fungicides have a high risk for resistance development in the fungi they control. These include Topsin-M, Scala, Vangard, the sterol-inhibiting fungicides (Rally, Rubigan, Indar, Inspire Super, and Procure); the strobilurin fungicides (Sovran, Cabrio, Pristine, and Flint); and the succinate dehydrogenase inhibiting fungicides (Fontelis, Luna Sensation, Luna Tranquility, and Merivon). Because they all have very specific modes of action, fungi such as the apple scab and the powdery mildew pathogens can rapidly develop resistance to them. Fungicide resistance, or at least reduced sensitivity, has been observed for apple scab and powdery mildew to both the sterol-inhibitor and strobilurin fungicides in the United States.

In order to delay the development of resistance, these fungicides should never be used alone in a season-long program and should be used as little as possible. Most of the newer fungicides have a limit to the number of applications that can be made per season (generally no more than four) and labels state that no more than two sequential applications of the fungicide should be made without alternating with another fungicide having a different mode of action. The sterol-inhibiting fungicides, the strobilurin fungicides, and the succinate dehydrogenase inhibiting fungicides have very different modes of action and can be alternated with each other in a fungicide resistance management program.

A good approach is to alternate one to two spray blocks of these materials. For example: two sprays of Sovran (a strobilurin fungicide) alternated with two sprays of Rally (a sterol-inhibiting fungicide) mixed with a broad spectrum protectant fungicide such as Captan, Mancozeb, or Polyram.

#### Use of Captan Fungicide

##### on Tree Fruit-Restricted Entry Intervals (REI)

Most Captan formulations (Captan 50W, Captan 80 WDG, Captan 4L) are currently available with a 24-hour REI. The REI was reduced from four days to 24 hours a few years ago for apples, cherries, plums/fresh prunes, and peaches. However, some formulations produced by certain companies still may have the four-day REI. Check the label of the Captan product you plan to purchase to be sure it has a 24-hour REI.

# PEAR

## **PEAR DORMANT TO BUD SWELL** Apply before growth starts in spring and when temperatures are above 45°F.

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Fire blight	Fixed copper fungicides (copper hydroxide, copper oxychloride, basic copper sulfate, bordeaux mixture)		If fire blight was severe last year, a fixed copper spray at the swollen bud stage is suggested. Do not apply copper after the swollen bud stage or when drying conditions are cool and slow because severe injury can occur. Many fixed copper fungicides are registered for use on pears. Label recommendations may vary; refer to individual label for specific application timing. Fixed coppers can be mixed with oil. <b>However, never combine copper sulfate alone with dormant oil.</b>

## **PEAR LATE DORMANT** Before buds break into green tip in the spring

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Scale insects, European red mite eggs	Superior oil	2%	Apply when temperatures are above 40°F — <b>never during freezing weather.</b> Do not apply within 2 weeks of a sulfur spray or later than delayed dormant.
European red mite eggs	Apollo 4 SC Savey 50 DF	4–8 fl oz 3–6 oz	Limit one Apollo or Savey application per year.
Pear psylla (adults)	Ambush 25 WP Asana XL 0.66 EC Danitol 2.4 EC Pounce 25 WP Proaxis 0.5 EC Warrior 1 CS Surround Mustang Max 0.8 EC Delegate 25 WG Superior oil	25.6 oz 19.2 fl oz 21.3 fl oz 25.6 oz 5.1 fl oz 5.1 fl oz 50 lb 4 fl oz 6–7 oz 1–3 gal	Insecticide may be combined with oil during dormant and delayed dormant periods only. Oil on wood inhibits egg laying. Apply oil as soon as first eggs are laid and again 7 days later if adults still present. Apply dilute. Use 3% at dormant, 2% at budburst, and 1% up to whitebud.  Apply this rate of Asana only during dormant to pre-bloom (white bud) stage.  Rate for Surround is per 100 gallons. Apply Surround every 7 to 14 days, beginning no later than green tip.

## PEAR PRE-BLOOM

When blossom buds are separated in the cluster before bloom

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Pear scab	Topsin-M WSB <sup>1</sup> Vintage SC <sup>1</sup> Procure 50 WP <sup>2</sup> Mancozeb 75 DF Ziram 76 DF <sup>3</sup> Sovran 50 WG <sup>3</sup> Flint 50 WG <sup>3</sup> Pristine 38 WG Scala 5 SC Vangard 75 WG Syllit 3.4F Inspire Super Fontelis Merivon	1 lb 8-12 fl oz 8-16 oz 3-6 lb 6-8 lb 2-2.5 oz 2-2.5 oz 14.5-18.5 oz 7-10 fl oz 5 oz 1.5-3 pt 12 fl oz 16-20 fl oz 4-5.5 fl oz	<sup>1</sup> Vintage, Inspire Super, and Procure also will control powdery mildew. Refer to the label for further information on recommended rates for use.  Gowan chemical company is voluntarily removing Vintage SC from the market. Gowan will sell and support Vintage SC through December 2012. The distribution channel typically has 2 years from the official date of cancellation to sell existing inventory. Growers typically have no time limitation to use up the Vintage SC they have purchased.
Pear psylla (hatching eggs)	Esteem 35 WP Dimilin 25 W Dimilin 2L Centaur 70 WDG Surround	4-5 oz 2.5-3 lb 40-48 fl oz 34.5-46 oz 50 lb	<sup>2</sup> See note on EBDC products (page 20) on use of Mancozeb.  <sup>3</sup> Sovran, Flint and Pristine also will control powdery mildew. Refer to the label for further information.  <sup>4</sup> See comments on Inspire Super on page 9.  Rate for Surround is per 100 gallons.

## PEAR BLOOM

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Pear scab	Same as for pre-bloom		Mancozeb may not be applied past bloom above the 3 lb per acre rate. Do not apply within 77 days of harvest.
Fire blight	Streptomycin 17 W <b>plus</b> Regulaid Mycoshield 17 WP Flame Out 17 WP	1.5 lb 1 lb 1 pt 1 lb 1 lb	Start fire blight sprays at the first sign of open blossoms; repeat sprays at 4- to 5-day intervals through bloom and petal fall. If warm, wet weather occurs during bloom, use the maximum rate of streptomycin of 100 ppm (0.5 lb per 100 gal).  Mycoshield and Flame Out (oxytetracycline) are registered for pear but not for apple. These products are less effective for fire blight control than streptomycin. However, where streptomycin-resistant strains of the fire blight pathogen are present, oxytetracycline is more effective than streptomycin.
Insects or mites	SAVE THE BEES! Do not use insecticides during bloom.		

## **PEAR PETAL FALL** 7 to 10 days after bloom

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Pear scab	Same as for pre-bloom (page 24)		
Fire blight	Same as for bloom (page 24)		Continue sprays for fire blight until the last petals have fallen.
Plum curculio, tarnished plant bug, stink bugs	Imidan 70 WP Danitol 2.4 EC Warrior 1 CS Proaxis 0.5 EC Brigade 2 E Baythroid XL 1 EC Mustang Max 0.8 EC Renounce 20 WP	2.13–5.3 lb 16–21.3 fl oz 2.5–5.12 fl oz 2.5–5.12 fl oz 2.6–12.8 fl oz 2–2.8 fl oz 1.28–4 fl oz 2.5–3.5 oz	
Pear psylla (nymphs)	Esteem 35 WP Agri-Mek 0.15 EC Calypso 4F Actara 25 WDG Assail 30 SG Surround Admire Pro 4.6 F Belay 2.13 SC	4–5 oz 10–20 fl oz 8 fl oz 5.5 oz 4–8 oz 50 lb 7 fl oz 6–12 fl oz	Apply Agri-Mek with 1% oil. Gives 3–4 weeks control at 10 oz rate. At 20 oz rate, control is season-long.  Surround rate is per 100 gallons.

## **PEAR FIRST AND SECOND COVER** 10 to 14 days after petal fall and 10 to 14 days later

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Pear rust mite	Belay 2.13 SC Agri-Mek 0.15 EC Nexter 75 WP Envidor 2 SC Carzol 92 SP	6–12 fl oz 10–20 fl oz 5.2–10.7 fl oz 16–18 fl oz 1–1.25 lb	First cover is the best time to control pear rust mite. Nexter will also suppress pear psylla.
Pear scab	Same as for pre-bloom (page 24)		
Codling moth, plum curculio	Same as for plum curculio at petal fall (above) <b>or</b> Assail 30 SG Dimilin 25 W Dimilin 2 L Altacor 35 WDG Belt 4 SC Delegate 25 WG	4–8 fl oz 0.75–1 lb 12–16 fl oz 2.5–4.5 oz 3–5 fl oz 4.5–7 oz	Asana, used at first cover for psylla, also controls codling moth and plum curculio. Dimilin, Belt, Delegate, and Altacor are effective against codling moth but not plum curculio. Apply Dimilin 50 to 75 degree-days after codling moth biofix (see page 23). Assail is for plum curculio only.
Pear psylla	Same as at petal fall (above)		Psylla control required for first cover only; not required for second cover. Best results found when psylla is in adult or young nymphal stage.

**PEAR SUMMER COVERS** Apply at 10- to 14-day intervals observing harvest restrictions and limitations

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Pear scab, sooty blotch, and flyspeck	Same as for pre-bloom except for Vangard <sup>1</sup> , Scala <sup>1</sup> and Mancozeb <sup>2</sup> (page 25)		Rubigan and Procure will not control sooty blotch and flyspeck and should not be used past second cover. Sovran, Flint, and Pristine provide excellent control of summer fruit rots as well as sooty blotch and flyspeck.
Codling moth	Belay 2.13 SC Imidan 70 WP Calypso 4 F Assail 30 SG Intrepid 2 F Confirm 2 F Dimilin 25 W Dimilin 2 L Asana XL 0.66 EC Brigade 2 EC Danitol 2.4 EC Proaxis 0.5 EC Warrior 1 CS Sevin XLR(4L) Entrust 80 WP Entrust 2 SC Mustang Max 0.8 EC Renounce 20 WP Avaunt 30 WDG Baythroid XL 1 EC Altacor 35 WDG Delegate 25 WG Belt 4 SC Cyd-X Cyd-X HP Carpovirusine	6–12 fl oz 2.1–5.3 lb 4–8 fl oz 3–6 oz 16 fl oz 20 fl oz 0.75–1 lb 12–16 fl oz 4.8–14.5 fl oz 2.6–12.8 fl oz 16–21.3 fl oz 2.5–5.1 fl oz 2.5–5.1 fl oz 3 qt 2–3 oz 6–10 fl oz 1.28–4 fl oz 2.5–3.5 oz 5–6 oz 2–2.4 fl oz 2.5–4.5 oz 4.5–7 oz 3–5 fl oz 1–6 fl oz 0.5–3 fl oz 6.8–13.5 fl oz	<sup>1</sup> Vangard and Scala have a 72-day PHI. <sup>2</sup> See note on Mancozeb on page 16. All Mancozeb products have a 77-day PHI.
Pear psylla	Actara, Assail, Belay, Calypso, or Admire as listed at petal fall, or Delegate 25 WG Portal 0.4 EC	6–7 oz 1–2 pt	Make 2 applications, 10–12 days apart to target second generation young nymphs. The first new summer adults appear about 3 weeks after full bloom. Second generation adults are found on terminals and water sprouts.
San Jose scale (crawlers)	Esteem 35 WP Diazinon AG 600 WBC  Admire 4.6 F Assail 30 SG Centaur 70 WDG Renounce 20 WP Movento 2 SC	4–5 oz 12.75 fl oz/ 100 gallons  2.8 fl oz 8 oz 34.5–46 oz 3–3.5 oz 6–9 fl oz	
European red mite	Savey 50 DF Apollo 4 SC Agri-Mek 0.15 EC Acramite 50 WS Portal 0.4 EC Kanemite 15 SC Envidor 2 SC Nexter 75 WP Zeal 72 WP Onager 1 EC	3–6 oz 4–8 fl oz 10–20 fl oz 0.75–1 lb 1–2 pt 21–31 fl oz 16–18 fl oz 4.4–5.2 oz 2–3 oz 12–24 oz	
Mealybug	Admire 4.6 F Actara 25 WDG Calypso 4 F Assail 30 SG Portal 0.4 EC Movento 2 SC Centaur 70 WDG	7 fl oz 4.5–5.5 fl oz 4–8 fl oz 4–8 oz 1–2 pt 6–9 fl oz 34.5–46 oz	

# CHERRY

## CHERRY DORMANT Before buds break in the spring

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Bacterial canker	<sup>1</sup> Copper compounds		<sup>1</sup> Bacterial canker is generally more serious on sweet than tart cherry.
European red mite eggs	Superior oil Apollo SC	2% 2–8 fl oz	Many copper compounds are registered for use as a dormant application for control of bacterial canker on cherry. See labels for rates and timing. Do not apply copper later than white bud stage; injury to flowers can occur.

## CHERRY EARLY BLOOM

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot (blossom blight)	<sup>1</sup> Topsin-M 70 WSB <b>plus</b> <sup>2</sup> Captan 50 WP <b>OR</b> <sup>3</sup> Rovral 50 WP Wettable sulfur 95% <sup>4</sup> Rally 40 WSP <sup>5</sup> Indar 75 WSP Inspire Super <sup>5</sup> Orbit 41.8 L Procure 50 WS Pristine 38 WG Elevate 50 WG Captevate 68 WDG Quash 50 WDG Topguard Fontelis Merivon	1.5 lb 4 lb 1–2 lb 18 lb 2.5–6 oz 2 oz 16–20 fl oz 4 fl oz 9–12 oz 10.5–14.5 oz 1–1.5 lb 3.75 lb 2.5–3.5 oz 14 fl oz 14–20 fl oz 4–6.7 fl oz	<sup>1</sup> Topsin-M and the sterol-inhibiting fungicides (Rally, Indar, Elite, and Orbit) should always be alternated or combined with another fungicide, such as Captan, so as to minimize the development of resistance. Topsin-M is also available in a flowable formulation (4.5 FL). <sup>2</sup> See note for Captan on page 23. <sup>3</sup> No more than two sprays of Rovral may be applied per season, and Rovral cannot be applied after petal fall on any stone fruit. <sup>4</sup> Rally is registered for control of brown rot (blossom blight), leaf spot, and powdery mildew on cherries. Do not apply more than 3.25 pounds of Rally 40 WSP per acre per season, or within 7 days of harvest. <sup>5</sup> Apply Indar and Orbit in a minimum of 50 gallons of water per acre. Indar also is available in a 2F (liquid) formulation.

## CHERRY FULL BLOOM

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot (blossom blight)	Same as for early bloom (above)		
Insects or mites	SAVE THE BEES! Do not apply insecticides during bloom.		

## CHERRY PETAL FALL

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot (blossom blight)	Same as for early bloom (page 28)		Rovral cannot be applied after petal fall.
Leaf spot	Bravo Syllit 3.4 F Indar 75 WSP Topguard Pristine 38 WG Gem 25 WG Fontelis Luna Sensation Merivon	3–4 pt 1.5–3 pt 2 oz 14 fl oz 10.5–14.5 oz 4–8 oz 14–20 fl oz 5–5.6 fl oz 4–6.7 fl oz	Except for sulfur, all materials listed for brown rot under early bloom may be used for both brown rot and leaf spot. Do not apply Bravo after shuck split.  Tart cherry is more susceptible to leaf spot than is sweet cherry.
Powdery mildew	Wettable sulfur 95% Rally 40 WSP Topguard Procure 50 WS Pristine 38 WG Gem 25 WG <sup>1</sup> Quintec 2.08 F Quash 50 WDG Inspire Super Fontelis Luna Sensation Merivon	18 lb 2.5–6 oz 14 fl oz 10–16 oz 10.5–14.5 oz 4–8 oz 7 fl oz 3.5–4 oz 16–20 fl oz 14–20 fl oz 5–5.6 fl oz 4–6.7 fl oz	Refer to the label for further information on recommended rates for use.  <sup>1</sup> Quintec is a protectant fungicide and must be applied before the powdery mildew fungus penetrates or infects tissues.
Plum curculio	<sup>2</sup> Imidan 70 WP Pounce 25 WP Asana XL 0.66 EC Baythroid XL 1 EC Danitol 2.4 EC Warrior 1 CS Mustang Max 0.8 EC Proaxis 0.5 EC Renounce 20 WP Assail 30 SG Calypso 4F	2.13–2.5 lb 6.4–12.8 oz 4.8–14.5 fl oz 2.4–2.8 fl oz 10.7–21.3 fl oz 2.5–5.12 fl oz 1.28–4 fl oz 2.56–5.12 fl oz 3–3.5 oz 5.3–8 oz 4–8 fl oz	<sup>2</sup> Do not use Imidan on sweet cherries.

## CHERRY SHUCK-FALL When shucks have split and are falling from expanding fruit

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Leaf spot	Topsin-M 70 WSB <b>plus</b> <sup>1</sup> Captan 50 WP <b>OR</b> Rally 40 WSP Indar 75 WSP Topguard Pristine 38 WG Gem 25 WG Bravo Inspire Super Syllit Fontelis Luna Sensation Merivon	1.5 lb 4 lb 2.5–6 oz 2 oz 14 fl oz 10.5–14.5 oz 4–8 oz 3–4 pt 16–20 fl oz 1.5–3 pt 14–20 fl oz 5–5.6 fl oz 4–6.7 fl oz	<sup>1</sup> See note on Captan on page 23.
Powdery mildew	Same as for petal fall (above)		
Plum curculio	Same as for petal fall (above)		

## CHERRY FIRST COVER SPRAY 10 days after shuck-fall

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Leaf spot	Same as for shuck-fall except not Bravo (page 29)		Do not apply Bravo after shuck-fall.
Powdery mildew and leaf spot	*Same as for petal fall or a copper fungicide (page 29)		*See comments on the use of copper for leaf spot control on page 32.
Plum curculio and cherry fruit fly	Imidan 70 WP Lorsban 50 WP Lorsban 75 WG Asana XL 0.66 EC Warrior 1 CS Baythroid XL 1 EC Mustang Max 0.8 EC Proaxis 0.5 EC Renounce 20 WP Assail 30 SG Danitol 2.4 EC Calypso 4F	2.1–2.5 lb 3 lb 1.33–2 lb 4.8–14.5 fl oz 2.5–5.12 fl oz 2.4–2.8 fl oz 1.28–4 fl oz 2.56–5.12 fl oz 3–3.5 oz 5.3–8 oz 10.7–21.3 fl oz 3–8 fl oz	Note: Lorsban may be used on tart cherries only. It is phytotoxic on sweet cherries.
Cherry fruit fly	Products listed above for two pests Admire Pro 4.6 F Entrust 80 WP Entrust 2 SC Delegate 25 WG Altacor 35WDG	2–2.8 fl oz 1.25–2.5 oz 4–8 fl oz 4.5–7.0 oz 3–4.5 oz	

## CHERRY SECOND COVER SPRAY 10 days after first cover

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Leaf spot	Same as for shuck-fall, except not Bravo (page 29)		Do not apply Bravo after shuck-fall.
Powdery mildew	Same as for petal fall (page 29)		
Plum curculio and cherry fruit fly	Same as for first cover (above )		

## CHERRY ADDITIONAL COVER SPRAYS

10 days after second cover, then every 10 to 14 days

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot	Same as for early bloom, except not Rovral (page 28)		Do not apply Rovral after petal fall.
Leaf spot	Same as for shuck-fall, except not Bravo (page 28)		Do not apply Bravo after shuck-fall.
Powdery mildew	Same as for petal fall (page 28)		
Cherry fruit fly	Imidan, Admire Pro, Danitol, Proaxis, Renounce, Asana, Mustang Max, Baythroid, Warrior, Entrust, Assail, or Delegate same as first cover (page 29) <b>OR</b> Diazinon AG 600 WBC Sevin XLR (4L) Lorsban 50 WP Lorsban 75 WG Calypso 4F	6.5–12.7 fl oz 2–3 qt 3 lb 2 lb 3–6 fl oz	This rate is per 100 gallons.  Note: Lorsban may be used on tart cherries only. It is phytotoxic on sweet cherries.
Borer control			Refer to section on borers of peach and stone fruit trees on pages 41–43.

## CHERRY PRE-HARVEST SPRAYS

Beginning 3 to 4 weeks before harvest

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot	Topsin-M 70 WSB <b>plus</b> <sup>1</sup> Captan 50 WP <b>OR</b> Indar 75 WSP Topguard Orbit 41.8 L Procure 50 WS Pristine 38 WG Elevate 50 WDG Captevate 68 WDG <sup>2</sup> Gem 25 WG Inspire Super Fontelis Luna Sensation Merivon	1.5 lb 4 lb  2 oz 14 fl oz 4 fl oz 12–16 oz 10.5–14.5 oz 1–1.5 lb 3.75 lb 4–8 oz 16–20 fl oz 14–20 fl oz 5–5.6 fl oz 4–6.7 fl oz	Pre-harvest use restrictions and limitations are variable according to product; refer to label for details.  <sup>1</sup> See note on Captan on page 23.  <sup>2</sup> Gem provides excellent control of cherry leaf spot but is weak on brown rot.
Spotted wing drosophila	Baythroid XL 1 EC Entrust 80 WP Entrust 2 SC Delegate 25 WG Danitol 2.4 EC Malathion 5 EC Pyganic 5 EC Renounce 20 WP Pounce 25 WP	1.28–4 fl oz 1.25–2.5 oz 4–8 fl oz 4.5–7 oz 10.7–21.3 fl oz 1.9 pt 4.5–18 fl oz 3–3.5 oz 12.8 oz	

## CHERRY POST-HARVEST SPRAYS

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Leaf spot	Bravo Syllit 3.4F Rally 40 WSP Topguard Adament 50 WG Orbit 41.8 L	3–4 pt 1.5–3 pt 2.5–6 oz 14 fl oz 4–8 oz 4 oz	Bravo can be applied on cherries after harvest, and for the purpose of fungicide resistance management, would be the fungicide of choice. Make one application of Bravo to foliage within 7 days after fruit is removed. In orchards with a history of high leaf spot incidence, make a second application 10 to 14 days later.
Leaf spot and powdery mildew	Rally 40 WSP Indar 75 WSP Topguard Pristine 38 WG Fontelis Luna Sensation Merivon	2.5–6 oz 2 oz 14 fl oz 10.5–14.5 oz 14–20 fl oz 5–5.6 fl oz 4–6.7 fl oz	

## CHERRY LEAF SPOT MANAGEMENT

### Integrated Copper/Sterol Inhibitor/Strobilurin Program

The objective is to reduce selection for resistance to the sterol inhibitor and strobilurin fungicides in the cherry leaf spot pathogen AND to reduce cost of the program.

	MATERIAL	RATES PER ACRE spray on 10- to 14-day interval	COMMENTS
Late petal fall or shuck split stage	Bravo WeatherStik	4 pt	Copper fungicides can cause leaf bronzing and russetting but have negligible effects on photosynthesis and do not noticeably affect yield or fruit quality. Adding lime to COCS (copper oxychloride) is recommended on the label to prevent plant injury.
1st Cover	Copper (e.g., Kocide 2000)	5 lb	
2nd Cover	Gem or Pristine	4 oz 14.5 oz	Trees under drought stress may be more susceptible to premature defoliation from copper injury. Therefore, irrigate copper-treated trees in dry weather.
3rd Cover	Copper (e.g., Kocide 2000)	5 lb	The integrated copper program has been tested on tart cherries only. Cherry leaf spot is generally less severe on sweet cherries. However, the risk of copper injury on sweet cherries is unknown.
4th Cover	Rally 40 WSP	6 oz	
5th Cover (if needed before harvest)	Pristine	10.5 oz	Many different copper fungicides are available at a range of prices but not all are labeled on all stone fruits in all areas. Check labels. We have tested and have had similar results with Kocide (45 DF or 2000 formulations), Cuprofix, and COCS.
Post-harvest	Bravo WeatherStik	4 pt	We have had good results using copper in 1st, 2nd, and 3rd cover sprays. However strobilurin and/or sterol inhibitor fungicides should be used in 4th and 5th pre-harvest covers to prevent brown rot and powdery mildew.
			The long-term effects of copper on soil health are not known. Copper is toxic to aquatic organisms, so take great care if using it near surface water.
			Do not apply copper when temperatures are predicted to exceed 80°F.

# PEACH

## **PEACH DORMANT** After leaves drop in the fall or before buds swell in spring

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Peach leaf curl	Bravo Carbamate 76 WDG Ziram 76 DF Copper hydroxide (Kocide) Copper oxychloride (COCS) Bordeaux mixture Syllit 3.4F	3–4 pt 4.5 lb 3.75–8 lb 8–16 lb 8–16 lb 3 pt	To effectively control peach leaf curl, fungicide must be applied before bud swell. Best control is achieved by applying in late autumn at leaf fall.
Mites	Superior oil		
San Jose scale	Esteem 35 WP Assail 30 SG	4–5 oz 5.3–8 oz	Apply Assail with horticultural oil.

## **PEACH PINK**

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot (blossom blight)	<sup>1</sup> Topsin-M 70 WSB <b>plus</b> <sup>2</sup> Captan 50 WP <b>OR</b> Bravo <sup>3</sup> Rovral 50 WP Wettable sulfur 95% Ziram 76 DF Rally 40 WSP <sup>4</sup> Orbit 41.8 L <sup>4</sup> Indar 75 WSP Inspire Super Pristine 38 WG Elevate 50 WDG Scala 5 SC Vanguard 75 WG Quash 50 WDG Topguard Fontelis Merivon	1.5 lb 4 lb 3.1–4.1 pt 1–2 lb 18 lb 4.5–8 lb 2.5–6 oz 4 fl oz 2 oz 16–20 fl oz 10.5–14.5 oz 1–1.5 lb 9–18 fl oz 5 oz 2.5–3.5 oz 14 fl oz 14–20 fl oz 4–6.7 fl oz	<sup>1</sup> Topsin-M and the sterol-inhibiting fungicides (Rally, Indar, Elite, and Orbit) should always be alternated or combined with another fungicide such as Captan, to minimize the development of resistance. Topsin-M also is available in a flowable formulation (4.5 FL).  <sup>2</sup> See note on Captan on page 23.  <sup>3</sup> No more than two applications of Rovral may be made per season, and Rovral may not be applied after petal fall on stone fruit.  <sup>4</sup> Apply Orbit and Indar in a minimum of 50 gallons of water per acre. Indar also is available in a 2F (liquid) formulation.
Tarnished plant bug and stink bugs	Belay 2.13 SC Asana XL 0.66 EC Danitol 2.4 EC Pounce 25 WP Warrior 1 CS Proaxis 0.5 EC Baythroid XL Sevin XLR (4L) Carzol 92 SP Actara 25 WDG Mustang Max 0.8 EC Renounce 20 WP Beleaf 50 SG Assail 30 SG Scorpion 35 SL Venom 70 SG	6 fl oz 4.8–14.5 fl oz 10.7–21.3 fl oz 6.4–16 oz 2.5–5.12 fl oz 2.5–5.12 fl oz 2–2.4 fl oz 3 qt 1–1.25 lb 4.5–5.5 oz 1.28–4 fl oz 2.5–3 oz 2–2.8 oz 5.3–8 oz 5.25–7 fl oz 2–4 oz	As pink begins to show, examine trees for tarnished plant bug. If present, apply insecticides. Make application before any blooms open. Use of pyrethroids (Ambush, Asana, Pounce, Warrior, Voliam Xpress, or Proaxis) can cause mite outbreaks because they are persistent and kill mite predators.  Beleaf is not labeled for stink bug control.  Scorpion and Venom for stink bugs; not labeled for plant bug control.

## PEACH PINK CONTINUED

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Oriental fruit moth (monitoring)	Refer to petal fall (below)		Pheromone traps to monitor oriental fruit moth should be in place now to determine the need for sprays at petal fall.
Oriental fruit moth (mating disruption)	Isomate-M 100  CheckMate OFM  CheckMate OFM-F Sprayable pheromone	100–150 dispensers  108–150 dispensers  1.32–2.93 fl oz	Place dispensers in upper third of tree now. Note, pheromone traps in orchards with mating disruption are expected to catch no moths ('trap shutdown'). See page 41.

## PEACH FULL-BLOOM

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot (blossom blight)	Same as for pink (page 32)		
Insects or mites	SAVE THE BEES! Do not apply insecticides during bloom.		

## PEACH PETAL FALL

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot	Same as for pink		Do not apply Rovral after petal fall.
Lesser peachtree borer (monitoring)			If borers have been a problem (gummosis on scaffold branches), set up a pheromone trap now to monitor moth flights to determine timing of borer sprays. See comments on pages 41–43.
Oriental fruit moth, plum curculio, catfacing insects (tarnished plant bug, stink bugs)	Asana, Baythroid, Renounce, Pounce, Actara, Mustang Max, Warrior, Proaxis, Danitol, or Assail as at pink (page 33) <b>or</b> Imidan 70 WP	2.13–4.25 lb	Catfacing is worst where weed control is poorest. Keep weeds mowed regularly. See comments at pink about the use of pyrethroids (page 33).
Oriental fruit moth	Products listed above for three species combined <b>or</b> Entrust 80 WP Entrust 2 SC Intrepid 2 F Altacor 35 WDG Delegate 25 WG Rimon 0.83 EC Belt 4SC	1.25–2.5 oz 4–6 fl oz 10–16 fl oz 3–4.5 oz 6–7 oz 20–40 fl oz 3–4 oz	
Plum curculio	Products listed above for the three species combined <b>or</b> Avaunt 30 WG Belay 2.13 Calypso 4F	5–6 oz 6 fl oz 4–8 fl oz	

## PEACH SHUCK-SPLIT

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot and scab	Topsin-M 70 WSB <b>plus</b> <sup>1</sup> Captan 50 WP <b>OR</b> Bravo Wettable sulfur 95% Ziram 76 DF Pristine 38 WG Inspire Super Quash 50 WDG Topguard Fontelis Merivon	1.5 lb 4 lb 3.1–4.1 pt 18 lb 4.5–8 lb 10.5–14.5 oz 16–20 fl oz 3.5–4 oz 14 fl oz 14–20 fl oz 4–6.7 fl oz	Do not apply Rovral after petal fall.  <sup>1</sup> See note on Captan on page 23.  <sup>2</sup> Gem provides excellent control of peach scab but is weak on brown rot.
Powdery mildew	Rally 40 WSP Pristine 38 WG <sup>2</sup> Gem 25 WG  Quintec 2.08F Quash 50 WDG Topguard Fontelis Merivon	2.5–6 oz 10.5–14.5 oz 4–8 oz  7 fl oz 3.5–4 oz 14 fl oz 14–20 fl oz 4–6.7 fl oz	<sup>3</sup> The use rate for Mycoshield on the label reads, "0.75–1.5 lbs per 50 to 200 gallons of water per acre." The use rate for Flame Out on the label reads, "150 ppm (parts per million), 6 oz per 50 gallons, 12 oz per 100 gallons, 3.75 lbs per 500 gallons of water." See the label for additional information on Mycoshield and Flame Out.  See notes about bacterial spot on page 41.
Bacterial spot	<sup>3</sup> Mycoshield 17 WP Flame Out 17 WP		
Plum curculio, catfacing insects	Same for petal fall (page 34)		
Oriental fruit moth	Same for petal fall (page 34)		
Green peach aphid	Admire Pro 4.6 F Beleaf 50 SG Movento 2 SC Closer 2 SC	1.4–2.8 fl oz 2–2.8 oz 6–9 fl oz 1.5–2.75 fl oz	
European red mite	Acramite 50 WS Apollo 4 SC Nexter 75 WP Savey 50 DF Envidor 2 SC Agri-Mek 0.15 EC Zeal 72 WP Onager 1 EC Portal 0.4	1 lb 2–8 oz 4.4 oz 3–6 oz 16–18 fl oz 10–20 fl oz 2–3 fl oz 12–24 fl oz 2 pints	For Nexter, use low rate for European red mite or high rate for twospotted mite. For Acramite use low rate for twospotted mite or high rate for European red mite. AgriMek is most effective if applied before leaves harden off.

## PEACH FIRST COVER 7 to 10 days after shuck split

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot and scab	Topsin-M 70 WSB <b>plus</b> <sup>1</sup> Captan 50 WP <b>OR</b> Wettable sulfur 95% Ziram 76 DF Pristine 38 WG Inspire Super Quash 50 WDG Topguard Fontelis Merivon	1.5 lb  4 lb  18 lb 4.5–8 lb 10.5–14.5 oz 16–20 fl oz 3.5–4 oz 14 fl oz 14–20 fl oz 4–6.7 fl oz	<sup>1</sup> See note on Captan on page 23.
Powdery mildew	Rally 40 WSP Inspire Super Wettable sulfur 95% Pristine 38 WG <sup>2</sup> Gem 25 WG Quintec 2.08 F Quash 2.08 F Topguard Fontelis Merivon	2.5–6 oz 16–20 fl oz 18 lb 10.5–14.5 oz 4–8 oz 7 fl oz 3.5–4 fl oz 14 fl oz 14–20 fl oz 4–6.7 fl oz	Rally can be applied on a 10- to 14-day interval for powdery mildew control until terminal growth stops.  <sup>2</sup> Gem provides excellent control of peach scab but is weak on brown rot.
Plum curculio, catfacing insects	Same for petal fall (page 34)		
Oriental fruit moth	Same for petal fall (page 34)		
European red mite	Same for shuck-split		
Lesser peachtree borer			Control of the first generation of lesser peachtree borer is during the time of peak moth flight, which is usually in late May or early June (see pages 41–43).

## PEACH SECOND COVER 10 days after first cover

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot and scab	Same for first cover (above)		
Powdery mildew	Same for first cover (above)		
Plum curculio, oriental fruit moth, catfacing Insects	Same for petal fall (page 34)		
Mites	Same for shuck-split (page 35)		

## PEACH THIRD, FOURTH, AND ADDITIONAL COVERS

Apply at 10- to 14-day intervals

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot and scab	Same for first cover (page 36)		Scab requires control until fruit is within 40 days of harvest.
Powdery mildew	Same for first cover (page 36)		
Oriental fruit moth	Same for petal fall (page 34)		
Mites	Same for shuck-split (page 35)		
San Jose scale	Esteem 35 WP Diazinon AG600 WBC  Centaur 70 WDG Movento 2 SC Assail 30 SG Belay 2.13 SC Admire Pro 4.6 F	4–5 oz 12.75 fl oz/ 100 gallons  34.5–46 oz 6–9 oz 5.3–8 oz 3–6 fl oz 1.4–2.8 fl oz	Time application for first activity of crawlers.
Peachtree borer			Peachtree borer is best controlled by a trunk drench at the time of peak moth flight, usually in early August (see pages 41–43).

## PEACH PRE-HARVEST

Apply according to label directions beginning 3 weeks before harvest

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot	Topsin-M 70 WSB <b>plus</b> <sup>1</sup> Captan 50 WP <b>OR</b> Ziram 76 DF Wettable sulfur 95% Orbit 41.8 L Indar 75 WSP Inspire Super Pristine 38 WG Quash 50 WDG Topguard Fontelis Merivon	1.5 lb  4 lb  4.5–8 lb 18 lb 4 fl oz 2 oz 16–20 fl oz 10.5–14.5 oz 3.5–4 oz 14 fl oz 14–20 fl oz 4–6.7 fl oz	Pre-harvest use, restrictions, and limitations are variable according to product; refer to label for details.  <sup>1</sup> See note on Captan on page 23.
Oriental fruit moth, Japanese beetle, and green June beetle	Sevin XLR (4L) Admire Pro 4.6 F Assail 30 SG Calypso 4F	2–3 qt 1.4–2.8 fl oz 5.3–8 oz 4–8 fl oz	Sevin is suggested here because it can be used up to three days before harvest. Oriental fruit moth pheromone traps will indicate the need for control. Provado does not control oriental fruit moth. Calypso is for Japanese beetle only.
Spotted wing drosophila	Baythroid XL 1 EC Renounce 20 WP Danitol 2.4 EC Sevin XLR Plus Entrust 2 SC Entrust 80 WP Malathion 57% EC Pyganic 5 E	1.28–4 fl oz 3–3.5 oz 10.7–21.3 fl oz 2–3 qt 4–8 fl oz 1.25–2.5 oz 2.4 pt 4.5–18 fl oz	

# PLUM

## PLUM DORMANT Before buds break in the spring

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Black knot			Prune out all black knots during the dormant period, making cuts 6 to 8 inches below any knots. Remove these prunings from the orchard and burn or bury them.
European red mite and scale insects	Superior oil	2 gal	This is the rate per 100 gallons.  Apply when temperatures are above 40°F—never during freezing weather.

## PLUM PRE-BLOOM

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot (blossom blight) and black knot	Topsin-M 70 WSB <b>plus</b> <sup>1</sup> Captan 50 WP <b>OR</b> Bravo	1.5 lb  4 lb  3.1–4.1 pt	Topsin-M should always be combined with another fungicide, such as Captan, to minimize the development of resistance.  Topsin-M also is available in a flowable formulation (4.5 FL).
Brown rot (blossom blight)	Topsin-M 70 WSB <b>plus</b> <sup>1</sup> Captan 50 WP <b>OR</b> Bravo <sup>2</sup> Rovral 50 WP Wettable sulfur 95% Orbit 41.8 L Inspire Super Pristine 38 WG Elevate 50 WDG Scala 5 SC Vanguard 75 WG Indar 75 WP Quash 50 WDG Topguard Fontelis Merivon	0.75–1 lb  4 lb  3.1–4.1 pt  1–2 lb 18 lb 4 fl oz 16–20 fl oz 10.5–14.5 oz 1–1.5 lb 9–18 fl oz 5 oz 2 oz 2.5–3.5 oz 14 fl oz 14–20 fl oz 4–6.7 fl oz	<sup>1</sup> See note on Captan on page 23.  <sup>2</sup> No more than two applications of Rovral can be made per season, and Rovral cannot be applied after petal fall on stone fruit.

## PLUM FULL BLOOM

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot (blossom blight) and black knot	Same as pre-bloom (page 38)		
Brown rot (blossom blight)	Same as pre-bloom (page 38)		
Insects or mites	SAVE THE BEES! Do not apply insecticides during bloom.		

## PLUM PETAL FALL

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot (blossom blight) and black knot	Same as for pre-bloom (page 38)		
Brown rot (blossom blight)	Same as for pre-bloom (page 38)		
Plum curculio and oriental fruit moth	Imidan 70 WP Asana XL Danitol 2.4 EC Warrior 1CS Baythroid XL Proaxis 0.5 EC Mustang Max 0.8 EC Renounce 20 WP Avaunt 30 WDG Assail 30 SG Calypso 4F	2.13–4.25 lb 4.8–14.5 fl oz 10.7–21.3 fl oz 2.5–5.1 fl oz 2–2.8 fl oz 2.5–5.1 fl oz 1.28–4 fl oz 2.5–3.5 oz 5–6 oz 5.3–8 oz 4–8 fl oz	Failure to control plum curculio may result in an increase in brown rot. Calypso is for plum curculio only.
Oriental fruit moth	Products listed above for plum curculio <b>or</b> Intrepid 2 F Entrust 80 WP Entrust 2 SC Altacor 35 WDG Delegate 25 WG Rimon 0.83 EC Belt 4 SC	10–16 fl oz 1.25–1.5 oz 4–8 fl oz 3–4.5 fl oz 6–7 oz 20–40 fl oz 3–4 oz	

## PLUM SHUCK-SPLIT

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot and black knot	Same as for pre-bloom (page 38)		Rovral cannot be applied after petal fall.
Brown rot	Topsin-M 70 WSB <b>plus</b> <sup>1</sup> Captan 50 WP <b>OR</b> Wettable sulfur 95% Bravo Pristine 38 WG	1.5 lb 4 lb 18 lb 3.1–4.1 pt 10.5–14.5 fl oz	<sup>1</sup> See note on Captan on page 23.
Plum curculio and oriental fruit moth	Same as for petal fall (above)		
Mites	Acramite 50 WS Nexter 75 W Savey 50 DF Envendor 2 SC Agri-Mek 0.15 EC Onager 1 EC Zeal 72 WP Portal 0.4	0.75–1 lb 4.4–5.2 oz 3–6 oz 16–18 fl oz 10–20 fl oz 12–24 oz 2–3 oz 2 pints	Limit one application of Savey per year.

## FIRST PLUM COVER SPRAY 7 to 10 days after shuck-split

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Black knot	Same as for shuck-split (page 39)		Bravo cannot be applied after shuck-split.
Brown rot	Same as for pre-bloom except Bravo and Rovral (page 38) <b>or</b> same as shuck-split (page 39)		Rovral cannot be applied after petal fall.
Plum curculio and oriental fruit moth	Same as for petal fall (page 39)		
Peachtree borers			Refer to section on peachtree borers on pages 41–43.

## SECOND AND ADDITIONAL PLUM COVER SPRAY 2 weeks after first cover spray and 10- to 14-day intervals thereafter

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot	Same as for shuck-split (page 39)		
Plum curculio and oriental fruit moth	Same as for petal fall (page 39)		
Japanese beetle	Sevin XLR (4 L) Admire Pro 4.6 F Warrior 1 CS Assail 30 SG Leverage 2.7 SE Calypso 4F	2–3 qt 1.4–2.8 fl oz 2.5–5.12 fl oz 5.3–8 oz 3.6–4.4 fl oz 4–8 fl oz	

## PLUM PRE-HARVEST SPRAYS Beginning 3 to 4 weeks before harvest

PEST/PROBLEM	MATERIAL	RATE/ACRE	COMMENTS
Brown rot	Topsin-M 70 WSB <b>plus</b> <sup>1</sup> Captan 50 WP <b>OR</b> Orbit 41.8 L Inspire Super Pristine 38 WG Indar 75 WP Topguard Fontelis Merivon	1.5 lb 4 lb 4 fl oz 16–20 fl oz 10.5–14.5 fl oz 2 oz 14 fl oz 14–20 fl oz 4–6.7 fl oz	Pre-harvest use, restrictions, and limitations are variable according to product; refer to label for details.  <sup>1</sup> See note on Captan on page 23.
Spotted wing drosophila	Baythroid XL 1 EC Renounce 20 WP Danitol 2.4 EC Sevin XLR Plus (4 L) Entrust 2 SC Entrust 80 WP Pyganic 5 EC	1.28–4 fl oz 3–3.5 oz 10.7–21.3 fl oz 2–3 qt 4–8 fl oz 1.25–2.5 oz 4.5–18 fl oz	

## Special Problems and Pests of Peach and Other Stone Fruit

### Bacterial Canker of Sweet Cherry

Bacterial canker is a sporadic but serious problem on sweet cherries. It is generally less severe on tart cherries, plums, and prunes. The disease is favored by cold, wet conditions during and shortly after bloom. Copper compounds are moderately effective in reducing populations of the pathogen and controlling the disease. Copper compounds should be applied according to the product label in the spring while trees are dormant. If conditions for the disease persist, then reduced-rate applications (25–35% of dormant rate) should be applied after budbreak but before bloom. Hydrated lime (6–9 lbs/acre) can be added to reduce the phytotoxicity that can occur when copper compounds are applied in cool, wet conditions.

### Bacterial Spot of Peach

Bacterial spot of peach can be a serious problem in certain varieties, areas, and years. The disease is favored by stormy, rainy weather during June and July. It causes the most damage in areas where the soil is sandy and where the sand is blown by strong winds. Planting cultivars that are resistant to bacterial spot provides the best control. Control programs using foliar sprays of zinc sulfate plus lime, or fall applications of copper with or without lime, have been tried in the past. None of these programs offered reliable control and, in some cases, caused foliar and twig damage. An antibiotic, oxytetracycline (Mycoshield or Flame Out) provides good control when properly applied. For best results, oxytetracycline must be used at 12 oz per 100 gallons of dilute spray. Use dilute or 2x; higher concentrates are not effective and may be phytotoxic. Once per week spraying of the entire tree is essential. If only one side of the tree is sprayed (alternate row middle), make certain the other side of the tree is sprayed within 3 to 4 days. Begin sprays at shuck-split and continue at 7-day intervals until 3 weeks before harvest. Copper sprays, applied for peach leaf curl at leaf drop, also may aid in control of bacterial spot.

### Phytophthora Root, Crown, and Collar Rots

Peach rootstocks are highly susceptible to Phytophthora root, crown, and collar rots. The main defense against these diseases is providing good soil drainage through proper site selection and tiling. However, Ridomil Gold EC 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- to 3-month intervals thereafter if soil is 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). Ridomil Gold EC is also registered for use on cherries (sweet and tart), nectarines, plums, and prunes. See label for further information and use rates.

### Phosphorous Acid (phosphonates and phosphites)

Several products containing phosphorous acid have been registered for use in the United States as nutritional supplements and "plant conditioners." Several of these products also are registered for use as fungicides for control of root and collar rot, caused by *Phytophthora* spp., on apple, pear, and stone fruit. Brand names for these products include Agri-Fos, ProPhyt, Phostrol, and Topaz. Several other products also may be available or introduced in the near future. Phosphorous acid is the active ingredient for these products and is essentially the same active ingredient as in the fungicide Aliette, which has been registered for use on tree fruit for many years. These materials are applied as a foliar spray. The active ingredient is highly systemic and moves down the tree from the leaves into the crown and roots. See the label for current use recommendations.

### Mating Disruption for Peach Pests

Several mating disruption products are registered for control of oriental fruit moth, lesser peachtree borer, and peachtree borer. They dispense species-specific sex attractants that are designed to prevent male moths from locating and mating with females. This strategy is most likely to succeed in blocks of at least 5 acres where initial populations of these pests are low. If mating disruption is used in smaller blocks or where infestations are greater, border sprays or additional sprays may be necessary. Mating disruption will not manage other insect pests that are normally controlled by cover sprays (plum curculio, green June beetle, and plant bugs). Mating disruption has been effective against oriental fruit moth. Although Isomate-LPTB is labeled for both lesser peachtree borer and peachtree borer, efficacy for borer control is still unknown.

### Borers of Peach, Cherry, and Plum Trees

The peachtree borer, lesser peachtree borer, and shot-hole borer often infest peach, apricot, cherry and plum trees. Peachtree borers infest the trunk at the soil line, while lesser peachtree borers infest scaffold limbs and the upper trunk. The peachtree borer is primarily a pest of young trees, whereas the lesser peachtree borer is a pest of older trees. The shothole borer is often found in trees of low vigor with dead and/or diseased limbs. Moths of the two peachtree borers lay their eggs on the surface of the bark; shothole beetles lay their eggs in the inner bark. Some of the regularly applied cover sprays aid in controlling borers; however, specific trunk and scaffold branch sprays are often required. Pheromone traps are available to monitor emergence of the adult (moth) stage of lesser peachtree borer and peachtree borer. Knowledge of the time of initial moth emergence and peak emergence can aid in proper timing of insecticide applications because insecticides target the hatching eggs laid by the newly emerged moths. See "Insecticides Used to Manage Borers of Peach, Cherry, and Plum Trees" on page 43.

## **Periodical Cicadas—See note on page 21.**

### **Brown Marmorated Stink Bug**

A new invasive species of stink bug, the brown marmorated stink bug, is spreading across the Midwest from the east. Where this species has become established, it occurs in greater number and causes greater damage to fruit crops than other stink bug species. Of the insecticides listed on page 33–34 for the control of plant bugs and stink bugs in peaches, Actara, Baythroid, and Belay have been effective against this species in early trials in the eastern United States. Lannate and Malathion also are among the more effective insecticides against this insect and labeled for use on peaches. For information on the identification of this insect, see [http://www.ncipmc.org/alerts/stinkbug\\_alert.pdf](http://www.ncipmc.org/alerts/stinkbug_alert.pdf). If you suspect this insect is present in your orchard, contact your state extension specialist in entomology.

### **Spotted Wing Drosophila**

Spotted wing drosophila is an invasive species of fruit fly or vinegar fly, and unlike other *Drosophila* species, it may infest ripening fruit before it is picked or beginning to ferment. Of the insecticides registered for use near harvest in cherries and peaches, Malathion, Baythroid, Renounce, Danitol, and Sevin are effective against this insect. For organic growers, Entrust or Pyganic are the best choices for control. The same insecticides, except for malathion, also are labeled for use on plums. For information on the identification of this insect, see <http://www.ncipmc.org/alerts/drosophila.pdf>. If you suspect this insect is present in your orchard, contact your state extension specialist in entomology.

### **RainGard, Cherry Cracking Suppressant**

RainGard is applied as a protective coating to decrease rain water uptake by the fruit to reduce cracking susceptibility. The first application is made 4 weeks before anticipated harvest and additional applications are made at 7-10 day intervals. Three weekly applications are much more effective in reducing rain cracking than a single application. Use 102 ounces of RainGard per 100 gal. per acre. Ground sprayer speed should not exceed 2 miles per hour. All fruit must be covered with RainGard for maximum crack prevention.

## Insecticides Used to Manage Borers of PEACH, CHERRY, and PLUM Trees

BORER	MATERIAL	RATE/ACRE	COMMENTS
Lesser peachtree borer	<sup>1</sup> Lorsban Advanced 4 EC Asana XL 0.66 EC Pounce 25 WP <sup>2</sup> Lorsban 50 W Warrior 1 CS Baythroid XL 1 EC <sup>3</sup> Isomate-PTB Dual Renounce 20 WP	1.5–4 pt 4.8–14.5 fl oz 6.4–25.6 oz 2–3 lb 2.5–5.1 fl oz 1.4–2 fl oz 150–250 dispensers 1.8–2.5 oz	The pheromone trap for lesser peachtree borer should be in place by peach petal fall (usually mid- to late April), in time to detect the first of the two generations of this pest.  Lorsban 50W for sour cherries only.  Lorsban is not labeled for use on plums. Use only Pounce, Ambush, Endosulfan, or Warrior on plums.  Where lesser peachtree borer has been a light to moderate problem, apply insecticide once at the peak of the second moth flight (often mid-August, usually post-harvest). Where lesser peachtree borer has been a moderate to heavy problem, make two applications: one 7 to 14 days after emergence of first-generation moths begins (spray mid-May to early June), and the second at the peak of the second-generation moth flight (often mid-August).
Peachtree borer	<sup>1</sup> Lorsban Advanced 4 EC <sup>2</sup> Lorsban 50 W Asana XL 0.66 EC Warrior 1 CS <sup>3</sup> Isomate-P Isomate-PTB Dual	1.5–4 pt 2.66–3.33 pt 4.8–14.5 fl oz 2.5–5.1 fl oz 100–250 dispensers 150–250 dispensers	The pheromone trap for peachtree borer should be in place by early June to detect the first emergence of the single generation of this pest where peachtree borer has been a light to moderate problem, make a single spray at the time of peak moth emergence (usually in late July or early August). Where peachtree borer has been a moderate to heavy problem, make two applications, one 7 to 14 days after moth emergence begins and another 6 to 8 weeks later.
Peachtree borer, preplant dip	Lorsban 75 WG Lorsban Advanced 4 E	2–4 lb 3 qt	Dip trees several inches above the graft and plant immediately or allow to dry before returning to storage. Do not allow trees to remain in the dip solution.
Shothole borer	Insecticide sprays are not effective.		Maintain tree health and vigor, prune dead and dying limbs, and remove dead trees to prevent beetle problems.

<sup>1</sup>Lorsban 4 EC: Apply as trunk spray; do not contact fruit. On peach or nectarine, do not make more than one application per season, nor within 14 days of harvest; on cherry, make two pre-harvest applications (the last one at least 6 days before harvest) and one post-harvest application.

<sup>2</sup>Lorsban 50 W is labeled for borer control on sour cherry but not on sweet cherry, peach, or nectarine.

<sup>3</sup>See Mating Disruption, page 41.

## Pre-harvest Intervals and Restricted Entry Intervals (REI)\* for Common Fungicides

TRADE NAMES	COMMON NAMES	FRAC CODE**	Pre-harvest Interval—Days					REI* (hours)
			APPLE	PEAR	PEACH	CHERRY	PLUM	
Aliette	fosetyl-AL	33	14***	14***	—	—	—	12
Agri-Fos, Phostrol, ProPhyt, Topaz	phosphorous acid	33	0	0	0	0	0	4
Agri-strep	streptomycin	25	50	30	—	—	—	12
Bayleton	triadimefon	3	0	0	—	—	—	12
Bravo	chlorothalonil	M	—	—	***	***	***	48
Cabrio	pyraclostrobin	11	0	—	—	—	—	12
Captan	captan	M	0	—	0	0	0	****
Captevate	captan + fenhexamid	M+17	—	—	—	0	—	24
Carbamate	ferbam	M	7	7	21	0	—	24
Dithane M-45	mancozeb	M	77***	77***	—	—	—	24
Elevate	fenhexamid	17	—	—	0	0	0	12
Flint	trifloxystrobin	11	14***	14***	—	—	—	12
Fontelis	penthiopyrad	7	28	28	0	0	0	12
Gem	trifloxystrobin	11	—	—	1	1	1	12
Indar	fenbuconazole	3	14***	—	0	0	0	12
Inspire Super	difenoconazole + cyprodinil	3+9	14**	14***	2***	2***	2***	12
Luna Sensation	fluopyram plus trifloxystrobin	7+11	14	—	—	1	—	12
Luna Tranquility	fluopyram plus pyrimethanil	7+9	72	—	—	—	—	12
Manzate	mancozeb	M	77***	77***	—	—	—	24
Merivon	fluxapyroxad plus pyraclostrobin	7+11	0	0	0	0	0	12
Mycoshield, Flameout	oxytetracycline	—	—	60	21	—	—	***
Orbit	propiconazole	3	—	—	0***	0***	0***	24
Penncozeb	mancozeb	M	77***	77***	—	—	—	24
Polyram	metiram	M	77***	—	—	—	—	24
Pristine	pyraclostrobin + boscalid	11+7	0***	0***	0***	0***	0***	12
Procure	triflumizole	3	14	14	—	1	—	12
Quash	metconazole	3	—	—	14	14	14	12
Quintec	quinoxyfen	13	—	—	7***	7***	7***	12
Rally	myclobutanil	3	14	—	7***	7***	—	24
Ridomil	mefenoxam	4	***	—	0	0	0	12
Rovral	iprodione	2	—	—	***	***	***	24
Vintage	fenarimol	3	30	30	—	0	—	12
Scala	pyrimethanil	9	72	72	2***	—	2***	12
Sovran	kresoxim-methyl	11	30***	30***	—	—	—	12
Sulfur		M	0	0	0	0	0	24
Syllit	dodine	M	7***	7***	15***	0	—	48
Topguard	flutriafol	3	14***	—	7***	7***	7***	12
Topsin-M	thiophanate-methyl	1	0	1***	1	1	1	12
Vangard	cyprodinil	9	0	0	2	2	2	12
Ziram	ziram	M	14	14	14	14	—	48

— Not registered or recommended.

\* All fungicides have a REI, which is the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REI; restrictions in REI may prohibit the use of certain pesticides during harvest.

\*\* FRAC Code represents the Mode of Action of the fungicide. For fungicide resistance management, do not tank mix or alternate fungicides with the same FRAC number in the spray program. M = multi-site inhibitors

\*\*\* Limited number of applications allowed or other restrictions apply—REFER TO LABEL DIRECTIONS.

\*\*\*\* The REI for most formulations of Captan is 24 hr; however, some product labels still have a 4-day REI. See note on Captan REI for tree fruit on page 2.

### Note on Fungicide Resistance Management

For fungicide resistance management, avoid successive applications of fungicides within the same group or with the same types of chemistry. **Strobilurin fungicides include:** azoxystrobin (Abound), trifloxystrobin (Flint or Gem), kresoxim-methyl (Sovran), and pyraclostrobin (Pristine). **Sterol-inhibiting fungicides include:** triadimefon (Bayleton), tebuconazole (Elite), fenbuconazole (Indar), difenoconazole (Inspire Super), myclobutanil (Rally), propiconazole (Orbit), and fenarimol (Vintage). **Benzimidazole fungicide:** thiophanate-methyl (Topsin-M).

The following fungicides are also at risk for resistance development: mefenoxam (Ridomil Gold), iprodione (Rovral), cyprodinil (Vangard), and pyrimethanil (Scala).

The following fungicides are broad spectrum protectants and are not considered at risk for fungicide resistance development: captan (Captan), copper, mancozeb (Dithane, Manzate, Penncozeb), chlorothalonil (Bravo), metiram (Polyram), ziram (Ziram), and sulfur.

## Efficacy of Selected Fungicides Against Apple Diseases

FUNGICIDE	SCAB	POWDERY MILDEW	RUST	BLACK ROT WHITE ROT	BITTER ROT	SOOTY BLOTH AND FLYSPECK
Bayleton*	P	E	E	O	O	O
Cabrio	E	E	-	-	-	-
Captan	G	O	O	G	E	F-G
Flint	E	G	G	G	E	E
Fontelis	E	E	G	?	?	?
Indar	E	E	E	O	O	G
Inspire Super	E	E	E	-	-	G
Luna Sensation	E	E	G	G	G	G
Luna Tranquility	E	E	G	-	-	-
Mancozeb (Dithane, Manzate, Penncozeb)	G	O	G	G	E	E
Merivon	E	E	F-G	G	G	G
Polyram	G	O	G	G	E	E
Pristine	E	E	E	G	G	E
Procure*	E	E	E	O	O	O
Rally*	E	E	E	O	O	O
Vintage*	E	E	E	O	O	O
Scala	G	-	-	-	-	-
Sovran	E	G	E	G	G	E
Sulfur	F	G	O	F	-	P
Syllit*	E	O	P	P	O	P
Topguard	E	E	E	-	-	-
Topsin-M*	E	E	O	G	P	E
Vanguard	G	-	-	-	-	-
Ziram	F	O	G	P	E	F-G

- Unknown or doesn't apply O = none P = poor F = fair G = good E = excellent

\* Many areas of the Midwest may contain strains of the apple scab and powdery mildew fungi tolerant of these chemicals. Therefore, these fungicides may not be effective in some areas.

## Efficacy of Selected Fungicides Against Stone Fruit Diseases

FUNGICIDE	BROWN ROT BLOSSOM BLIGHT	BROWN ROT FRUIT ROT	PEACH LEAF CURL	PEACH SCAB	POWDERY MILDEW	CHERRY LEAF SPOT	BLACK KNOT OF PLUM
Adament	E	E	-	E	E	E	-
Bravo	G	-	E	G	O	E	E
Captan	G	F-G	-	G	O	G	G
Captevate	E	E	-	-	-	G	G
Elevate	E	E	-	-	-	-	-
Fixed copper	-	-	G	-	F	G	P
Fontelis	E	E	-	F-G	G	F-G	-
Gem	-	-	-	E	G	E	-
Indar*	E	E	-	-	G	E**	-
Topguard	E	E	-	-	G	G	-
Luna Sensation	E	E	-	-	G	F-G	-
Merivon	E	E	-	F-G	G	F-G	-
Orbit*	E	E	-	G	G	G**	-
Pristine	G	G	-	G	E	E	-
Procure*	G	G	-	-	E	G**	-
Rally*	E	-	-	-	E	E**	-
Rovral	E	E	-	P	-	F	-
Rubigan (Vintage)*	-	-	-	-	G	E**	-
Quash	G	G	-	G	-	-	-
Quintec	O	O	O	O	G	O	O
Scala	G	G	-	-	-	-	-
Sulfur	F	P	-	G	G	P	O
Syllit*	-	P	G	-	O	G	-
Topsin-M*	E	E	-	G	F	G	F
Inspire Super	E	E	-	G	E	-	-
Vanguard	G	G	-	-	-	-	-
Ziram	P-F	P-F	G	G	-	F	-

- Unknown or doesn't apply; O = none; P = poor; F = fair; G = good; E = excellent

\* Many areas of the Midwest may contain strains of the brown rot, powdery mildew, and cherry leaf spot fungi tolerant of these chemicals. Therefore, these fungicides may not be effective in some areas.

\*\* Excellent where the leaf spot pathogen is not resistant but only fair where sterol-inhibiting fungicides have been used extensively.

# Pre-Harvest Intervals and Restricted-Entry Intervals (REI) for Insecticides and Miticides

(see list of generics on page 49)

TRADE NAME	COMMON NAME	Pre-Harvest Interval—Days							
		Apple	Pear	Peach	Cherry	Plum	REI* Hours	IRAC	
Acramite	bifenazate	7	7	3	3	3	12	UN	
Actara	thiamethoxam	14/35	14/35	14	14	14	12	4A	
Admire (foliar)	imidacloprid	7	7	7	7	7	12	4A	
Admire (soil)	imidacloprid	21	21	21	21	21	12	4A	
Agri-flex (RUP)	abamectin+thiamethoxam	35	35	—	—	—	12	6+4A	
Agri-Mek (RUP)	abamectin	28	28	—	—	21	12	6	
Altacor	chlorantraniliprole	5	5	10	10	10	4	28	
Apollo	clofentezine	45	21	21	21	—	12	10A	
Asana (RUP)	esfenvalerate	21*	28*	14*	14*	14*	12	3	
Assail	acetamiprid	7	7	7	7	7	12	4A	
Avaunt	indoxacarb	14	28	14	14	14	12	22	
Azinphosmethyl (RUP)	azinphosmethyl	14–21	14–21	—	15	—	14–15 days	1B	
Baythroid XL (RUP)	beta-cyfluthrin	7	7	7	7	7	12	3	
Belay	clothianidin	7	7	21 (Belay)	—	—	12	4A	
Beleaf 50 SG	flonicamid	21	21	14	14	14	12	9C	
Belt	flubendiamide	14	14	7	7	7	12	28	
Brigade (RUP)	bifenthrin	—	14	—	—	—	12	3	
Calypso	thiacloprid	30	30	14	14	14	12	4A	
Carzol	formetanate hydrochloride	*	UPF*	UPF*	—	—	5 days	1A	
Centaur	buprofezin	14	14	14	14	14	12	16	
Closer	sulfoxaflor	7	7	7	7	7	12	4C	
Cobalt (RUP)	chlorpyrifos+gamma-cyhalothrin	UPF	—	14*	21*	—	4 days	1B+3	
Cobalt Advanced (RUP)	chlorpyrifos+lambda-cyhalothrin	28	—	14*	21*	—	4 days	1B+3	
Confirm	tebufenozide	14	14	—	—	—	4	18	
Cyd-X (OMRI)	coddling moth granulovirus	0	0	—	—	—	4	—	
Danitol (RUP)	fenpropathrin	14	14	3	3	3	24	3	
Delegate	spinetoram	7	7	14	7	7	4	5	
Delta Gold (RUP)	deltamethrin	21	21	—	—	—	12	3	
Dimethoate	dimethoate	—	28	—	—	—	48	1B	
Dimilin* (RUP)	diflubenzuron	—	14	UPF	UPF	UPF	12	15	
Diazinon (RUP)	diazinon	21	21	21	21	21	4 days	1B	
Dicofol	dicofol	7	7	—	—	—	35 days	—	
Dipel (OMRI)	<i>Bacillus thuringiensis</i>	0	0	0	0	0	4–12	11B2	
Endigo (RUP)	lambda-cyhalothrin+thiamethoxam	35	35	14	14	14	24	3A+4A	
Endosulfan, Thionex	endosulfan	21	—	—	—	—	24	2A	
Entrust (OMRI)	spinosad	7	7	14	7	7	4	5	
Envendor	spiroticlofen	7	7	7	7	7	12	23	
Esteem	pyriproxyfen	45	45	14	14	14	12	7C	
Gladiator (RUP)	zeta-cypermethrin+avermectin B1	28	28	21	21	21	12	3+6	
Imidan	phosmet	7	7	14	7	7	72	1B	
Intrepid	methoxyfenozide	14	14	7	7	7	4	18	
Kanemite	acequinocyl	14	14	—	—	—	12	20B	
Lannate (RUP)	methomyl	14	7	4	—	—	*	1A	
Leverage (RUP)	imidacloprid+cyfluthrin	7	7	7	7	7	12	4A+3	
Lorsban (RUP, EC only)	chlorpyrifos	UPF*	*	14*	21	—	4 days	1B	
Malathion	malathion	—	—	7	3	—	12–24	1B	
Movento	spirotetramat	7	7	7	7	7	24	23	
M-Pede (OMRI)	potassium salts of fatty acids	0	0	0	0	0	12	—	
Portal	fenpyroximate	14	14	7	7	7	12	21	

RUP = Restricted-use pesticide

— not registered or recommended

OMRI = Organic Materials Review Institute—approved for use in organic production

UPF = until petal fall

\* Specific pre-harvest intervals or restricted entry intervals vary for different formulation, application rates, crops, or geographical location. See product labels for details.

## Pre-Harvest Intervals and Restricted-Entry Intervals (REI) for Insecticides and Miticides continued

TRADE NAME	COMMON NAME	Pre-Harvest Interval—Days							IRAC
		Apple	Pear	Peach	Cherry	Plum	REI* Hours		
MSR Spray Conc. (RUP)	oxydemetonmethyl	*	30	*	*	*	48*	1B	
Mustang Max (RUP)	zeta-cypermethrin	14	14	14	14	14	12	3	
Neemix (OMRI)	azadirachtin	0	0	0	0	0	12	UN	
Nexter	pyridaben	25	7	7	300	7	12	21A	
Pounce (RUP)	permethrin	*	*	14*	3*	—	12	3	
Proaxis (RUP)	gamma cyhalothrin	21	21	14	14	14	24	3	
Proclaim (RUP)	emamectin benzoate	14	14	—	—	—	12	6	
Provado	imidacloprid	7	7	0	7	7	12	4A	
Renounce (RUP)	cyfluthrin	7	7	7	7	7	12	3	
Rimon	novaluron	14	—	8	—	8	12	15	
Saf-T-Side	horticultural oil	0	0	0	0	0	12	—	
Savvy, Onager	hexythiazox	28	28	28	28	28	12	10A	
Sevin	carbaryl	3	3	3	3	3	12	1A	
SpinTor	spinosad	7	7	14	7	7	4	5	
Sunspray	horticultural oil	0	0	0	0	0	12	—	
Superior oil (some OMRI)	horticultural oil	*	*	*	*	*	12	—	
Supracide (RUP)	methidathion	*	*	*	*	*	72	1B	
Surround (OMRI)	kaolin	0	0	0	0	0	4	—	
Vendex (RUP)	fenbutatin-oxide	14	14	14	14	14	48	12B	
Venom, Scorpion	dinotefuran	—	—	3/21	—	—	12	4	
Voliam Flexi	thiamethoxam+chlorantraniliprole	35	35	14	14	14	12	28+4A	
Voliam Xpress (RUP)	lambda-cyhalothrin+chlorantraniliprole	21	21	14	14	14	24	28+3	
Vydate (RUP)	oxamyl	14	14	—	—	—	48	1A	
Warrior (RUP)	lambda-cyhalothrin	21	21	14	14	14	24	3	
Zeal	etoxazole	14	14	7	7	7	12	10B	

RUP = Restricted-use pesticide

— not registered or recommended

OMRI = Organic Materials Review Institute—approved for use in organic production

UPF = until petal fall

\* Specific pre-harvest intervals or restricted entry intervals vary for different formulation, application rates, crops, or geographical location.  
See product labels for details.

## Pre-harvest Intervals and Restricted-Entry Intervals (REI) for Growth Regulators

TRADE NAME	COMMON NAME	Pre-Harvest Interval—Days							REI* Hours
		Apple	Pear	Peach	Sweet Cherry	Tart Cherry	Plum		
Apogee	Prohexadione-calcium	45			*				12
Amid Thin-W	NAD	21 DAFB*	7 DAPF*						48
Ethrel/Motivate	ethephon	7			7	7			48
Fruitone N	NAA	2	2						48
K-Salt Fruit Fix 200	NAA	7	5						24
K-Salt Fruit Fix 800	NAA	7	5						24
MaxCel	6-benzladenine	86	86						12
Pro-Gib	gibberellic acid (GA3)				Fruit is straw colored	14–28 DAFB	4–5 weeks before harvest		12
Pro-vide	GA4+7								4
Promalin	6BA+GA4+7		**		**				4
ReTain	AVG	7	7	7			7		12
Sucker-Stopper RTU (lawn/garden use)	NAD		DS & SP	DS & SP					
Tree-Hold Sprout Inhibitor A-112	NAA		DS & SP	DS & SP					12

DAFB = Days after full bloom

DAPF = Days after petal fall

DS = Dormant season

SP = During summer pruning when shoots are 6–12 inches in height

\*Registered in the Midwest only in IN and OH

\*\*Non-bearing trees only

## Pre-harvest Intervals and Restricted-Entry Intervals (REI) for Herbicides

	TRADE NAME	COMMON NAME	HRAC CODE	RISK OF RESISTANCE	SIGNAL WORD	PRE-HARVEST INTERVAL
<b>PREEMERGENCE</b>						
apple, pear, cherry	Casoron 4G	dichlobenil	L	Medium	Caution	
apple, pear, peach, nectarine, plum, cherry	Alion Chateau 51 WDG Goal 2 XL <b>restricted use</b> Karmex 80 DF Kerb 50 WP Princep 4L Solicam 80 DF Surflan 4AS	indaziflam flumioxazin oxyfluorfen diuron pronamide simazine norflurazon oryzalin	L E E C2 K1 C1 F1 K1	Low Medium Medium Medium Low Medium Medium Low	Caution Caution Warning Caution Caution Caution Caution Caution	14 d 60 d 14 d
apple, peach	Sinbar 80WP	terbacil	C1	Medium	Caution	60 d
peach, plum	Treflan HFP 4EC	trifluralin	K1	Low	Caution	
non-bearing	Gallery 75DF Prowl 3.3EC Showcase 2.5TG Snapshot 2.5TG XL 2G	isoxaben pendimethalin triflualin + isoxaben + oxyfluorfen triflralin +isoxaben benefin + oryzalin	L K1 E,K1,L L,K1 K1	Medium Low Medium Medium Low	Caution Caution Caution Caution Caution	1 yr 1 yr

<b>POSTEMERGENCE</b>						
apple, pear, peach, nectarine, plum, cherry	Aim 2EC Amine4 Fusilade DX 2 EC <b>restricted use</b> Goal 2XL Gramoxone Karmex 80DF Poast 1.5EC Recoil 3.2E Roundup 5.5L Scythe 4.2E	cargentrazon 2,4-D amine fluazifop-P oxyfluorfen paraquat diuron sethoxydim 2, 4-D + glyphosate glyphosate pelargonic acid	E O A E D C2 A G,O G —	Medium Low High Medium Medium Medium High Low Low —	Caution Danger Caution Warning Poison Caution Warning Danger Caution Warning	3 d 14 d 1 yr 14 d 40 d 1–17 d <sup>1</sup>
apple	Rely 1L Sandeia 75DF	glufosinate halosulfuron	H B	Low Medium	Warning Caution	14 d 14 d
apple, pear	Treevix	saflufenacil	E	Low	Caution	0 d
peach, plum, nectarine, cherry	Stinger 3EC Weedaxe 1.8E	clopyralid 2, 4-D amine	O O	Low Low	Caution Warning	30 d 40 d
non-bearing	Basagran 4L MSMA6 Plus Reglone 2L Select 2 EC	bentazon MSMA diquat clethodim	C3 Z D A	Medium Low Medium High	Caution Caution Warning Warning	1 yr 1 yr

<sup>1</sup>PHI 1 day for apples and pears; 17 days for stone fruit

## Generic Insecticides

COMMON NAME	ORIGINAL BRAND NAME AND CURRENT MANUFACTURER	OTHER BRAND NAMES AND MANUFACTURER
abamectin	Agri-Mek 0.15 EC (Syngenta)	Abba 0.15 EC (Makhteshim) Epi-Mek 0.15 EC (Syngenta) Reaper 0.15 EC (UAP) Temprano 0.15 EC (Chemtura) Zoro (Cheminova)
acephate	Orthene 90 SP (Valent)	Bracket 90 (Agrilience) Bracket 90 WSP (Agrilience)
<i>Bacillus thuringiensis</i>	Dipel (Advan)	Agree (Advan) Biobit (Valent) CoStar (Advan) CryMax (Advan) Deliver (Advan) Jackpot WP (Advan) Javelin (Advan) Lepinox (Advan) Xentari (Valent)
bifenthrin	Brigade 2 EC (FMC) Capture 2 EC (FMC)	Bifenture 2 EC (United Phosphorous) Discipline 2 EC (Amvac) Fanfare 2 EC (Makhteshim) Sniper 2 EC (UAP/Loveland) Tailgunner Tundra 2 EC (Agrilience)
carbaryl	Sevin XLR 4L (Bayer) Sevin 80 S (Bayer)	Carbaryl 4L (UAP/Loveland; Drexel) Carbaryl 80S (Drexel)
chlorpyrifos	Lorsban 4 E (Dow)	Chlorpyrifos 4 E (Makhteshim) Govern 4 E (TENKOZ) Hatchet (Dow AgroSciences) Nufos 4 E (Cheminova) Pilot 4 E (Gharda) Vulcan Warhawk 4 E (UAP/Loveland) Whirlwind 4 E (Helena) Yuma 4 E (Agrilience)
cyfluthrin	Baythroid (Bayer)	Tombstone 2 E (UAP)
dimethoate	Cyon 4EC (no longer made)	Dimate 4 EC (Agrilience) Dimethoate 400, 4EC (UAP/Loveland, Helena, Drexel, MicroFlo, Cheminova)
endosulfan	Thiodan 3 EC (no longer made)	Thionex 3EC (Makhteshim) Endosulfan 3EC (Drexel)
endosulfan	Thiodan 50 WP (no longer made)	Thionex 50 W (Makhteshim)
esfenvalerate	Asana XL 0.66 EC (Dupont)	Adjourn 0.66 EC (Makhteshim)
gamma cyhalothrin	Proaxis (UAP/Loveland)	Proaxis 0.5 EC (Tenkoz)
imidacloprid	Admire 2 F Admire Pro Provado 1.6 F (Bayer) Provado 75 WSB	Advise 2 F (Agrilience) Alias 2 F (Makhteshim) Pasada 1.6 F (Makhteshim) Couraze 1.6 F, 75 WP, 2 F (Cheminova) Imida E-AG, 1.6 F, 2 F (Etigra) Macho 2 FL (Albaugh) Malice 75 WSP (UAP/Loveland) Montana 2 F (Rotam North America) Nuprid 1.6 F, 2 F (Nufarm) Prey 1.6 F (UAP/Loveland) Torrent 2 F (Sipcam Argo) Widow 2 F (UAP)
kaolin	Surround (NovaSource)	Snow Plus (WilburEllis)
lambda-cyhalothrin	Warrior 1 EC (Syngenta)	Lambda-Cy 1 EC (United Phosphorus) Lambda T 1 EC (Helena) Silencer 1 EC (Makhteshim) Taiga Z 1 CS (Agrilience)
permethrin	Pounce 3.2 EC (FMC)	Arctic 3.2 EC (Agrilience) Permethrin 3.2 EC (UAP/Loveland, Helena, MicroFlo) Perm-Up 3.2 EC (United Phosphorus) Perm Star AG (LG Int'l)
pyriproxyfen	Esteem, Knack	Pitch
zeta-cypermethrin	Mustang (FMC)	Respect 0.8 EC (BASF)

## Orchard Vole Control

Mice, known as voles, can cause serious damage to fruit plantings. Frequently, damage occurs but is not noticed until trees become weak, die, or are removed. Damage can be anticipated each year, particularly from late summer to early spring, as mice eat bark from the base of small saplings. Such damage can result in girdling death of the tree. Apple trees are most susceptible, but hungry voles will attack other fruit trees. Apple trees on dwarfing root stocks are particularly palatable to these mice.

Many plantings are made in a hedgerow pattern, which does not permit cultivation between trees. Such plantings favor vole migration, as do mulches and vigorous sods. High populations also favor vole migrations. No single material or technique is effective for complete control of voles. It is, therefore, suggested that both the materials and the methods of control vary during the season.

### General Orchard Management Practices

Several general orchard management practices can be employed to reduce risk of injury and improve effectiveness of control.

Tree guards can be constructed from "hardware cloth" or similar materials with mesh no larger than 0.25 inch. These guards should enclose the tree and extend from several inches below soil surface (voles dig in the top 2 to 3 inches of soil) to several inches above maximum snow line (about 18 inches). Pea-sized gravel or cinders, when placed around the trees, 4 to 6 inches wide and deep, also tend to discourage meadow voles from attacking crowns of trees but do not discourage other mouse species. To proliferate, voles need abundant amounts of cover. Thus, maintaining a clean area 1- to 2-feet wide around the base of trees discourages surface feeding. This also will regulate vole populations in the long term. Chemical weed control in early spring significantly reduces the amount of labor involved in keeping the area around the tree clean.

The orchard cover or sod should be mowed short in late August and again after harvest to reduce runway cover and aid baiting. Cleaning out drainage ditches and fence rows and picking up or crushing all dropped fruit discourages large vole populations.

### Orchard Vole Control Program

#### Essential Knowledge

Determine species of voles (with snap traps). Three species may be found: meadow vole (*Microtus pennsylvanicus*), prairie vole (*Microtus ochrogaster*), and pine vole (*Pitymys pinetorum*). Materials for control may be the same, but control methods differ. Quick field identifications for both juveniles and adults are based on the length of the tail.

**Pine vole:** tail length about same as the hind foot.

**Meadow and prairie vole:** tail length about twice that of the hind foot.

Determine timing and site of infestations (with snap traps). Knowing when and where mice are most abundant makes control easier.

#### Control

Control of voles in orchards can be accomplished using either zinc phosphide or chlorophacinone baits. Both baits must be used according to label directions.

Zinc phosphide is an acute bait that causes the death of mice within 24 hours. It is available as either a weather-resistant pellet bait or mixed with prepared grains, such as oats and corn. Zinc phosphide is usually well accepted by mice. However, it is not effective if applied more than twice.

Chlorophacinone (e.g., RoZol™), an anticoagulant bait, is available as a weather-resistant, pellet-style bait. This bait is highly accepted by rodents, but death is delayed for several days. For effective control, a second application of chlorophacinone is needed within 20 to 40 days.

Baits can be attractive to other wildlife, including birds and domestic pets. Bait must be applied directly in runways or bait stations (see below), or broadcast. Pick up all spilled materials to avoid consumption by non-target animals.

#### Efficacy of Baits Against Meadow and Pine Voles

Chlorophacinone is more effective against pine voles than meadow voles, while zinc phosphide is more effective against meadow voles than pine voles. Consistent use of one of these chemicals will result in shifts of vole population from one species to another. Therefore, alternate baiting using zinc phosphide in the first application, followed by chlorophacinone in the second application, to reduce populations of both species.

#### Techniques for Baiting

1. Machine baiting: Expose bait in artificial trail (Trail Builder).
2. Trail baiting: Expose bait in natural, active runways only.
3. Broadcast baiting: (NOT RECOMMENDED FOR PINE VOLE CONTROL). Broadcast bait by hand, cyclone type seeder, or tractor drawn equipment at recommended rates. When using zinc phosphide baits, the 2% concentration is recommended.

OBSERVE SAFETY PRECAUTIONS. Zinc phosphide is a restricted use material. Read and follow all label directions and precautions.

Percentage Comparison of Control Methods		
Method	Meadow or Prairie Voles	Pine Voles
Machine	90–95%	80–85%
Trail	80–85%	70–75%
Broadcast	78%	Not Recommended

### Timing

Apply on a sunny day in late fall when voles are active. Voles begin to build up in early August, but baiting should be delayed as late as possible in the fall. The most effective period for application is just before snow cover after the grass cover has been reduced by frost and the fruit is rotted. Spot treatment during the winter and into early spring is recommended. Treat marginal lands to prevent re-invasion.

### Pre-Harvest Baiting Is Not Recommended

Application of poisoned bait before harvest to prevent vole damage to fruit in cold storage is not a sound practice for the following reasons:

1. The recommended methods of orchard vole control do not always result in 100 percent control. Therefore, some voles survive the pre-harvest control and enter into boxes of fruit on the ground that will be carried into cold storage.
2. The pre-harvest poison application will reduce the population of voles in the orchard; competition among survivors will be greatly reduced; and food and cover will be ample. Under these favorable conditions, survivors breed, and there might be eight young per litter. In a very short time, populations may recover to original levels, and will not be exposed to poisoned baits applied during the normal control season.
3. The recommended control season for voles in orchard and winter storage facilities is just prior to freezing conditions. Note: Check your control program with snap traps. Lack of visible damage does not indicate the efficacy of your program.

### Control in Storage

1. Before Harvest
  - a) Poison rats and mice in storage one month before picking; keep storage area baited and free of debris.
  - b) Clean up outside debris, especially near loading area, one week before picking.
  - c) Rodent-proof storage; seal all holes and cracks. Mice can fit through a hole the size of a dime.
2. During Harvest
  - a) Move filled boxes into storage quickly; any box left overnight may have mice.
  - b) As you load fruit into storage, bait the storage area. Place teaspoonful amounts in bait stations, on floor, along alleys, between rows of boxes, and under pallets. Do not place open baits on floors or any areas where contamination might occur. Commercial bait stations are available from agricultural supply companies. Always prevent contact with fruit.

### Bait Stations in the Orchard

Bait stations can be prepared in several ways, and eliminate or reduce the opportunity for non-target animals to contact the bait. Squares of heavy roofing shingles or other weather-resistant materials, placed out of traffic areas between trees, can serve as bait stations to protect the bait and hiding of rodents. Some growers have constructed bait stations that require less refilling by building inverted T-shaped stations from PVC tubing and fittings that provide bait storage and a protected feeding area. Place bait stations in the field 2 to 3 weeks before adding the bait.

## Suggestions for Growth Regulators

### Ethepron on Apples

Ethepron, which is available as a 21.3% formulation of 2-chloroethylphosphonic acid (ETHREL, CEPHA, or MOTIVATE), may (a) promote early color development and maturity, (b) loosen fruit for easier harvesting by hand or machine, and (c) increase fruit bud formation and early bearing on young trees.

### Promotion of Early Color Development and Maturity

To obtain increased red coloration and early maturity, apply 14 to 21 days prior to anticipated harvest at a concentration of 150 to 300 ppm (0.5 to 1 pt. per 100 gal water). For concentrate sprays, use 2.5 pints per acre in 50 to 100 gallons of water. Use lower dosage ranges for late maturing varieties. Red color development should be apparent in about 7 days. Ethepron is most effective under weather conditions that favor color development.

Do NOT apply ethephon during hot weather or when hot weather is forecasted for the next 14 days. Apply ethephon between 60°F and 90°F. Most red apple varieties do not develop red color during hot weather either with or without ethephon. Ethepron speeds up ripening. Do not use ethephon on Golden Delicious.

**Add a fruit drop inhibitor to control pre-harvest drop of the fruit.** NAA (naphthaleneacetic acid) may be added to the same spray as ethephon. NAA is effective for 7 to 10 days, and a second application might be necessary if harvest is delayed.

**Precautions.** No spreader-sticker is necessary. Ethepron will not overcome poor management practices. Trees of moderate vigor, well-pruned and thoroughly sprayed, respond most favorably with well-colored fruit of uniform maturity. For dense trees, harvest outer fruit first and then apply ethephon. Harvest at proper maturity; do not delay harvest to obtain additional red coloration. Treat only the acreage that can be harvested and marketed on a timely basis. Fruit treated with ethephon should be marketed promptly and may have short shelf life.

### For Early Bearing on Young Trees

To increase fruit bud development on young, non-bearing trees, apply a foliar spray of ethephon 1 to 2 weeks after full bloom, using a dosage of 1,000 ppm (3.33 pt per 100 gal of water). For spur-type trees, the rate should be reduced to 500 ppm (1.66 pt per 100 gal of water). *Caution:* Do not use this treatment on trees that have started to bear fruit because the application may de-fruit trees completely.

### Stop-Drop Sprays

If used properly, stop-drop sprays can significantly reduce pre-harvest apple drop. Use knowledge of orchard conditions when applying stop-drop sprays, and keep notes on the responses in your orchard.

Concentration and Timing of Stop-Drop Application		
Variety	Application Time Before Picking	NAA Concentration
Red Delicious	7–10 days	10–15 ppm
Jonathan	7–10 days	10 ppm
Golden Delicious	7 days	10 ppm
Rome Beauty	7 days	10 ppm
Winesap	7 days	15 ppm

**Naphthaleneacetic Acid or NAA** (Fruitone N, Amid-Thin W, K-salt Fruit Fix 800, K-salt Fruit Fix 200, and PoMaxa) should be applied before the beginning of fruit drop (7 to 14 days before harvest) at the rate of 5 ppm for summer varieties and 10 ppm for late varieties. It should normally prevent fruit drop for 7 to 10 days. A second application of NAA should be made within 7 to 10 days of the first application if fruits were not harvested. Do not use more than 2 NAA applications. Do not apply within 2 days of harvest. NAA works best as a dilute spray.

Using NAA too early, or in greater than recommended concentrations, may accelerate fruit maturity and decrease storage life. Apply stop-drop sprays at concentrations no higher than 3x. Stop-drop sprays may be applied with pesticides. Do not use stop-drop sprays on trees in low states of vigor; healthy leaves are essential for these sprays to be effective.

### ReTain

ReTain is labeled on apple, pear, peach, nectarine, plum, prune, and apricot. The active ingredient in ReTain, aminoethoxy-vinylglycine (AVG), is a natural inhibitor of ethylene synthesis. Ethylene gas is normally produced by ripening fruit and promotes further ripening and pre-harvest drop in some varieties. After treatment with ReTain, fruit produce less ethylene, which slows the ripening process and reduces pre-harvest drop. Growers who have large plantings of a variety may consider applying ReTain to some of the planting as a harvest management tool to allow a later harvest of treated trees.

**Timing.** Best results are obtained when ReTain is applied before the first visible signs of ripening. Research has shown that ReTain should be applied 4 weeks prior to the optimum harvest date on apples and 1–2 weeks prior to the anticipated beginning of the normal harvest period for untreated fruit for other fruit types. The PHI is 7 days.

**Application rate and number.** ReTain should be applied as a single application; multiple applications have no additional benefit. The label rate is one pouch (0.73 lb) per acre, but rates as low as 0.44 lb per acre also can be effective in optimal application conditions. The higher rate helps fruit retain their firmness during storage.

ReTain should be diluted in at least 100 gal of water per acre. Best results are obtained when applied under slow drying conditions. Thorough wetting and coverage are essential for optimum effectiveness. Although ReTain seems to be compatible with other materials, it should be applied alone.

**Additives.** The inclusion of a silicone-based spreader sticker (e.g., Stylwet L-77) is absolutely critical for good results.

**Comments.** ReTain is expensive; therefore, it should be used only on high value, productive blocks with good fruit quality. Treated fruit should be stored separately.

### **Apogee**

Apogee is mainly used on trees that are overly vigorous due to crop loss, inappropriate rootstock, or tree spacing. Apogee can decrease the length of shoots by 30 to 60 percent. Reduced shoot growth, following Apogee treatment, can reduce susceptibility to fire blight. See pages 20–21 for more details.

### **Sprout and Sucker Control on Apple and Pear**

Tre-Hold Sprout Inhibitor A112 can be used to inhibit sprouting when applied to pruning cuts on scaffold limbs and trunk bases and to rootstock suckers on bearing and non-bearing trees.

To make 1 gallon of spray mixture, add 10 fl oz of Tre-Hold to 1 gal of water. For sunscald protection, 1 to 4 pt of interior white latex paint may be substituted for an equal volume of water. One gallon of dilute spray will treat 50 to 100 trees.

Tre-Hold RTU Sprout Inhibitor, a ready to use formulation (1.15% Ethyl, 1-NAA), also is available to control sprouts and sucker growth on apples and pears. Follow manufacturer's label for use. The herbicide Rely may be used to control suckers on apple. Follow manufacturer recommendations and precautions.

**Pro-Gibb on Cherries** The active ingredient in Pro-Gibb is a natural plant hormone, gibberellin A<sub>3</sub>. It can be used to maintain and extend high fruiting capacity of bearing tart cherry trees and to reduce occurrence of "blind" nodes by stimulating lateral vegetative buds and a more productive balance of lateral shoots and spurs. Apply 4 to 8 fl oz of Pro-Gibb 4% in 100 gal finished spray, from 14 to 28 days after bloom, in 50 to 150 gal per acre. Do not spray within one month of harvest.

To reduce flowering and fruiting in young tart and sweet cherry trees, and to minimize the competitive effect of early fruiting on tree development, apply 20 to 40 oz of Pro-Gibb 4% in 100 gal of water, 2 to 4 weeks after bloom. Under low vigor, two applications are recommended with at least a 7-day interval between sprays. Since Pro-Gibb acts on buds that will flower the following growing year, responses will not begin to be visible until the year after application. Do not spray trees during the year of planting.

### **ProVide 10 SG on Apples**

**Russetting** Applications of ProVide, a mixture of gibberellins A<sub>4</sub> and A<sub>7</sub>, reduces, but does not eliminate, russetting on 'Golden Delicious'. ProVide should be applied 2 to 4 times, beginning at petal fall and continuing at 7- to 10-day intervals. The rate is 60 to

100 grams applied in 100 gal of solution per acre (15–25 ppm). Do not use surfactants with ProVide because of the potential of some surfactants to cause russetting. Under conditions of high humidity and rain, best russet control will be obtained with four 100 gram per acre applications. Do not use excessive spray volumes since excess moisture can induce russet. Direct 85 percent of the spray volume to the upper two-thirds of the tree.

**Stayman Cracking** ProVide 10 SG applications should start 2 to 3 weeks before cracking begins, normally by mid-June to mid-July. Apply 3 to 4 consecutive sprays at 14- to 21-day intervals at an application rate of 100 to 200 grams of ProVide per 100 gal per acre, per application. Because cracking is influenced by weather changes and because it can occur over extended periods, multiple applications have given the best response. Apply in early morning or late evening under slow drying conditions to maximize absorption.

### **Promalin on Apples**

Promalin contains 1.8% 6BA N-(phenylethyl)-1H-purine-6-amine and 1.8% gibberellins A<sub>4</sub> and A<sub>7</sub>. A single application to 'Delicious' from early king bloom to the early stages of petal fall of the side blossoms elongates the fruit and encourages development of more prominent calyx lobes. The rate of application is 1 to 2 pt in 75 to 200 gal of spray mixture per acre. If the bloom period is prolonged, two applications provide better results. The first application of 0.5 to 1 pt of Promalin per acre is made at the beginning of the bloom period as above. The second application of 0.5 to 1 pt of Promalin per acre is made 3 to 21 days later when the remainder of the canopy comes into bloom. Do not exceed 2 pt per acre for the combined sprays. Do not apply Promalin when air temperatures are lower than 40°F or higher than 90°F.

### **Promalin for Branching**

Promalin may be applied as a single application alone or in a Promalin-latex paint spot application to apples, non-bearing pears, and non-bearing sweet cherries. This treatment increases lateral bud break and shoot growth and improves branch angles to produce a stronger, better shaped tree for early production. Non-bearing pear and sweet cherry applications must be made one year before harvest.

Foliar Promalin applications on bearing and nursery apples and non-bearing pears can be made at 1–3 inches of new terminal growth. The applications rate is 125–500 ppm (0.25–1 pt Promalin per 5 gal of spray solution). On apple, non-bearing pears, and non-bearing sweet cherries, trees may be treated when they have reached a terminal height at which lateral branching is desired. For this treatment Promalin is applied at 250–1,000 ppm (0.5–2 pt) Promalin per 5 gal of spray solution.

Promalin-latex paint applications must be made before bud break or new shoot tips may be injured causing shoot growth failure. It should be applied uniformly to cover the bark surface with a brush or sponge only on one-year-old wood. The application rate is 5,000–7,500 ppm (0.2–0.33 pt or 3.2–5.3 fl oz) Promalin per pt of latex paint.

## Chemical Thinning of Apples

Chemical sprays can reduce fruit set on apples and thus promote larger fruit size at harvest and increase return bloom. These have become standard practices in most commercial orchards. Proper usage is vital to the success of chemical thinning.

NAA (naphthalene acetic acid), NAD (naphthalene acetamide), Sevin (1-naphthyl-N-methylcarbamate), and MaxCel (6-benzyladenine) are suggested. Apply NAA to fall and winter varieties when king fruit are 11–13 mm in diameter. For fruit larger than 13 mm, Sevin is more effective than NAA. Sevin gives uniform results from petal fall to 21 days later. NAD is most effective when applied from late bloom to petal fall. NAD is milder than NAA and is less likely to cause over-thinning.

The combination of NAA plus Sevin should be applied on fall and winter varieties when king fruit are 11–13 mm in diameter, and on summer varieties (Wealthy and Earliblaze) at petal fall.

Use of NAA on early summer varieties may result in excessive foliage injury, fruit cracking and premature ripening.

In the warmer parts of the Midwest, concentrations of NAA that successfully thin frequently cause pygmy

apples on spur-type Red Delicious. These small seedless apples persist through harvest and are a nuisance. Sevin is preferred for thinning spur-type Red Delicious. In some experiments, Sevin has over-thinned Rome and Gallia Beauty and should not be used on these varieties.

NAA is not successful in thinning Fuji, as this often results in pygmy apples. Honeycrisp is easy to overthin and combinations should not be used.

Variability of results and excessive foliage injury, often experienced with NAA, may be avoided by using it at one-third and one-half of the rates recommended on the label in combination with 0.75 pt of "Tween 20" per 100 gal. The addition of the "Tween 20" increases the rate of foliar absorption and decreases the effects of seasonal factors, such as temperature, relative humidity, and wind, on the drying rate and amount of material entering the leaf. The elimination of foliage wilting and tree "shock" results in better fruit size at harvest than the same amount of fruit thinning obtained by the full dosage of NAA alone.

Wetting agents that have been used successfully in tests in Illinois and Indiana include Regulaid and Nu Film 17.

### RECOMMENDED CHEMICAL THINNERS FOR APPLE<sup>1</sup>

CULTIVARS	NAD <sup>2,3,4</sup> (PPM)	NAD <sup>2,4</sup> (PPM)	NAA <sup>2</sup> + WA <sup>5</sup> (PPM)	SEVIN XLR PLUS <sup>2,6,7</sup> (qts/100 gal)	MAXCEL <sup>2,8</sup>	COMBINATIONS <sup>2,3,7,8</sup> (PPM + qt/100 gal)
<b>Summer Varieties</b>	35–50				E	NAA 5–10 + Sevin ½–1
Paulared		5–10	3–5	½–1	M	
Gala		5–10	3–5	½–1	M	
Jonamac		5–10	3–5	½–1	M	
McIntosh	35–50	7½–12	3–5	¼–½	E	
Jonathan	35–50	7½–12	3–5	¼–½	E	
Spartan		10–15	5–7½	½–1	?	
Cortland	35–50	7½–12	3–5	¼	E	
Grimes Golden	35–50	5–10	5–7½		?	NAD 25–50 + Sevin ½–1
Red Delicious/non-spur		5–10	3–5	½–1	E	
Red Delicious/spur		10–5	5–7½	½–1	M	
Honeycrisp		3–5		¼–½	?	N.R.
Empire		10–15	5–7½	½–1	E	
Golden Delicious		10–20	5–10	½–1	M	NAA 5–10 + Sevin ½–1
Blushing Golden				¼–½	?	
Firmgold				¼–½	?	
Idared				½–1	E	
Winesap	35–50	7½–10	3–5	½–1	E	
Stayman & Turley	35–50	7½–10	3–5	½–1	M	
Braeburn		7½	7½			NAA 7½ + Sevin 1
Rome	50–60	15–20	7½–10	N.R. <sup>9</sup>	E	
Fuji <sup>8</sup>		N.R. <sup>9</sup>			H	MaxCel 200 ppm + Sevin 1

<sup>1</sup> See *Apple Thinning Guide* by P. Schwallier, Great Lakes Publishing (616) 887-9008 and the Pennsylvania Tree Fruit Production Guide at <http://agsci.psu.edu/tfp/g/part1>.

<sup>2</sup> Lower concentrations suggested when conditions are favorable for thinning.

<sup>3</sup> Applications of NAD (Amid-Thin) should be made from late bloom to petal fall.

<sup>4</sup> Applications of NAA or Sevin or the combination should be made to fall and winter varieties when king fruits are 11–13 mm in diameter. On summer varieties, such as Wealthy and Earliblaze, the combination should be applied at petal fall.

<sup>5</sup> WA = Wetting Agent: Tween 20, Regulaid, or Amway Wetting Agent at 0.75 to 1 pt per 100 gal.

<sup>6</sup> The addition of NAA at 2.5 to 4 ppm to Sevin stimulates the initiation of fruit buds for return bloom. This low NAA rate should not thin fruit or cause pygmy apples on Red Delicious.

<sup>7</sup> The Sevin XLR Plus formulation is most commonly used for thinning and is the only formulation labeled for early use (petal fall to 6 mm diameter). Consult the label if other Sevin formulations are used.

<sup>8</sup> Variety ease of thinning with MaxCel: E = Easy; M = Moderate; H = Hard. See MaxCel Recommendation Tables (page 55) for suggested rates of Maxcel and Sevin for thinning.

<sup>9</sup> N.R. = not recommended

### **MaxCel, Exilis Plus, RiteWay for Thinning**

Apply 75 to 200 ppm in spray volumes of a minimum of 100 gal per acre. Use sufficient volume to ensure complete coverage. In most cases, 100 gal per acre are adequate. Apply when the average king fruitlets are 5 to 15 mm in diameter. Only two applications are allowed per season. Do not exceed 308 fl oz (182 grams 6-BA) of MaxCel or RiteWay, or 296 fl oz of Exilis Plus per acre per season for all uses or apply within 86 days of harvest. Do not add surfactant to tank.

Applications are most effective when the maximum temperature is above 65°F on the day of application and the following 2 to 3 days. Generally, only one application is sufficient.

Do not tank-mix these materials with products containing NAA and use on varieties especially Red Delicious and Fuji that are susceptible to producing pigmy fruit when treated with NAA.

### **Important Reminders about Chemical Thinning**

NAA generally gives best results under fast drying conditions and when the temperature is between 70° and 75°F. Amid-Thin gives the best results under slow drying conditions and is often applied in the evening.

Thorough spraying and uniform coverage are necessary for satisfactory results. However, if you want to reduce the degree of thinning or are afraid of over-thinning, reduce the concentration but not amount per tree. Lower limbs are easier to thin. Reduce spray application on lower limbs by shutting off one or more nozzles; some spray applied to the tree tops will fall on lower limbs.

Concentrate sprays of chemical thinners have been satisfactory. Calibration allows the right amount of material to reach all parts of the tree and row. Avoid

double applications to row ends, etc. Miscalibration of the sprayer manifold is magnified in concentrate application. Concentrating more than 4x has resulted in variable results and should be avoided.

Applying chemical thinning sprays after frost or freezing temperatures is risky. Foliage exposed to such conditions absorbs chemicals more readily, and over-thinning may result. If you must spray under such conditions, reduce the concentration 25 to 30 percent.

Chemical thinners are generally more effective under the following conditions: (1) low vigor trees, (2) light pruning, (3) heavy bloom, (4) poor pollination, (5) high humidity before spraying, (6) slow drying of spray, (7) poor air drainage, and (8) cloudy, cool weather preceding or following the bloom period.

Keep records of the prevailing conditions when you make applications, and leave several trees unsprayed to evaluate the results of thinning. This allows you to work out the concentrations best suited for your orchard.

### **Defruiting Young Apple Trees**

It is often desirable to remove all the fruit from young trees when they have not reached a profitable bearing size. NAA at 15 ppm + Sevin XLR at 1 qt/100 gal applied at petal fall will effectively defruit Jonathan, Red Delicious, and McIntosh. For other cultivars, use NAA at the recommended rate + Sevin XLR at 1 qt/100 gal. These sprays may not completely defruit the trees, but higher rates of NAA may cause leaf damage.

### **NAA Formulations**

Not all NAA formulations have the same amount of active ingredients. Because calculating ppm can be difficult, the table below describes materials and amounts of formulation per 100 gallons of water required to make a 10 ppm solution (table developed by R. Marini, VPI).

### **MaxCel for Apples and Pears**

<b>Use</b>	For fruit thinning, sizing, and enhanced return bloom
<b>Application</b>	Apply 75 to 200 ppm spray concentration. Refer to dilution table on label for assistance.
<b>Spray Volume</b>	Use sufficient volume to ensure complete tree coverage.
<b>Spray Timing</b>	Apply when average king fruit diameter is between 5 and 15 mm. 10 mm is optimal. Do not apply more than twice in a season.

### **MaxCel for Thinning Apples Only**

<b>Thinning Difficulty</b>	<b>Aggressive</b>	<b>Moderate</b>	<b>Slight</b>
Hard to thin	100–150 ppm + Sevin + oil	100 ppm + Sevin	100 ppm
Moderate to thin	100 ppm + Sevin	75–100 ppm + Sevin	75 ppm
Easy to thin	75–100 ppm + Sevin	75 ppm	50–75 ppm

<sup>1</sup>See recommended Chemical Thinners for Apples table (page 54) for variety thinning difficulty rating.

### **NAA Formulations for Chemical Thinning of Apples**

<b>Trade Name</b>	<b>Chemical</b>	<b>Formulation</b>	<b>Acid equivalent (% of active ingredient)</b>	<b>Amount of formulation per 100 gallons to make 10 ppm</b>
Amid-Thin W	1-Naphthaleneacetamide	WP	8.4	1.6 oz
Fruitone N	1-Naphthaleneacetic acid, sodium salt (3.5%)	WP	3.1	4.0 oz
PoMaxa	1-Naphthaleneacetic acid, sodium salt (3.5%)	liquid	3.1	4.0 fl oz
K-salt Fruit Fix 800	1-Naphthaleneacetic acid, potassium salt (24.2%)	liquid	20.2	0.63 fl oz
K-salt Fruit Fix 200	1-Naphthaleneacetic acid, potassium salt (6.25%)	liquid	5.18	2.47 fl oz

## Chemical Weed Control

Controlling weeds is increasingly important as the number of trees per acre increases, particularly in hedge rows. Herbicides can provide good weed control with little labor and frequency at a low cost. Herbicides, when used properly, improve plant or tree growth and control insects, diseases, and mice.

### Proper Application

To be effective, herbicides must be properly selected for the weeds they are to control. They must be applied at the proper time, at the proper rate, and with the proper equipment. The degree of weed control depends largely on the skill of the operator.

In most cases, the herbicide rates given are for overall coverage (broadcast rates). For band treatment, common in tree fruit plantings, reduce the amounts according to the portion of area treated. For example, if a grower wants to control weeds in a 4-foot-wide band beneath a crop planted in rows 10 feet apart, the rate of herbicide needed per acre of crop will be 4/10 of the broadcast rate per acre.

Herbicides can injure fruit trees if used improperly. Therefore sprayer adjustment and calibration should be as precise as possible to ensure accurate and uniform applications. Use a nozzle appropriate for herbicide application at low pressures (15 to 25 pounds) on a fixed-boom type applicator, unless the label has a specific recommendation. This type of sprayer is easily calibrated and, when designed properly, will deposit herbicide uniformly over the row. Consider using one of the recently introduced low-drift nozzles such as Turbo TeeJet Nozzle or TurboDrop Nozzle. They have been designed to provide similar performance to traditional flat fan nozzles while reducing the number of very small droplets that are highly subject to drift. Do not attempt to apply pre-emergence herbicides around fruit plants with hand guns or weed and back-pack sprayers.

Calibrate the sprayer carefully and apply herbicides according to the suggested rates. Note that when applying many herbicides to the soil, rates should be adjusted according to soil characteristics. Generally, lower rates should be used on sandy soil with low organic matter and higher rates on heavier-textured soil and those high in organic matter.

With some herbicides, no rate changes are suggested. If you are unsure about a herbicide's effectiveness or possible crop damage, test it on a small portion of the planting before using extensively. Continued use of the same herbicide can lead to resistance development in weeds or establishment of tolerant weeds. When possible, rotate herbicides to avoid these problems and improve weed control.

### Tank Mixes

Certain herbicides can be tank mixed with other herbicides to increase the spectrum of weed species controlled. Consult herbicide labels for specific information.

### Use Restrictions

Herbicide use is controlled by federal regulations that prescribe crops upon which herbicides can be used, as well as the timing and rates of application. Use only registered materials at the recommended rates. Product labels are the final authority. Follow them carefully.

Herbicide labels are often complicated. Always refer to the specific label for detailed directions, precautions, and restrictions.

### Good Rules to Remember

1. Use a fixed spray boom, uniform speed, flat fan nozzles, and low pressure for even applications without drift.
2. Follow restrictions for herbicide use on young trees. Allow trees to become well established and soils well-settled before applying.
3. Follow rate suggestions based upon soil type.
4. Use herbicide sprayers for herbicides only.
5. Clean sprayers thoroughly when changing herbicides, especially when 2,4-D has been used.
6. Store herbicides as carefully as you would any other pesticide.
7. Dispose of excess spray material carefully; avoid damage to shrubbery, lawns, etc.
8. Do not graze treated areas.
9. **READ THE LABEL. UNDERSTAND IT THOROUGHLY. FOLLOW DIRECTIONS.**

### Herbicide Resistance Management

Avoid using the same product, or chemically related products, for several consecutive years to avoid a buildup of herbicide-resistant weed biotypes. Rotate herbicides and include non-chemical controls whenever possible to reduce dependence and avoid weed resistance.

## Herbicide Recommendations for Apple and Pear

WEED PROBLEM	MATERIAL & RATE	NOTES AND COMMENTS
<b>PREEMERGENCE</b>		
Annual grasses and broadleaves	Alion (Indaziflam 1.67 lb ai/gal) at 5.0–6.5 fl oz in minimum of 10 gal of water	Trees must be established at least 3 years after transplanting. Avoid direct or indirect spray contact with crop foliage, green bark, roots, or fruit as it may cause localized crop injury and death. Allow at least 30 days between applications. Do not apply more than 10.3 fl oz per acre in a 12-month period. Do not apply to frozen ground. Do not apply within 25 feet of ponds, rivers, streams, or wetlands. Spot spraying is not recommended. Shake container well before use. PHI = 14 days
Annual and perennial grasses and broadleaves	Casoron 4G (granular)(dichlobenil 4% ai) at 100–150 lb	<b>Perennial Weeds:</b> Apply from Nov. 15 to Feb. 15 as a soil surface application at 150 lb. No need to remove old weed growth before application. Also may be incorporated in late fall or early spring before May 1 and incorporated immediately. <b>Annual Weeds:</b> Apply in early spring after cultivation before weeds emerge. Rain or irrigation is needed for activation. A shallow incorporation is recommended. Apply 4 weeks after transplanting when soil has completely settled.
Annual and perennial grasses and broadleaves	Casoron CS (dichlobenil 1.4 lb ai/gal) at 1.4 to 2.8 gal in 7–100 gal of water	Apply from late fall to early spring prior to weed emergence or when weeds are less than 2 inches tall. Apply when temperatures are below 70°F. Do not use on light sandy soils or until 1 year after transplanting. Do not use in nurseries.
Annual broadleaves and suppression of grasses	Chateau WDG (flumioxazin 51% ai) at 6–12 oz in 15–75 gal of water	Do not apply to trees established less than 1 year unless protected from spray contact by non-porous wraps. Do not apply after bud break on apples unless using a hooded or shielded sprayer. Do not apply to fine textured soils. Do not make more than 2 applications in a growing season or a sequential application within 30 days of the first application. Do not apply when plants are under stress. All applications to pears or within 100 meters of pears must be made when they are dormant and 2 months before spring bud break. Do not incorporate. Do not allow drift to contact foliage or green bark. Maximum rate is 24 oz per season. Minimum 30 days between applications. PHI = 60 days.
Annual broadleaves and suppression of grasses	Goal 2XL (oxyfluorfen 2 lb ai/gal) at 2–8 pt in minimum of 40 gal of water	<b>Dormant Application Only:</b> Effective both preemergence (5–8 pt) and postemergence (2–8 pt) as directed spray on weeds larger than 4 inches. Do not apply from bud swell until harvest completion. Can be mixed with other preemergence herbicides or with Roundup or Gramoxone. Maximum rate is 8 pt per year.
Annual grasses and broadleaves	Karmex 80 DF (diuron 80% ai) at 4 lb in 25–40 gal of water	Effective both preemergence and postemergence (min. 70°F with high humidity). Apply under trees established at least 1 year. Do not treat trees grafted on full-dwarf rootstocks. Maximum 1 application per year. <b>Apple only:</b> May be tank mixed with Sinbar (1.5–2 lb each) in orchards established at least 2 years. Karmex/Sinbar can be applied in the spring before weeds emerge or after harvest in the fall.
Annual and perennial grasses and certain broadleaves	Kerb 50 WP (pronamide 50% ai) at 3–6 lb on light soils to 4–8 lb on heavy soils in 40–50 gal of water	Apply as a directed spray in the fall after harvest prior to soil freeze-up or early winter when temperatures are below 55°F. Rainfall or irrigation is required to activate. Maximum 1 application per year and 8 lb per acre per year. Kerb has early postemergence activity also. <b>Restricted use pesticide.</b>

## Herbicide Recommendations for Apple and Pear continued

WEED PROBLEM	MATERIAL & RATE	NOTES AND COMMENTS
<b>PREEMERGENCE</b>		
Annual grasses and broadleaves	Matrix FNV (rimsulfuron 25% ai) at 4 oz in minimum of 10 gal of water	Apply only to crops that have been established for one full growing season and are in good health and vigor. Weeds are controlled for 60 to 90 days after application. Matrix will burn down small actively growing weeds less than 1 inch in height. When weeds are present at application, a labeled burndown herbicide, such as glyphosate, paraquat, or glufosinate, with an appropriate adjuvant will improve control. Avoid direct or indirect contact with crop foliage or fruit, except undesirable suckers. Do not use Matrix FNV in a spray solution with a pH below 4.0 or above 8.0. Best results are obtained when the soil is moist at the time of application and ½ inch of rainfall or sprinkler irrigation occurs within 2 weeks of application. PHI = 7 days.
Annual grasses and broadleaves	Princep 4L (simazine 4 lb ai/gal) at 2–4 qt in minimum of 40 gal of water	Apply under trees established at least 1 year. Apply in spring before weeds emerge avoiding contact with fruit, foliage, or stems.
Broadleaves	Sandea (halosulfuron-methyl 75% ai) ½–1 oz in minimum of 15 gal of water	<b>Apple only:</b> Apply a single or sequential application based on weed pressure. Apply to bare ground for best results. If small weeds are present, mix with a postemergence broad spectrum herbicide.
Annual grasses and broadleaves	Sinbar 80 WP (terbacil 80% ai) at 2–4 lb in minimum of 20 gal of water	<b>Apple only:</b> Apply either in the spring before weeds emerge or during early stages of seedling growth or after harvest in the fall. Trees must be established at least 3 years. Do not contact foliage or fruit with spray or mist. PHI = 60 days. <b>Non-bearing: (young, newly planted) Apple and Pear:</b> Apply at 0.5–1 lb. Make the first application after a significant rainfall or irrigation event that will allow the ground to settle around the base of the trees. Make 1 to 2 applications per season. Maximum rate is 1 lb per year. Do not use on soils with <1% OM.
Annual grasses and broadleaves and suppression of yellow nutsedge	Solicam 78 DF (norflurazon 78.6% ai) at 5 lb in minimum of 20 gal of water	Apply a directed spray to settled and firm soil from fall to early spring before weeds emerge. Soil should be settled and firm. Rainfall or irrigation ½ inch is needed within 4 weeks. Do not contact fruit or foliage. Do not apply after bud break on sandy loam soils. Check label for maximum amount allowed per year depending on soil type. <b>Apple:</b> Can be applied immediately after planting. <b>Pear:</b> Minimum 12 months after planting before first application. PHI = 60 days.
Annual grasses and certain broadleaves	Surflan 4 AS (oryzalin 4 lb ai/gal) at 2–6 qt in 20–40 gal of water	Make a single band or broadcast application to the ground beneath trees before weeds emerge. Apply alone to weed-free soil or postemergence mixed with Roundup or Gramoxone. Rainfall or irrigation (½ inch) is required for activation. Minimum 2.5 months between applications. Maximum rate is 12 qt per year.
<b>POSTEMERGENCE</b>		
Annual broadleaves	Aim 2 EC (carfentrazone 2 lb ia/gal) at 2 fl oz in 20 gal of water	Apply any time during the season. Always add nonionic surfactant 0.25% v/v or crop oil 1% v/v. Mix with Roundup or Gramoxone for broader weed control. Maximum 7.9 fl oz per year. Minimum 14 days between applications. PHI = 3 days. <b>Sucker control:</b> Apply when suckers are green. Do not allow spray to contact fruit, foliage, or green bark.

## Herbicide Recommendations for Apple and Pear continued

WEED PROBLEM	MATERIAL & RATE	NOTES AND COMMENTS
<b>POSTEMERGENCE</b>		
Annual and some perennial broadleaves	Amine 4 (2,4-D) or Saber at 3 pt in 5–25 gal of water	Apply as directed spray to annuals 1 to 2 inches high and to perennials up to early bud stage. Do not allow spray to contact leaves, fruit, or limbs of tree. Use coarse spray and low pressure to avoid drift. Non-bearing trees must be established at least 1 year. On bearing trees, do not apply during bloom or after or before irrigation. Do not apply to bare ground. Maximum 2 applications per year and 75 days between applications. PHI = 14 days.
Annual broadleaves and suppression of grasses	Chateau WDG (flumioxazin 51% ai) at 6–12 oz in 15–75 gal of water	Do not apply to trees established less than 1 year unless protected from spray contact by non-porous wraps. Do not apply after bud break on apples unless using a hooded or shielded sprayer. Do not apply to fine textured soils. Do not make more than 2 applications in a growing season or a sequential application within 30 days of the first application. Do not apply when plants are under stress. All applications to pears or within 100 meters of pears must be made when they are dormant and 2 months before spring bud break. Apply alone preemergence or tank mix with Roundup or Gramoxone postemergence with a crop oil 1% v/v or NIS 0.25% v/v. Do not incorporate. Do not allow drift to contact foliage or green bark. Maximum rate is 24 oz per season. Minimum 30 days between applications. PHI = 60 days.
Most annual and perennial grasses	Fusilade DX 2 EC (fluazifop-P 2 lb ai/gal) at 16–24 fl oz in 25 gal of water	<b>Non-bearing only:</b> Apply as a directed spray to actively growing grasses before they exceed recommended growth stages. Always add crop oil 1% v/v or nonionic surfactant 0.25% v/v. Avoid contact with crop foliage. Rainfast in 1 hour. Maximum rate is 72 fl oz per year. Minimum 5 days between applications. PHI = 1 year.
Annual broadleaves	Goal 2XL	See PREEMERGENCE section (page 57) for details.
Most annual grasses and broadleaf weeds and top kill of perennial weeds	Gramoxone Inteon 2L (paraquat 2 lb ai/gal) at 2.5–4 pt in minimum of 10 gal of water	Apply as directed spray to actively growing weeds. Repeat applications are necessary to give sustained control. Apply as a coarse spray. Always add nonionic surfactant 0.25% v/v or crop oil 1% v/v. Do not allow spray to contact leaves, fruit, or green stems. Maximum 5 applications per year. <b>Restricted use pesticide.</b>
Annual grasses and broadleaves	Karmex 80 DF	See PREEMERGENCE section (page 57) for details
Annual and perennial grasses	Poast 1.5 EC (sethoxydim 1.5 lb ai/gal) at 1.5–2.5 pt in 25 gal of water	Apply as a directed spray to actively growing grass before they exceed maximum recommended heights. Always add crop oil 1.25% v/v. Maximum rate is 2.5 pt per application and 7.5 pt per season. PHI = 14 days.
Annual and perennial grasses and broadleaves	Recoil 3.65 E (glyphosate + 2,4-D) at 1–4 qt in 15–100 gal of water	Use on non-bearing (well-established, 1 year or older) and bearing trees before and after bloom. Maximum 2 applications per season. Minimum 75 days between treatments. PHI = 14 days. Apply as a directed and shielded spray with flat-fan nozzles and low pressures (20–25 psi). Avoid contact with fruit, foliage, stems, or lower limbs. Apply when soil is moist and do not irrigate for 5 to 7 days after application.
Annual and perennial grasses and broadleaves	Rely 280 (glufosinate 2.34 lb ai/gal) at 48–82 fl oz in minimum of 20 gal of water	<b>Apple only:</b> Apply as a directed spray to actively growing weeds. Avoid spray drift or mist contact with green bark, stems, or foliage as injury may occur. Only trunks with callused, mature brown bark should be sprayed unless protected by nonporous wraps, grow tubes, or waxed containers. Maximum rate is 164 fl oz of Rely 280 per acre in a 12-month period. Do not make spot or directed spray applications to tree trunks or to apple suckers as tree injury may occur. PHI = 14 days.
Annuals and some perennial grasses and broadleaves	Roundup WeatherMax, Roundup PowerMax 5.5 EC (glyphosate 5.5 lb ai/gal) at 11 fl oz–3.3 qt in 10–40 gal of water	Rate depends on weed species and stage of growth. See label for details. Maximum of 7 qt/acre/year. Apply as preplant broadcast application or in fall for control of roots and rhizomes of perennial weeds or as a directed spray or wiper application (20–100% solution) to actively growing weeds in established plantings. Always add AMS 8.5–17 lb/100 gal in hard water or drought conditions. Do not allow spray to contact any part other than mature bark. Avoid application to suckers and recent pruning wounds. Does not provide residual control; can be mixed with labeled preemergence herbicides. PHI = 1 day.

## Herbicide Recommendations for Apple and Pear continued

WEED PROBLEM	MATERIAL & RATE	NOTES AND COMMENTS
<b>POSTEMERGENCE</b>		
Broadleaves and nutsedge	Sandeza (halosulfuron-methyl 75% ai) ½–1 oz in minimum of 15 gal of water	<b>Apple only:</b> For best results, use a nonionic surfactant with postemergence applications. Avoid spray drift on tree foliage and fruit and do not apply when temperatures exceed 85°F. Do not apply to trees established less than one year or apply more than 2 oz of Sandea per 12-month period. Sandea may not control ALS-resistant weeds. Make a single application using a minimum of 0.75 oz/acre of Sandea when nutsedge is fully emerged at the 3- to 5-leaf stage. A second application may be made later in the season for secondary nutsedge emergence
Annual and perennial broadleaves	Treevix (saflufenacil 0.7 lb ai) at 1 oz in 20 to 40 gal of water	Trees must be established for 12 months prior to Treevix application. May be applied as a single application or up to 3 times per season with a separation of 21 days between sprays. Maximum of 3.0 oz/acre per cropping season. Trunk shields should be used until trees have been established for 2–3 years. For optimum burndown, use with methylated seed oil (MSO), ammonium sulfate (AMS), or urea ammonium nitrate (UAN) adjuvant. Do not use a nonionic surfactant as a substitute for MSO. Only apply when wind is 10 MPH or less and is blowing away from non-target areas. Rainfast in 1 hour. Do not use in tree nurseries. PHI = 0 days.
Annuals and perennial grasses and broadleaves	Scythe 4.2 E (pelargonic acid 4.2 lb ai/gal) at 3–10% spray mix	For contact non-selective control or burndown of a broad spectrum of actively growing weeds. Use low rate for annual weed control and high rates for maximum vegetative burndown. Use as a directed or shielded spray. Can be mixed with Roundup.
Annual and perennial broadleaves	Venue (Pyraflufen ethyl 2% ai) at 0.7 to 4.0 fl oz plus other labeled herbicides in minimum of 10 gal of water	Apply as a directed spray during dormant period and prior to bloom. Avoid contact with foliage and green bark. More effective on weeds less than 4 inches tall and 3 inches in diameter. Use higher rate and spray volume for larger weeds. Do not make more than 3 applications or exceed 6.8 fl oz/acre in one season. Allow a minimum of 30 days between applications. Addition of crop oil concentrate (COC) or nonionic surfactant is recommended. May be mixed with 2, 4-D, glyphosate, or grass herbicides for enhanced control. Spray water pH needs to be less than 7.5. On non-bearing trees the PHI is 12 months.

## Herbicide Recommendations for Peach, Nectarine, Plum, and Cherry

WEED PROBLEM	MATERIAL & RATE	NOTES AND COMMENTS
<b>PREEMERGENCE</b>		
Annual grasses and broadleaves	Alion (Indaziflam 1.67 lb ai/gal) at 5.0–6.5 fl oz in minimum of 10 gal of water	Trees must be established at least 3 years after transplanting. Avoid direct or indirect spray contact with crop foliage, green bark, roots, or fruit as it may cause localized crop injury and death. Allow at least 30 days between applications. Do not apply more than 10.3 fl oz per acre in a 12-month period. Do not apply to frozen ground. Do not apply within 25 feet of ponds, rivers, streams, or wetlands. Spot spraying is not recommended. Shake container well before use. PHI = 14 days
Annual and perennial grasses and broadleaves	Casoron 4G (granular) (dichlobenil 4% ai) at 100–150 lb	<b>Cherry only:</b> For perennial weeds, apply from November 15 to February 15 as a soil surface application at 150 lb. There is no need to remove old weed growth before application. Also can be applied incorporated in late fall or early spring before May 1 and incorporated immediately. For annual weeds, apply in early spring after cultivation before weeds emerge. Rain or irrigation is needed for activation. A shallow incorporation is recommended. Apply 4 weeks after transplanting after soil has completely settled.
Annual and perennial grasses and broadleaves	Casoron CS (dichlobenil 1.4 lb ai/gal) at 1.4 to 2.8 gal in 7–100 gal of water	<b>Cherry only:</b> Apply from late fall to early spring prior to weed emergence, or when weeds are less than 2 inches tall. Apply when temperatures are below 70°F. Do not use on light sandy soils or until 1 year after transplanting. Do not use in nurseries.
Annual broadleaves and suppression of grasses	Chateau WDG (flumioxazin 51% ai) at 6–12 oz in 15–75 gal of water	Do not apply to trees established less than two years unless protected from spray contact by non-porous wraps. Do not apply during the period after flowering through leaf drop, unless shielded application equipment ensures that spray drift will not contact crop foliage. Do not apply to fine-textured soils. Do not make more than 2 applications in a growing season. Do not apply within 100 meters of non-dormant pears. Apply alone preemergence or tank mix with Gramoxone postemergence with a crop oil 1% v/v or NIS 0.25% v/v. Do not incorporate. Do not allow drift to contact foliage or green bark. Maximum rate is 24 oz per season. Minimum 30 days between applications. PHI = 60 days.
Annual broadleaves and suppression of grasses	Goal 2XL (oxyfluorfen 2 lb ai/gal) at 5–8 pt in minimum of 40 gal of water	<b>Dormant application only:</b> Effective both preemergence (5–8 pt) and postemergence (2–8 pt) as a directed spray on weeds larger than 4 inches. Do not apply from bud swell until harvest completion. Can be mixed with other preemergence herbicides or with Roundup or Gramoxone. Maximum rate is 8 pt per year.
Annual grasses and broadleaves	Karmex 80DF diuron (80% ai) at 2–5 lb in 25–40 gal of water	<b>Peach only:</b> Effective both preemergence and postemergence (minimum 70°F with high humidity). Apply under trees established at least 3 years. Maximum 1 application per year. PHI = 3 months. PHI for IL and MO = 20 days. May be tank mixed with Sinbar (2 lb each) in orchards established at least 2 years. Karmex/Sinbar can be applied in the spring before weeds emerge or after harvest in the fall.
Annual and perennial grasses and certain broadleaves	Kerb 50WP (pronamide 50% ai) at 3–6 lb on light soils to 4–8 lb on heavy soils in 40–50 gal of water	Apply as a directed spray in the fall after harvest and prior to solid freeze-up or early winter when temperatures are below 55°F. Rainfall or irrigation is required to activate. Maximum 1 application per year and 8 lb per year. Kerb has early postemergence activity also. <b>Restricted use pesticide.</b>

## Herbicide Recommendations for Peach, Nectarine, Plum, and Cherry continued

WEED PROBLEM	MATERIAL & RATE	NOTES AND COMMENTS
<b>PREEMERGENCE</b>		
Annual grasses and broadleaves	Matrix FNV (rimsulfuron 25% ai) at 4 oz in minimum of 10 gal of water	Apply only to crops that have been established for one full growing season and are in good health and vigor. Weeds are controlled for 60 to 90 days after application. Matrix will burn down small actively growing weeds less than 1 inch in height. When weeds are present at application, a labeled burndown herbicide, such as paraquat, with an appropriate adjuvant will improve control. Avoid direct or indirect contact with crop foliage or fruit, except undesirable suckers. Do not use Matrix FNV in a spray solution with a pH below 4.0 or above 8.0. Best results are obtained when the soil is moist at the time of application and ½ inch of rainfall or sprinkler irrigation occurs within 2 weeks of application. PHI = 14 days.
Annual grasses and broadleaves	Princep 4L (simazine 4 lb ai/gal) at 1.6–4 qt in minimum of 40 gal of water	Apply under trees established at least 1 year. Apply in spring before weeds emerge avoiding contact with fruit, foliage, or stems. <b>Peach only:</b> use only in AR, MO and states east of the Mississippi River. <b>Plum and sweet cherry only:</b> use only in MO and states east of the Mississippi River.
Annual grasses and broadleaves	Sinbar 80WP (terbacil 80% ai) at 2–4 lb in minimum of 20 gal of water	<b>Peach only:</b> Apply either in the spring before weeds emerge or during early stages of seedling growth or after harvest in the fall. Trees must be established at least 3 years. Do not contact foliage or fruit with spray or mist. PHI = 60 days. <b>Non-bearing (young, newly planted) stone fruits:</b> Apply at 0.5–1 lb. Make the first application after a significant rainfall or irrigation event that will allow the ground to settle around the base of the trees. Make 1 or 2 applications per season. Maximum rate is 1 lb per year. Do not use on soils with <1% OM.
Annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (noraflurazon 78.6% ai) at 3.75–5 lb in minimum of 20 gal of water	Apply a directed spray to settled and firm soil from fall to early spring before weeds emerge. Soil should be settled and firm. Rainfall or irrigation ½ inch is needed within 4 weeks. Do not contact fruit or foliage. Do not apply after bud break on sandy loam soils. Check label for maximum amount allowed per year depending on soil type. <b>Peach, Nectarine:</b> minimum 6 months; <b>Plum:</b> minimum 12 months, <b>Cherry:</b> minimum 18 months after planting before first application. PHI = 60 days.
Annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lb ai/gal) at 2–6 qt in 20–40 gal of water	Make a single band of broadcast application to the ground beneath trees before weeds emerge. Apply alone to weed-free soil or postemergence mixed with Roundup or Gramoxone. Minimum ½ inch rainfall or irrigation is required for activation. Minimum 2.5 months between applications. Maximum rate is 12 qt per year.
Annual grasses and broadleaves	Treflan HFP 4EC (trifluralin 4 lb ai/gal) at 1.5–4 pt in 5–40 gal of water	<b>Peach, plum only:</b> Incorporate within 24 hours to reduce loss of activity. <b>New plantings:</b> Apply 1.25–2 pt and incorporate before transplanting. <b>Established plantings:</b> Apply 2–4 pt and incorporate prior to period of weed germination or after removal of weeds with tillage of herbicides.

## Herbicide Recommendations for Peach, Nectarine, Plum, and Cherry continued

WEED PROBLEM	MATERIAL & RATE	NOTES AND COMMENTS
<b>POSTEMERGENCE</b>		
Annual broadleaves	Aim 2 EC (carfentrazone 2 lb ai/gal) at 2 fl oz in 20 gal of water	Apply any time during the season. Add nonionic surfactant (2 pt/100 gal) or crop oil concentrate (1 gal/100 gal). Mix with Roundup or Gramoxone for broader weed control. Maximum 7.9 fl oz per year. Minimum 14 days between applications. PHI = 3 days. <b>Sucker management:</b> Apply when suckers are green. Do not allow spray to contact fruit, foliage, or green bark.
Annual and some perennial broadleaves	Amine 4 (2,4-D) or Saber at 3 pt in 5–25 gal of water	Apply as directed spray when annuals are 1 to 2 inches high and when perennial weeds are in pre-bud to early bud stage. Do not allow spray to contact leaves, fruit, or limbs of tree. Use coarse spray and low pressure to avoid drift. Non-bearing trees must be established 1 year. On bearing trees, PHI = 40 days. Do not apply during bloom, or after or before irrigation. Do not apply on bare ground. Maximum 2 applications per year and 75 days between applications.
Most annual and perennial grasses	Fusilade DX 2EC (fluzifop-P 2 lb ai/gal) at 6–16 fl oz in 25 gal of water	Apply as a directed spray to actively growing grasses before tilling. Always add nonionic surfactant 0.25% v/v or crop oil 1% v/v. Rainfast in 1 hour. Avoid contact with foliage. Maximum rate is 72 fl oz/yr. Minimum 5 days between applications. PHI = 14 days.
Annual broadleaves	Goal 2XL	See PREEMERGENCE section (page 61) for details.
Most annual grasses and broadleaf weeds and top kill of perennial weeds	Gramoxone Inteon 2L (paraquat 2 lb ai/gal) at 2.5–4 pt in minimum of 10 gal of water	Apply as directed spray to actively growing weeds. Repeat applications are necessary to give sustained control. Apply as a coarse spray. Always add nonionic surfactant 0.25% v/v or crop oil 1% v/v. Do not allow spray to contact leaves, fruit, or green stems. Maximum 3 applications per year. PHI = 14 days (peach), 28 days (nectarine, plum, cherry). <b>Restricted use pesticide.</b>
Annual grasses and broadleaves	Karmex 80DF	See PREEMERGENCE section (page 61) for details.
Annual and perennial grasses	Poast 1.5 E (sethoxydim 1.5 lb ai/gal) at 1.5–2.5 pt in 25 gal of water	Apply as a directed spray to actively growing grasses before they exceed maximum recommended heights. Always add crop oil 1.25% v/v. Do not apply more than 2.5 pt per application and 5 pt per season. Peach, plum, and nectarine are very tolerant to Poast and may be applied over the top of small non-bearing trees. PHI = 25 days.
Annual and perennial grasses and broadleaves	Recoil 3.65 EC (glyphosate + 2, 4-D) at 1–4 qt in 15–100 gal of water	Apply as a directed and shielded spray with flat-fan nozzles and low pressures (20–25 psi). Avoid contact with fruit, foliage, stems, or lower limbs. Apply when soil is moist and do not irrigate for 5 to 7 days after application. Make up to 2 applications through the dormant or growing season as needed. PHI = 40 days.
Annuals and some perennial grasses and broadleaves	Roundup WeatherMax, Roundup PowerMax 5.5 EC (glyphosate 5.5 lb ai/gal) at 11 fl oz–3.3 qt in 10–40 gal of water (many other formulations)	Rate depends on weed species and stage of growth. See label for details. Apply as preplant broadcast application or in fall for control of roots and rhizomes of perennial weeds or as a directed spray or wiper application (20–100% solution) to actively growing weeds in established plantings. Always add AMS 8.5–17 lb/100 gal in hard water or drought conditions. Do not allow spray to contact any part other than mature bark. Avoid application to suckers and recent pruning wounds. Use extreme care to ensure that no part of peach tree is contacted with spray. Apply only near trees that have been planted in the orchard for 2 or more years. Does not provide residual control; can be mixed with labeled preemergence herbicides. PHI = 17 days.
Annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lb ai/gal) at 3–10% spray mix	For contact non-selective control or burndown of a broad spectrum of actively growing weeds. Use low rate for annual weed control and high rates for maximum vegetative burndown. Use as a directed or shielded spray. Can be mixed with Roundup.

## Herbicide Recommendations for Non-Bearing Fruit Trees Only

WEED PROBLEM	MATERIAL & RATE	NOTES AND COMMENTS
<b>POSTEMERGENCE</b>		
Annual broadleaves and yellow nutsedge	Basagran 4L (bentazon 4 lb ai/gal) at 1.5–2 pt in minimum of 20 gal of water.	Apply as a directed postemergence. Always add crop oil 1% v/v. Avoid spraying stems, bark, or foliage. Maximum 2 pt per application and 4 pt per season. PHI = 1 yr.
Most broadleaves	Gallery 75DF (isoxaben 75% ai) at 0.66–1.33 lb in minimum of 10 gal of water	Apply in late summer to early fall; or preemergence in early spring prior to seed germination or immediately after cultivation. Do not apply to new transplants until soil has settled with no cracks present. Rainfall or irrigation ( $\frac{1}{2}$ inch) is needed within 21 days of application. Not effective on germinated weeds. Minimum 60 days between applications. Maximum rate is 4 lb per acre.
Annual grasses and broadleaves	MSMA 6 Plus at 2.66 pt in 50–100 gal of water	Not labeled for nectarines. Apply as a postemergence directed spray. Maximum 3 applications per year. Do not allow spray to contact foliage, stems, or bark. PHI = 1 yr.
Annual grasses and certain broadleaves	Prowl 3.3 EC (pendimethalin 3.3 lb ai/gal) at 2.4 qt for short-term and 4.8 for long-term weed control in minimum of 20 gal of water	Do not apply if buds have started to swell. May be applied preplant incorporated, preplant surface, or preemergence. For best results, rain or irrigation is needed within 21 days of application. Not effective on germinated weeds. Do not allow spray to contact leaves, shoots, or buds. For new plantings, do not apply until soil has settled and no cracks are present.
Annual grasses and broadleaves	Reglone 2L (diquat 2 lb ai/gal) at 1.5–2 pt in minimum of 15 gal of water	Apply postemergence as a directed spray using a shield for contact burn of weeds. Complete coverage is essential for good control. Can be used during site preparations and up to 1 year of harvest. Do not allow contact with green stems, foliage, or fruits. Do not use for food or feed for 1 year after application.
Most annual and perennial grasses	Select 2EC (clethodim 2 lb ai/gal) at 6–8 fl oz	Apply postemergence as a directed spray to young actively growing grasses. Do not use crop oil. Always add nonionic surfactant at 0.25% v/v. May be applied as a spot treatment at 0.65–1.3 fl oz per gal. Rainfast in 1 hour. Maximum rate is 32 fl oz per year.
Annual grasses and broadleaves	Showcase 1.25G (granular) (trifluralin + isoxaben + oxyfluorfen 1.25 lb ai/50 lb bag) at 100–200 lb	For use on stone fruits only, not labeled for apple or pear. Use as a dormant application for stone fruits only. Apply prior to weed germination or immediately after cultivation.
Annual grasses and certain broadleaves	Snapshot 2.5TG (isoxaben + trifluralin 2.5% ai) at 100–200 lb	Apply preemergence on weed-free clean soil. For best results $\frac{1}{2}$ inch rain or irrigation is needed within 3 days of application. Not effective on germinated weeds. Minimum 60 days between applications. Maximum rate is 600 lb per year.
Annual grasses and broadleaves	XL 2G (granular) (benefin + oryzalin 1 lb ai/50 lb bag) at 200–300 lb	Apply only to established plantings. Apply preemergence to weed-free soil or immediately after cultivations. Rainfall ( $\frac{1}{2}$ inch) or irrigation is needed within 21 days of applications for herbicide activation. Minimum 4 months between applications. Maximum rate is 900 lb per year.
Annual and perennial broadleaves	Venue (Pyraflufen ethyl 2% ai) at 0.7 to 4.0 fl oz plus other labeled herbicides in a minimum of 10 gal of water	Apply as directed spray during dormant period and prior to bloom. Avoid contact with foliage and green bark. More effective on weeds less than 4 inches tall and 3 inches in diameter. Use higher rate and spray volume for larger weeds. Do not make more than 3 applications or exceed 6.8 fl oz/acre in one season. Allow a minimum of 30 days between applications. Addition of crop oil concentrate (COC) or nonionic surfactant is recommended. May be mixed with 2,4-D, glyphosate, or grass herbicides for enhanced control. Spray water pH needs to be less than 7.5. On non-bearing trees the PHI is 12 months.

## Floral Development Stages for Fruit Crops and Critical Temperatures for Flower Bud Kill

	<b>Apple</b>		<b>Pear</b>		<b>Peach</b>		<b>Tart Cherry</b>		<b>Plum &amp; Prune</b>	
Stage	°F 10% Kill	°F 90% Kill	°F 10% Kill	°F 90% Kill	°F 10% Kill	°F 90% Kill	°F 10% Kill	°F 90% Kill	°F 10% Kill	°F 90% Kill
<b>1</b>										
<b>2</b>	15° Silver tip	2°	15° Swollen bud	1°	18° Swollen bud	2°	17° Bud burst	5°	14° Swollen bud	1°
<b>3</b>	18° Green tip	10°	20° Bud burst	7°	23° Half-inch green	5°	25° Green tip	14°	18° Bud burst	3°
<b>4</b>	23° Half-inch green	15°	26° Green cluster	15°	25° Pink	18°	26° Tight cluster	17°	26° Green cluster	16°
<b>5</b>										
<b>6</b>	27° Tight cluster	21°	26° White bud	22°	27° Bloom	24°	27° Swollen bud	24°	26° White bud	21°
<b>7</b>	28° Pink	25°	28° Bloom	23°	28° Petal fall	25°	28° Bloom	25°	27° Bloom	23°
<b>8</b>	28° Bloom	25°	28° Petal fall	24°	28° Petal fall--shucks on	25°	28° Petal fall	25°	28° Petal fall	23°
<b>9</b>	28° Petal fall	25°	28° Fruit set	24°	28° Fruit set--shucks off	28°	28° Fruit set	25°	28° Fruit set	

## Record Keeping Requirements for Production Chemicals

The following lists contain trade name, common name, manufacturer, EPA registration number, Restricted Entry Interval (REI), runoff and leaching potential. The lists were prepared to provide growers a convenient place to find information for pesticide record keeping requirements. This is a partial list of the commonly used pesticides on fruit crops in Michigan and is not intended to be a complete list. The registration of pesticides may vary from state to state. It is the grower's responsibility to confirm the registration number and REI for the specific pesticide used by checking the label attached to the package. The information contained herein does not supersede the label directions. To protect yourself, others, and the environment, always read the label before applying any pesticides.

## Fungicides/Bactericides

Trade Name	Common Name	Manufacturer	EPA Reg #	REI <sup>1</sup>	Runoff/Leaching Potentials <sup>2</sup>	Oral LD <sub>50</sub>	Dermal LD <sub>50</sub>	Class and FRAC Code <sup>3</sup>
Abound	azoxystrobin	Syngenta	100-1098	4 hrs	1/3	>5000	>4000	methoxyacrylate - 11
Actinovate	streptomyces lydicus	Natural Industries	73314-1	1 hr	2/3	-	-	glucopyranosyl antibiotic - 25
Adamant	tebuconazole-trifloxystrobin	Bayer CropScience	264-1052	12 hrs	1/2	>5000	>5000	triazole/oximino acetate - 3 & 11
Ag Streptomycin	streptomycin sesquisulfate	Bayer CropScience	264-974	12 hrs	1/3	>5000	>2000	glucopyranosyl antibiotic - 25
Ag Streptomycin	streptomycin sesquisulfate	Makhteshim-Agan	66222-121	12 hrs	1/3	>5436	>5000	glucopyranosyl antibiotic - 25
AgriFos	potassium phosphate	Liquid Fertiliser	71962-1	4 hrs	3/1	-	-	-
Agri-Mycin 17 Ag	streptomycin	NuFarm	55146-96	12 hrs	3/1	>5000	>2000	glucopyranosyl antibiotic - 25
AlietteWDG	fosetyl-Al	Bayer CropScience	264-516	12 hrs	3/3	2860	>2000	ethyl phosphonate - 33
Armicarb 100	potassium bicarbonate	Helena	5905-541	4 hrs	3/1	2700	>5000	not classified
Bayleton 50 DF	triadimenol	Bayer CropScience	264-737	12 hrs	3/2	812-1470	>2000	triazole - 3
Botran 75 W	dicloran	Gowan	10163-189	12 hrs	2/3	>4640	>6320	aromatic hydrocarbon - 14
Bravo WeatherStik	chlorothalonil	Syngenta	50534-188-100	12 hrs	2/3	9000	>2000	chloronitrile - M5
Bumper	propiconazole	Makhteshim-Agan	66222-42	24 hrs	1/2	972-2000	>5000	triazole - 3
Cabrio	pyraclostrobin	BASF	7569-187	12 hrs	1/3	>2000	>2000	methoxy carbamate - 11
Captan 80 WDG	captan	Arista	66222-58-66330	24-72 hrs	3/3	>2000	>5000	phthalimide - M4
Captac 4 FL	captan	Arista	66330-239	24-48 hrs	3/3	>5000	>2000	phthalimide - M4
Captivate	fenhexamid+captan	Arista	66330-48	24-48 hrs	3/3	>2000	>5000	hydroxyanilide/phthalimide - 17 & M4
Champ DP	copper hydroxide	NuFarm	55146-57	24 hrs	1/3	1346	>5000	inorganic - M1
Champ Formula 2	copper hydroxide	NuFarm	55146-64	24 hrs	1/3	1630	>5000	inorganic - M1
Chlorothalonil 720	chlorothalonil	Arista	66330-362	12 hrs	2/3	9000	>2000	chloronitrile - M5
Copper Sulfate	copper sulfate	ChemOne Ltd	56576-1	24 hrs	1/3	330	-	inorganic - M1
Cuprofix Dispers	basic copper sulfate	Cerexagri-Nisso	4581-396-82695	24 hrs	1/3	>2000	>4000	inorganic - M1
Cuprofix MZ Dispers	basic copper sulfate+mancobez	Cerexagri-Nisso	4581-397-82695	24 hrs	1/3	>4470	>2000	inorganic/dithiocarbamate - M1 & M3
Cuprofix Ultra Dispers	basic copper sulfate	Cerexagri-Nisso	4581-413-82695	12 hrs	1/3	300-960	>2000	inorganic - M1
Dithane M-45	mancobez	DowAgroSciences	62719-387	24 hrs	1/3	>5000	>5000	dithiocarbamate - M3
Eagle	myclobutanil	DowAgroSciences	62719-463	24 hrs	2/2	3749-5000	>2000	triazole - 3
Elevate	fenhexamid	Arista	66330-35	12 hrs	3/3	>2000	>2000	hydroxyanilide - 17
Elite 45 DF	tebuconazole	Bayer CropScience	264-749	12 hrs	1/2	2593-4865	>2000	triazole - 3
Endura	boscald	BASF	7569-197	12 hrs	1/2	>2000	>2000	pyridine-carboxamide - 7
Equus 500 ZN	chlorothalonil	Makhteshim-Agan	66222-150	12 hrs	2/3	3750	>2000	chloronitrile - M5
Equus 720 SST	chlorothalonil	Makhteshim-Agan	66222-154	12 hrs	2/3	>5000	>5000	chloronitrile - M5
Equus DF	chlorothalonil	Makhteshim-Agan	66222-149	12 hrs	2/3	>5000	>2000	chloronitrile - M5
Ferbam Granulfo	ferbam	Taminco, Inc.	45728-7	24 hrs	3/2	>5000	>4000	dithiocarbamate - M3
Flint	trifloxystrobin	Bayer CropScience	264-777	12 hrs	2/3	>5050	>2000	oximino acetate - 11
Fosphite	potassium salts	JH Biotech	68573-2	4 hrs	3/1	-	-	not classified
Gavel	mancobez+xomamide	DowAgroSciences	62719-441	48 hrs	1/3	>5000	>5000	dithiocarbamate/toluamide - M3 & 22
Gem	trifloxystrobin	Bayer CropScience	264-781	12 hrs	2/3	>5050	>2000	oximino acetate - 11
Indar	fenbuconazole	DowAgroSciences	62719-421	12 hrs	1/3	4000	>2000	triazole - 3
Inspire Super MP	difenconazole	Syngenta	100-1262	12 hrs	1/3	3129	>2000	triazole - 3
Iprodione 4L AG Flowable	iprodione	Arista	66330-297	24-48 hrs	3/3	>2000	>1000	dicarboximide - 2
Iprodione 50WP AG	iprodione	Micro-Flo	51036-341	24-48 hrs	3/3	>2000	>1000	dicarboximide - 2
JMS Stylet Oil	paraffinic oil	JMS Flower Farms	65564-1	4 hrs	1/-	10000	-	not classified
Kocide 101	copper hydroxide	Griffin	1812-288	24 hrs	1/3	833	>5000	inorganic - M1
Kumulon DF	sulfur	Arista	51036-352-66330	24 hrs	1/1	>2200	>2000	inorganic - M2
Lime Sulfur Solutions	lime sulfur	Miller	66196-2-72	48 hrs	1/-	-	-	inorganic - M2
Maneb 75 DF	maneb	Cerexagri-Nisso	4581-371-82695	24 hrs	1/3	>5000	>2000	dithiocarbamate - M3
Maneb 80 W	maneb	Cerexagri-Nisso	4581-255-82695	24 hrs	1/3	>5000	>2000	dithiocarbamate - M3
ManKocide	mancobez+copper hydroxide	DuPont	352-690	24 hrs	1/3	2532	>5000	dithiocarbamate/inorganic - M3 & M1
ManKocide	mancobez+copper hydroxide	Griffin	1812-360	24 hrs	1/3	-	-	dithiocarbamate/inorganic - M3 & M1
Mertect 340-F	thiabendazole	Syngenta	100-889	12 hrs	1/3	>5000	>5050	benzimidazole - 1
Messenger	harpin protein	Eden Bioscience	69834-2	4 hrs	2/3	>5000	>6000	-
Microthiol Dispers	sulfur	Cerexagri-Nisso	4581-373-82695	24 hrs	1/1	>2000	>2000	inorganic - M2
Miller Sulfoxir	lime sulfur	Miller	66196-3-72	48 hrs	1/-	820	>2000	inorganic - M2
Mycoshield Ag Terramycin	oxytetracycline	NuFarm	55146-97	12 hrs	2/3	>5000	>2000	tetracycline antibiotic - 41
Nevado	iprodione	Makhteshim-agan	66222-144	24-48 hrs	3/3	>1170	>2000	dicarboximide - 2
Nova 40 W	myclobutanil	DowAgroSciences	62719-411	24 hrs	2/2	>1000	>5000	triazole - 3
Orbit	propiconazole	Syngenta	100-702	12 hrs	1/2	1310	>5000	triazole - 3
Orius	tebuconazole	Makhteshim-agan	264-749-66222	12 hrs	1/2	2593-4865	>2000	triazole - 3
Oxidate	hydrogen dioxide	Biosafe Systems	70299-2	SL	3/3	330	1410	-
Penncozeb 75 DF	mancobez	Cerexagri-Nisso	4581-370-82695	24 hrs	1/3	>4470	>2000	dithiocarbamate - M3
Penncozeb 80 WP	mancobez	Cerexagri-Nisso	4581-358-82695	24 hrs	1/3	>5000	>2000	dithiocarbamate - M3
Phostrol	phosphoric acid	NuFarm	55146-83	4 hrs	3/1	>5000	>5000	-
PlantShield	Trichoderma harzianum	Bioworks	68539-4	SL	2/3	-	-	-
Polyram 80 DF	metiram	Loveland	7969-105-34704	24 hrs	2/3	>5000	>2000	dithiocarbamate - M3
Presidio	fluopicolide	Valent	59639-140	12 hrs	2/1	>2000	>4000	pyridinylmethyl-benzamide-43
Pristine	boscald+pyraclostrobin	BASF	7569-199	12 hrs - 5 days	1/2	1490	>2000	pyridine - carboxamide/methoxy-carbamate - 7 & 11
Procure 50 WS	triflumizole	Chemtura	400-431	12 hrs	3/2	2230	>2000	imidazole - 3
ProPhyt	potassium salts	Helena	42519-22-5905	4 hrs	3/1	>5000	>4000	-
PropMax	propiconazole	DowAgroSciences	62719-346	24 hrs	1/2	-	-	triazole - 3
Purespray Green	petroleum distillates	Petro-Canada	69526-9	4 hrs	1/-	>5000	>2000	-
Quali-pro Chlorothalonil DF	chlorothalonil	Farmsaver.com	72167-25-73220	12 hrs	2/3	-	-	chloronitrile - M5
Quash 50WDG	metconazole	Valent	59639-147	12 hrs	1/2	1750	>5000	triazole - 3
Quintec	quinoxifen	DowAgroSciences	62719-375	12 hrs	1/3	>2000	>2000	quinalone - 13
Revis	mandipropamid	Syngenta	100-1254	4 hrs	1/-	>5000	>5000	mandelic acid amides - 40
Ridomil Gold EC	metalaxyl-M	Syngenta	100-801	48 hrs	3/3	1172	>2020	acylalanine - 4
Ridomil Gold MZ	metalaxyl-M/mancobez	Syngenta	100-803	48 hrs	1/3	>5000	>2000	acylalanine/dithiocarbamate - 4 & M3
Ridomil Gold GR	metalaxyl-M	Syngenta	100-798	48 hrs	3/3	>5000	>2000	acylalanine - 4
Rootshield	Trichoderma harzianum	Bioworks	68539-3	NA	2/3	-	-	-
Roval 4 F	iprodione	Bayer CropScience	264-482	24-48 hrs	3/3	1170	>2000	dicarboximide - 2
Roval 50 WP	iprodione	Bayer CropScience	264-453	24-48 hrs	3/3	>5000	>2000	dicarboximide - 2
Rubigan 1 EC	fenarimol	Gowan	10163-273	12 hrs	2/1	1057-1270	>2000	pyrimidine - 3
Saf-T-Side	petroleum distillates	Lawn & Garden Products	48813-1-54705	4 hrs	1/-	>5000	>2000	-
Scala	pyrimethanil	Bayer CropScience	264-788	12 hrs	3/2	4505-5000	>5000	anilinopyrimidine - 9
Scholar	fludioxonil	Syngenta	100-969	NA	1/3	>5050	>2020	phenylpyrrole - 12
Serenade Max	Bacillus subtilis	Agraquest	69592-11	4 hrs	2/3	>5000	>2000	-
Sonata	Bacillus pumilus	Agraquest	69592-13	4 hrs	2/3	>5000	>5000	-
Sovran	kresoxim-methyl	BASF	7569-154	12 hrs	3/3	>5000	>2000	oximino acetate - 11
Sporan	various oils	Ecosmart Technologies	67425-99999	NA	1/-	-	-	-
Switch	cypromidin+fludioxonil	Syngenta	100-953	12 hrs	1/3	>5000	>2000	anilino-pyrimidine/phenylpyrrole - 9 & 12
Syllit FL	dodine	Agripharm S.A.	55260-6	48 hrs	2/3	>5000	>2000	guanidine - M7
Tanos	famoxadone/cymoxanil	DuPont	352-604	12 hrs	2/3	>5000	>2000	oxazolidine-dione/cyanoacetamide-oxime - 11 & 27
Tebuzol 45DF	tebuconazole	United Phosphorus	70506-113	12 hrs	1/2	>2000	>2000	triazole - 3
Thiophanate Methyl	thiophanate-methyl	Makhteshim-Agan	72167-10-66222	12 hrs - 7 days	2/3	>5000	>2000	thiophanate - 1
Thiram Granulfo	thiram	Taminco, Inc.	45728-21	24 hrs	3/3	2400	>2000	dithiocarbamate - M3
Topsin-M 70 WP	thiophanate-methyl	United Phosphorus	73545-11-70506	12 hrs	2/3	>5000	>2000	thiophanate - 1
Trilogy	neem oil	Certis USA	70051-2	4 hrs	1/-	>5000	-	-
Vanguard WG	cypromidin	Syngenta	100-828	12 hrs	1/3	>5000	>2000	anilino-pyrimidine - 9
Vintage	fenarimol	Gowan	10163-275	12 hrs	2/1	>2000	>4000	pyrimidine - 3
Wettable Sulfur	sulfur	Loveland	34704-734	24 hrs	1/1	5000	>2000	inorganic - M2
Ziram 76 DF	ziram	Cerexagri-Nisso	4581-74-82695	48 hrs	3/2	1899	>5000	dithiocarbamate - M3
Ziram Granulfo	ziram	Taminco, Inc.	45728-12	48 hrs	3/2	478	>2000	dithiocarbamate - M3

\* = Restricted Use Pesticide

<sup>1</sup>REI = Restricted Entry Interval, SL—See Label. Some REIs vary by crop, always check the label.

<sup>2</sup>1 = high, 2 = intermediate, 3 = low. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties database. [http://www.wsi.nrcs.usda.gov/products/W20/pest\\_mgt.html](http://www.wsi.nrcs.usda.gov/products/W20/pest_mgt.html).

<sup>3</sup>Chemical Group and Fungicide Resistance Action Committee codes taken from <http://www.frac.info>. Adapted from Michigan Extension Bulletin e-154 (used with permission).

## Insecticides/Miticides

Trade Name	Common Name	Manufacturer	EPA Reg #	REI <sup>1</sup>	Runoff/ Leaching Potentials <sup>2</sup>	Oral LD <sub>50</sub>	Dermal LD <sub>50</sub>	Class and IRAC Code <sup>3</sup>
Acrimate 50WS	bifenazate	Chemtura	400-503	12 hrs - 5 days	2/3	>5000	>5000	unknown - UN
Actara 25WG	thiamethoxam	Syngenta	100-938	12 hrs	2/1	>5000	>2000	neonicotinoid - 4A
Admire	imidacloprid	Bayer CropScience	264-758	12 hrs	2/1	4143-4870	>2000	neonicotinoid - 4A
*Agri-Mek 0.15 EC	avermectin B1	Syngenta	100-898	12 hrs	2/3	300	>1800	avermectin - 6
Altafcor 35WG	chlorantraniliprole	DuPont	352-730	4 hrs	-/-	>5000	>5000	diamide - 28
*Ambush 25 WP	permethrin	Amvac	5481-502	12 hrs	2/3	>5000	>2000	pyrethroid - 3A
Apollo SC	clofentezine	Makhteshim-Agan	66222-47	12 hrs	1/3	>5000	>2400	growth inhibitor - 10A
*Asana XL	esfenvalerate	DuPont	352-515	12 hrs	2/3	458	>2000	pyrethroid - 3A
Assail 30SG	acetamiprid	Nippon Soda	8033-23	12 hrs	3/2	1064	>2000	neonicotinoid - 4A
Avaunt 30WG	indoxacarb	DuPont	352-597	12 hrs	1/3	687-1867	>5000	Channel blocker - 22A
Aza-Direct	azadirachtin	Gowan	71908-1-10163	4 hrs	2/1	>5000	>2000	unknown - UN
*Battalion 0.2 EC	deltamethrin	Arysta LifeScience	264-1007-66330	12 hrs	1/3	416-445	>2000	pyrethroid - 3A
*Baythroid XL	cyfluthrin	Bayer CropScience	264-840	12 hrs	2/3	647-695	>2000	pyrethroid - 3A
Belay	clothianidin	Valent	59639-150	12 hrs	2/1	3044	>5000	neonicotinoid - 4A
*Beleaf 50SG	pyridinecarboxamide	FMC	71512-10-279	12 hrs	3/3	>2000	>2000	feeding blocker - 9C
Belt 45C	flubendiamide	Bayer CropScience	264-1025	12 hrs	-/-	>2000	>4000	diamide - 28
Biobit HPWP	Bt var kurstaki	Valent	73049-54	4 hrs	1/3	>5000	>2500	disruptor of insect midgut membranes - 11
*Brigade WSB	bifenthrin	FMC	279-3108	12 hrs	2/3	335	>2000	pyrethroid - 3A
Calypso	thiocloprid	Bayer CropScience	264-806	12 hrs	2/3	300-500	>4000	neonicotinoid - 4A
*Capture	bifenthrin	FMC	279-3069	12 hrs	2/3	262	>2000	pyrethroid - 3A
Carbaryl 4 L	carbaryl	Loveland	34704-447	12 hrs	3/3	699	>4000	carbamate - 1A
Carbaryl 80	carbaryl	Drexel	19713-50	12 hrs	3/3	281	>2000	carbamate - 1A
Centaur WDG	buprofezin	Nichino	71711-21	12 hrs	2/3	>5000	>2000	chitin biosynthesis inhibitor - 16
Clutch 50 WDG	clothianidin	Valent	66330-40-59639	12 hrs	2/1	3900-4700	>5000	neonicotinoids - 4A
Confirm 2F	tebufenozide	DowAgroSciences	62719-420	4 hrs	2/1	>5000	>5000	diacyldihydrazine - 18
*Danitol 2.4 EC	fenpropathrin	Valent	59639-35	24 hrs	2/3	66	>2000	pyrethroid - 3A
Delegas 25WG	spinetoram	Dow AgroSciences	62719-541	4 hrs	-/-	>5000	>5000	spinosyn - 5
Deliver	Bt kurstaki	Certis	70051-69	4 hrs	1/3	>5000	-	disruptor of insect midgut membranes - 11
*Diazinon AG 600	diazinon	Loveland	66222-103-34704	3-5 days	1/3	1600	>2020	organophosphate - 1B
*Diazinon 50 W	diazinon	Makhteshim-Agan	66222-10	3-5 days	1/3	1960	>2020	organophosphate - 1B
Entrust	spinosad	DowAgroSciences	62719-282	4 hrs	3/3	>5000	>2000	spinosyn - 5
Envidor 2 SC	spiroticlofen	Bayer CropScience	264-831	12 hrs	2/3	>2000	>4000	tetronic & tetramic acid derivative - 23
Esteem 35 WP	pyriproxyfen	Valent	59639-115	12 hrs	2/3	>5000	>5000	juvenile hormone mimic - 7C
Evergreen	pyrethrin + piperonyl butoxide	MGK	1021-1770	12 hrs	2/3	>3129	>5000	pyrethroid - 3A
GF-120 NF	spinosad	DowAgroSciences	62719-498	4 hrs	3/3	>5000	>5000	spinosyn - 5
*Guthion Solupak	azinphos-methyl	Makhteshim-Agan	66222-162	7-15 days	2/3	12.3-24.7	>2000	organophosphate - 1B
*GuthionSolupak50WP	azinphos-methyl	Bayer CropScience	264-733	7-15 days	2/3	12.3-24.7	>2000	organophosphate - 1B
Imidan 70 WP	phosmet	Gowan	10163-169	2-14 days	3/3	258-275	>4.64	organophosphate - 1B
Intrepid 2F	methoxyfenozide	DowAgroSciences	62719-442	4 hrs	2/1	>5000	>2000	diacyldihydrazine - 18
Javelin WG	Bt kurstaki	Certis	70051-66	4 hrs	1/3	>5100	>5000	disruptor of insect midgut membranes - 11
Kanemite 15 SC	acequinocyl	Arysta LifeScience	66330-38	12 hrs	2/3	>5000	>2000	electron transport inhibitors - 20B
*Lannate 90 SP	methomyl	DuPont	352-342	2-7 days	3/1	30-34	>2000	carbamate - 1A
*Lannate 24 LV	methomyl	DuPont	352-384	2-7 days	3/1	49-89	>2000	carbamate - 1A
*Leverage 2.7F	cyfluthrin + imidacloprid	Bayer CropScience	264-770	12 hrs	2/1	200	>5000	pyrethroid & neonicotinoid - 3 & 4A
*Lorsban 50W WSP	chlorpyrifos	Dow AgroSciences	62719-221	NA	2/3	382	>2000	organophosphate - 1B
*Lorsban 4 EC	chlorpyrifos	DowAgroSciences	62719-220	1-4 days	2/3	300-776	>5000	organophosphate - 1B
Lorsban 75WG	chlorpyrifos	DowAgroSciences	62719-301	1-4 days	2/3	>500	>5000	organophosphate - 1B
Malathion 8 Flowable	malathion	Gowan	10163-21	12-24 hrs	3/3	5400-5700	>2000	organophosphate - 1B
Malathion 57EC	malathion	Loveland	34704-108	12 hrs	3/3	550	>2000	organophosphate - 1B
M-Pede	fatty acids	Dow AgroSciences	62719-515	12 hrs	-/-	>5000	>2000	-
Movento 2F	spirotetramat	Bayer CropScience	264-1050	24 hrs	-/-	>2000	>4000	tetronic acid derivative - 23
Neemix 4.5	azadirachtin	Certis	70051-9	12 hrs	2/1	>5000	-	unknown - UN
Nexter	pyridaben	BASF	7969-106	12 hrs	1/3	1930	>2000	METI acaricide - 21A
Oberon	spiromesifen	Bayer CropScience	264-719	12 hrs	2/3	>2000	>4000	tetronic acid derivative - 23
Platinum	thiamethoxam	Syngenta	100-939	12 hrs	2/1	>5000	>2000	neonicotinoid - 4A
Portal 5 EC	fenpyroximate	Nichino	71711-19	12 hrs	1/3	810-1004	>5000	METI acaricide - 21A
*Pounce 3.2 EC	permethrin	Agrilance	279-3014-1381	12 hrs	2/3	1030	>2000	pyrethroid - 3A
Provado	imidacloprid	Bayer CropScience	264-763	12 hrs	2/1	4143-4870	>2000	neonicotinoid - 4A
*Proaxis 0.5 CS	gamma-cyhalothrin	Loveland	74921-3-34704	24 hrs	1/3	>2500	>5000	pyrethroid - 3A
Pyganic	pyrethrins	MGK	1021-1771	12 hrs	2/3	-	-	pyrethroid - 3A
Rimon	novaluron	Chemtura	66222-35-400	12 hrs	1/3	3914-5000	8000	benzoylurea - 15
Savay 50DF	hexythiazox	Gowan	10163-250	12 hrs	2/3	>5000	>5000	mite growth inhibitor - 10A
Sevin 80 Solupak	carbaryl	Bayer CropScience	264-316	12 hrs	3/3	203-406	>5000	carbamate - 1A
Sevin XLR Plus	carbaryl	Bayer CropScience	264-333	12 hrs	3/3	699	>4000	carbamate - 1A
Sevin 4F	carbaryl	Bayer CropScience	264-349	12 hrs	3/3	590	>2000	carbamate - 1A
Spintor 2SC	spinosad	DowAgroSciences	62719-294	4 hrs	3/3	>5000	>5000	spinosyn - 5
Sulfurix	calcium polysulfide	Miller	66196-3-72	48 hrs	-/-	820	>2000	-
Sunspray Ultra Fine Spray Oil	superior oil	Sunoco	862-23	4 hrs	-/-	>15000	-	-
*Supracide 25 WP	methidathion	Gowan	10163-244	3 days	3/3	53	>2020	organophosphate - 1B
Surround WP	kaolin	TKI	61842-18	4 hrs	2/3	>5000	-	-
*Thionex	endosulfan	Makhteshim-Agan	66222-63	24 hrs	1/3	45	256	cyclodiene organochlorine - 2A
*Thionex 50W	endosulfan	Makhteshim-Agan	66222-62	24 hrs	1/3	41	>2000	cyclodiene organochlorine - 2A
*Vendex 50 WP	fenbutatin-oxide	United Phosphorus	70506-211	48 hrs	1/3	>5000	>2000	organotin miticide - 12B
*Venom	dinotefuran	Valent	59639-135	12 hrs	2/1	>5000	>5000	neonicotinoid - 4A
Voliam Flexi 40WDG	thiamethoxam + pyrazole	Syngenta	100-1319	12 hrs	2/1	>5000	>5000	neonicotinoid - 4A & 28
*Vydare L	oxamyl	DuPont	352-372	48 hrs	3/3	9-10	>5000	carbamate - 1A
*Warrior	lambda-cyhalothrin	Syngenta	100-1112	24 hrs	2/3	351	>2000	pyrethroid - 3A
Zeal	etoxazole	Valent	59639-138	12 hrs	2/3	>5000	>5000	mite growth inhibitor - 10A

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<sup>3</sup>Chemical Group and Insecticide Resistance Action Committee codes taken from <http://www.irac-online.org/eClassification/>

## Herbicides

Trade Name	Common Name	Manufacturer	EPA Reg #	REI <sup>1</sup>	Runoff/ Leaching Potentials <sup>2</sup>	Oral LD50	Dermal LD50	Chem Group and HRAC Code <sup>3</sup> (WSSA Code)
Aim 1.9EW	carfentrazone	FMC	279-3242	12 hrs	3/3	4077	>4000	triazolinone - E (14)
Callisto	mesotrione	Syngenta	100-1131	12 hrs	3/3	>5000	>5000	triketone - F1 (27)
Casoron 1.4CS	dichlobenil	Chemtura	400-541	12 hrs	2/2	>5000	>5000	nitrile - L (20)
Casoron 4G	dichlobenil	Chemtura	400-168	12 hrs	2/2	>5000	>2000	nitrile - L (20)
Chateau WDG	flumioxazin	Valent	59639-119	12 hrs	2/3	>5000	>2000	N-Phenylphthalimide - E (14)
Evital 5G	norflurazon	Amvac	5481-506	12 hrs	2/2	>5000	>2000	pyridazinone - F1 (12)
Formula 40 2,4-D		NuFarm	228-357	48 hrs	3/1	866-1058	>2000	phenoxy-carboxylic-acid - O (4)
Fusilade DX	fluazifop-P	Syngenta	100-1070	12 hrs	2/3	>5000	>2000	aryloxyphenoxy-propionate - A (1)
Gallery 75DF	isoxaben	Dow Agrosciences	62719-145	12 hrs	1/3	>5000	>5000	benzamide - L (21)
Goal 2XL	oxyfluorfen	Dow Agrosciences	62719-424	24-48 hrs	2/3	2985-4594	>4000	diphenylether - E (14)
*Gramoxone Inteon	paraquat	Syngenta	100-1217	12-24 hrs	1/3	310	>2000	bipyridylum - D (22)
Karmex 80DF	diuron	DuPont	352-692	12 hrs	2/2	>5000	>5000	urea - C2 (7)
*Kerb 50WP	pronamide	Dow Agrosciences	62719-397	24 hrs	2/1	>5000	>10000	benzamide - K1 (3)
Matrix FNV	rimsulfuron	DuPont	352-671	4 hrs	3/2	>5000	>2000	sulfonylurea - B (2)
Poast	sethoxydim	BASF	7969-58	12 hrs	3/3	4285-5000	>4000	cyclohexanedione - A (1)
Princep 90WDG	simazine	Syngenta	100-603	12 hrs	2/1	>5000	>2000	triazine - C1 (5)
Princep 4L	simazine	Syngenta	100-526	12 hrs	2/1	>5000	>5050	triazine - C1 (5)
Prowl 3.3EC	pendimethalin	BASF	241-337	24 hrs	1/3	3956	>2000	dinitroaniline - K1 (3)
Rely 280	glufosinate	Bayer CropScience	264-660	12 hrs	3/3	1910-2170	1380-1400	phosphinic acid - H (10)
Roundup	glyphosate	Monsanto	524-445	12 hrs	1/3	>5000	>5000	glycine - G (9)
Roundup Ultra	glyphosate	Monsanto	524-475	4 hrs	1/3	5108	>5000	glycine - G (9)
Sandeia 75DF	halosulfuron-methyl	Gowan	81880-18-10163	12 hrs	2/3	1287	>5000	sulfonylurea - B (2)
Select Max 0.97	clethodim	Valent	59639-132	24 hrs	3/3	>5000	>5000	cyclohexanedione - A (1)
Sinbar 80WDG	terbacil	TKI	61842-13	12 hrs	2/1	500-2784	>5000	uracil - C1 (5)
Solicam 80DF	norflurazon	Syngenta	100-849	12 hrs	2/2	1140	>2000	pyridazinone - F1 (12)
Spartan 4F	sulfentrazone	FMC	279-3220	12 hrs	2/1	2084	>2000	triazolinone - E (14)
Starane Ultra	fluroxypyr	Dow Agrosciences	62719-577	24 hrs	3/2	>5000	>5000	pyridine carboxylic acid - O (4)
Surflan AS	oryzalin	United Phosphorus	70506-43	24 hrs	3/3	12600	>10000	dinitroaniline - K1 (3)
Stinger	clopyralid	Dow Agrosciences	62719-73	12 hrs	3/1	>5000	>5000	pyridine carboxylic acid - O (4)
Touchdown HiTech	glyphosate	Syngenta	100-1182	12 hrs	1/3	>5000	>5000	glycine - G (9)
Treewise	saflufenacil	BASF	7969-276	12 hrs	-/-	>2000	>2000	Pyrimidindione - E (14)
Ultra Blazer	acifluorfen	United Phosphorus	70506-60	48 hrs	3/2	2020	>2000	diphenylether - E (14)
Velpar L	hexazinone	DuPont	352-392	48 hrs	2/1	4120	>5000	triazinone - C1 (5)
Venue	pyraflufen	Nichino	71711-25	12 hrs	2/3	>5000	>2000	phenylpyrazole - E (14)
Weedar 64	2,4-D	NuFarm	71368-1	48 hrs	3/2	1161	1544	phenoxy-carboxylic-acid - O (4)

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<sup>3</sup>Chemical Group and Herbicide Resistance Action Committee codes taken from <http://www.hracglobal.com>.

## Plant Growth Regulators

Trade Name	Common Name	Manufacturer	EPA Reg #	REI <sup>1</sup>	Runoff/ Leaching Potentials <sup>2</sup>	Oral LD50	Dermal LD50	Chem Group
Accel	6BA + GA4+7	Valent	73049-29	12 hrs	2/2	>3000	>2000	cytokinin+gibberellin
Apogee	prohexadione-Ca	BASF	7969-188	12 hrs	3/2	>5000	>2000	unclassified
Amid-Thin-W	NAD	Amvac	5481-426	48 hrs	3/2	>10000	>5000	auxin
Ethrel	ethephon	Bayer CropScience	264-267	48 hrs	2/3	>5000	>2000	ethylene releaser
Exilis Plus	6-benzyladenine	Fine Americas, Inc	62097-9-82917	12 hrs	2/2	>2000	>2000	cytokinin
Fruitone N	NAD	Amvac	5481-427	48 hrs	3/2	>10000	>5000	auxin
MaxCel	6-benzyladenine	Valent	73049-407	12 hrs	2/2	>5000	>5000	cytokinin
PoMaxa	1-Naphthalene Acetic Acid, Sodium Salt	Valent U.S.A. Corp.	73049-487	48 hrs	3/2	>5000	>5000	auxin
Pro-Gibb	gibberellic acid (GA3)	Valent	73049-15	12 hrs	3/3	>5000	>2000	gibberellin
Promalin	6BA+GA4+7	Valent	73049-41	4 hrs	2/2	>5050	>5050	cytokinin+gibberellin
ReTain	AVG	Valent	73049-45	12 hrs	2/3	>7000	>5000	ethylene inhibitor
RiteWay	6-benzyladenine	Nufarm Americas, Inc	71368-60	12 hrs	2/2	>5000	>5000	cytokinin
Sucker Stopper	NAD	Lawn & Garden	5481-429-54705	12 hrs	3/3	5585	>5000	auxin

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## Nematicides

Trade Name	Common Name	Manufacturer	EPA Reg #	REI <sup>1</sup>	Runoff/ Leaching Potentials <sup>2</sup>	Oral LD50	Dermal LD50	Chem Group
*Telone II	dichlorpropene	Dow Agrosciences	62719-32	5 days	3/2	224-713	333-504	unclassified
*Telone C-17	dichlorpropene + chloropicrin	Dow Agrosciences	62719-12	5 days	3/2	304-519	200-500	unclassified
*Telone C-35	dichlorpropene + chloropicrin	Dow Agrosciences	62719-302	5 days	3/2	100-200	907-1000	unclassified
*Vapam HL	metam-sodium	Amvac	5481-468	48 hrs	3/2	812	>2020	unclassified
*Vydate L	oxamyl	DuPont	352-372	48 hrs	3/3	9-10	>5000	carbamate - 1A

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## Suggested record keeping form for restricted-use pesticides

Adapted from Michigan State University CES Publication E-154, 1993 (used with permission)

**National Capital Poison Center**  
**If you have a poison emergency, call**  
**1-800-222-1222**

This is the single telephone for poison emergencies in the United States. It is supported by a network of 65 poison centers around the country. When you call, you will be automatically connected to the poison center for your area according to the area code and exchange of the phone number you are calling from.

Call this number 24 hours a day, 7 days a week to talk to a poison expert. Call right away if you have a poison emergency. Also, call if you have questions about a poison or about poison prevention.

If you call from a cell phone, you will reach a poison center. Depending on your cell phone carrier, you might reach the poison center in the area you are calling from or in the "home" area of your cell phone. Either center can help you and will arrange for you to have local assistance at your current location.

**To learn more about how to  
handle poison emergencies go to:  
[www.poison.org](http://www.poison.org)**

**Legal Responsibilities for Pesticide Use**

Pesticides suggested for use in this publication are registered by the Environmental Protection Agency, Pesticides Regulation Division and are cleared for use as indicated on the individual labels. The legal limitations in the use of these pesticides should be strictly observed to prevent excessive residues in or on harvested fruit. Each grower is responsible for the residues on fruit from his/her orchard and should follow labels carefully and observe cut off dates and rates of application. Some of the pesticides listed may be on the EPA restricted use list.