



2009 Midwest Tree Fruit Spray Guide

Illinois

University of Illinois Extension
ICSG4-09

Indiana

Purdue Extension
ID-168

Iowa

Iowa State University Extension
PM 1282

Kansas

Kansas State University Agricultural Experiment
Station and Cooperative Extension Service
S-146

Kentucky

University of Kentucky Cooperative Extension Service
ID-92

Missouri

University of Missouri and Missouri State University
MP651

Ohio

Ohio State University Extension
506A2

Wisconsin

University of Wisconsin Cooperative Extension Service
A3314

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

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.

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Midwest Tree Fruit Pest Management Handbook

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.

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 organo-phosphates or carbamates, just in case.
8. For maximum safety, get a blood test to deter-

mine 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.

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.

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 hand-gun 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 which 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 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.

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 cubic feet ^a)	Maximum Dilute Spray (gallons/acre ^b)
30	20	15	436	300
26	16	10	354	225
24	14	10	254	180
22	14	10	272	200
20	12	10	261	185
18	10	8	242	175
16	8	8	174	125
14	6	6	149	105
12	6	6	131	90

^a 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.

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

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.

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

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:

$$\begin{aligned} & (\text{TRV gallonage}) \\ & \times (0.75) \\ & \times \text{dilute pesticide rate/100 gal.} \\ & = \text{concentrate pesticide application rate/acre} \end{aligned}$$

$$\begin{aligned} & 400 \text{ gal./acre} \times 0.75 \times 2 \text{ lb/100 gal.} = 6.0 \text{ lb/acre} \\ & \text{If the TRV base gallonage is less than 200 gal/acre,} \\ & \text{use 200 gal. to compute the pesticide application} \\ & \text{rate.} \end{aligned}$$

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				

How to calculate tree row volume gallonage

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

$\frac{\text{cu ft of TRV/acre (from Step 2)} \times \text{tree density (from Step 3)}}{1,000}$

= 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 feet of row/acre

Step 2

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

= 365,904 cubic feet of TRV/acre

Step 3

Density has been given as 0.85.

Step 4

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

= 311 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	Tree 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 3) 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.

Fungicide Resistance Alert

The development of strains of the apple scab fungus with resistance to the sterol inhibiting or DMI fungicides (Rally, Indar, Bayleton, Elite, Orbit, Procure, and Rubigan) 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.

APPLE

About 400 gallons of dilute spray are required to adequately cover an acre of mature, standard, well-pruned apple trees in full leaf, 20 to 22 feet in height, in rows spaced 35 feet apart.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
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APPLE DORMANT TO SILVER TIP

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

Fire Blight	Fixed copper fungicides (Copper hydroxide) (Copper oxychloride) (Basic copper sulfate)			If fire blight was severe last year, a fixed copper spray at silver tip is suggested. Do not apply copper after 1/4-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. However, never combine copper sulfate alone with dormant oil.
Crown rot (Collar Rot)	Ridomil Gold EC Aliette 80WP Phosphorous Acid			Refer to crown rot section on page 13 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.

¹ Primary Scab				¹ See note on page vi on fungicide resistance.
Protectant Program				² See note on Captan on page 16.
	² Captan 50 WP	1.5 lb	6 lb	³ If Syllit (Cyprex) has a long history of use in your orchard, fungicide resistance may be a problem.
	³ Syllit 3.4 F		1.5-3 pt	
	Ziram 76 DF	2 lb	6 - 8 lb	
	⁴ Mancozeb 75 DF	1.5 lb	6 lb	⁴ See note on Mancozeb and Polyram on (Restrictions on EBDC Products) page 13.
	⁴ Polyram 80 DF	1.5 lb	6 lb	
	Vanguard 75 WG		5 oz	
	Scala 5 SC		7 - 10 fl oz	

Fungicide Resistance Management: Sovran, Pristine & Flint (strobilurin fungicides) and Rally, Rubigan, Indar and Procure (sterol-inhibiting fungicides). To limit the potential for development of fungicide resistance, do not make more than four applications of a strobilurin or sterol-inhibiting fungicide per season. In addition, no more than two sequential sprays of a strobilurin or sterol-inhibiting fungicide should be made without alternating to a fungicide with different chemistry. For example: two sprays of Sovran alternated with two sprays of Rally mixed with a broad spectrum protectant. See note on fungicide resistance management on page 16.

APPLE GREEN TIP (cont.)

Primary Scab
(continued)

San Jose Scale, European Red Mite eggs, Aphid eggs	Superior oil	2 gal		Apply oil when temperature is above 40 F; never during freezing weather. Check label for fungicide/oil compatibility. Oil is most effective when sprayed dilute under calm conditions to assure thorough coverage of all woody tissue.
	<i>plus one of the following</i>			
	Lorsban 4 E	0.5 - 1 pt		
	Lorsban 50W		3 lb	
	Lorsban 75 WG	0.33 - 0.67 lb	1 - 2.67 lb	
	Supracide 25 WP		4 - 6 lb	
	Supracide 2 E	1 - 2 pt	3 - 12 pt	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.
	Diazinon AG 600	12.75 fl oz		
Spotted Tentiform Leafminer				Put pheromone traps in place now to monitor adult leafminer activity.

APPLE HALF-INCH GREEN

Primary Scab	Renounce 20 WP		2.5 - 3.0 fl oz	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.
San Jose Scale	Same as for green tip or Esteem 35 WP		4 - 5 oz	
European Red Mite eggs	Superior oil	2 gal		Delaying oil application until this time will give better control of mites than earlier applications.
Spotted Tentiform Leafminer, adults	Esteem 35 WP		3 - 5 oz	Killing adults at half inch green is not as effective as killing hatching eggs at early petal fall. Control may be improved by spraying in the evening when moths are most active. Use of pyrethroids (Ambush, Asana, Baythroid, Pounce, Danitol, Decis, Proaxis, and Warrior) is likely to cause mite outbreaks because pyrethroids are persistent and kill mite predators. Esteem at this time also will control rosy apple aphids.
	Ambush 25 WP		6.4 - 25.6 oz	
	Asana XL 0.66 EC	2 - 5.8 fl oz	4.8 - 14.5 fl oz	
	Baythroid		2.0 - 2.4 fl oz	
	Danitol 2.4 EC		10.7 - 21.3 fl oz	
	Decis 1.5 EC		0.9 - 1.9 fl oz	
	Pounce 25 WP		6.4 - 12.8 oz	
	Pounce 3.2 EC		4 - 8 fl oz	
	Proaxis 0.5 EC		2.56 - 5.12 fl oz	
	Warrior 1 CS		2.56 - 5.12 fl oz	
	Vydate L 2 L	0.5 - 1 pt	2 - 4 pt	
Endosulfan 50 WP	1 lb	4 lb		
Endosulfan 3 EC	0.67 qt	2.67 qt		
Mustang Max		1.28 - 4 fl oz		

APPLE TIGHT CLUSTER

7 days after Half-Inch Green

¹ Scab only	³ Captan 50 WP	1.5 lb	6 lb	¹ See comments on fungicide resistance on page vi.
Protectant	Ziram 76 DF	2 lb	6 - 8 lb	
Program	⁴ Mancozeb 75 DF	1.5 lb	6 lb	² Growers using an <u>Extended Protectant</u> program should use an SI fungicide (Rally, Rubigan, Indar 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. Sovran, Flint and Pristine are sometimes recommended for use alone. However, due to the risks of resistance development in the scab fungus, they should probably be tank-mixed with a protectant fungicide as well.
7-day Interval	⁴ Polyram 80 DF	1.5 lb	6 lb	
	Vanguard 75 WG		5 oz	
	Scala 5 SC		7 - 10 fl oz	
Scab, Rust, and Powdery Mildew	Bayleton 50 WP	0.5 - 2 oz	2 - 8 oz	³ See note on Captan on page 16. ⁴ See note on Mancozeb and Polyram on page 13. ⁵ Nova Fungicide has been renamed Rally. ⁶ Indar also is available as a 75WSP ⁷ Do not apply Flint with an organo-silicate surfactant to avoid damage on leaves and fruit. ⁸ Inspire Super MP is a mixture of difenconazole at 4 fl oz/A plus cyprodinil (Vanguard) at 4 oz/A. Both materials are sold separately in the same box as Inspire Super MP. They must be tank mixed prior to use.
¹ Protectant	⁵ Rally WSP	1.25 - 2 oz	5 - 8 oz	
Program	Rubigan EC	3 fl oz	8 - 12 fl oz	
7-day Interval	Procure 50 WP	3 - 4 oz	12 - 16 oz	
	⁶ Indar 2 F		6 - 8 fl oz	
	Sovran 50 WG	1 - 1.6 oz	4 - 6.4 oz	
	⁷ Flint 50 WG		2 - 2.5 oz	
	Pristine 38 WG		14.5 - 18.5 oz	
	Difenconazole (Inspire SuperMP) ⁸		4 fl oz	
	<i>plus</i> cyprodinil (Vanguard WG)		4 fl oz	
² Extended Protectant	³ Captan 50 WP	1.5 lb	6 lb	⁶ Indar also is available as a 75WSP
Program	⁴ Mancozeb 75 DF	12 oz	3 lb	
10-day Interval	⁴ Polyram 80	12 oz	3 lb	
	Ziram 76 DF	1.5 - 2 lb	6 - 8 lb	
	<i>plus</i> cyprodinil (Vangaud WG)		4 fl oz plus 4 oz	⁷ Do not apply Flint with an organo-silicate surfactant to avoid damage on leaves and fruit.
				⁸ Inspire Super MP is a mixture of difenconazole at 4 fl oz/A plus cyprodinil (Vanguard) at 4 oz/A. Both materials are sold separately in the same box as Inspire Super MP. They must be tank mixed prior to use.
				Fungicide Resistance Management: See note on page 16.

APPLE PINK

7 to 10 days after Tight Cluster

Scab, Rust, and Powdery Mildew	Same as for tight cluster.	A critical time for control for scab, rust, and powdery mildew.	
		Rust diseases need to be controlled with sprays at regular intervals from pink through the second cover spray. Rally, Bayleton, Rubigan, Indar, 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.	

Pest/Problem	Material	Rate/100 gal	Rate/ Acre	Comments
APPLE PINK (cont.)				
Rosy Apple Aphid	Lorsban 50 WP	8 - 12 oz	2 - 3 lb	Scout for curled leaves at early pink. Apply aphicide at pink if any curled leaves with rosy apple aphid inside are found. 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.
	Lorsban 75 WG	0.33 - .067 lb	1 - 2.67 lb	
	Endosulfan 50 WP	1 lb	4 lb	
	Endosulfan 3 EC	0.7 qt	2.7 qt	
	Diazinon AG 600	12.7 fl oz	51 fl oz	
	Esteem 35 WP		3 - 5 oz	
	Assail 30 SG		2.5 - 4.0 oz	
	Calypso 4 F	0.5 - 1 fl oz	2 - 4 fl oz	
	Actara 25 WDG		4.5 oz	
	Vydate 2 L	1 - 2 pt	4 - 8 pt	
	Asana XL		4.8 - 14.5 fl oz	
	Pounce 3.2 EC		4 - 16 fl oz	
	Warrior 1CS		2.6 - 5.1 fl oz	
	Danitol 2.4 EC		10.7 - 21.3 fl oz	
	Proaxis 0.5 EC		2.56 - 5.12 fl oz	
	Mustang Max		1.28 - 4 fl oz	
	Beleaf 50 SG		2.0 - 2.8 fl oz	
Spotted Tentiform Leafminer	Same as half inch green OR			
	Carzol SP	4 - 5 oz	1 - 1.25 lb	
	Calypso 4 F	0.5 - 1 fl oz	2 - 4 fl oz	
	Assail 30SG		2.5 oz	
	Actara 25 WDG		4.5 oz	
	Intrepid 2F		8 - 12 fl oz	
	Altacor 35 WDG		2.5 - 4.0 oz	
Tarnished Plant Bug	Endosulfan, Ambush, Asana, Danitol, Warrior, Proaxis, Decis Pounce, Baythroid, and Renounce as listed for tentiform leafminer at half-inch green OR			Use of pyrethroids (Ambush, Asana, Danitol, Proaxis, Pounce, and Warrior) is likely to cause mite outbreaks because they are persistent and kill mite predators.
	Avaunt 30 WDG	1 - 2 fl oz	5 - 6 oz	
	Calypso 4 F	0.5 - 1 fl oz	2 - 4 fl oz	
	Lannate 90 SP	0.1 - 0.2 lb	0.5 - 1 lb	
	Lannate LV	0.4 - 0.75 pt	1.5 - 3 pt	
	Beleaf 50 SG		2.0 - 2.8 fl oz	
	Actara 25 WDG		2.0 - 2.75 oz	
	Assail 30 SG		4.0 - 8.0 oz	
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)	1 lb	2 lb	Add Solubor to pesticide spray; check compatibility before adding. Urea can be added to pesticide sprays when needed.
	AND/OR Feed Grade Urea (nitrogen)	3 lb	3 lb	

Pest/Problem	Material	Rate/100 gal	Rate/ Acre	Comments
APPLE BLOOM 7 to 10 days after Pink				
Scab, Powdery Mildew, and Rust	Same as for tight cluster. (page 3)			
Fire Blight (Blossom Blight)	Streptomycin 17 WP	4-8 oz	1.5 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 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 MARYBLTY. Streptomycin is not recommended for use after petal fall.
	OR Streptomycin 17 WP	4 oz	1 lb	
	<i>plus</i> *Regulaid	1 pt	1 pt	
Fire Blight (Shoot Blight)	<u>Growth Regulator</u> Apogee 27.5 W <i>plus</i> *Regulaid	36 - 48 oz		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 13-14.
		1 pt		*Do not concentrate Regulaid.
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 14 for information on how to use traps to determine optimal timing of insecticides.
Codling Moth (control)	Isomate-C Plus		400 dispensers/acre	See section on mating disruption on page 14. Additional products and formulations are also available.
Red Delicious shape	Promalin		1 pt	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 to 10 days after bloom

Scab, Powdery Mildew and Rust	Same as for tight cluster (page 3)			
Fire Blight	Same as for bloom (page 5)			Continue sprays on susceptible varieties until all petals have fallen.
Plum Curculio, Leafrollers, Oriental Fruit Moth	Guthion 50 WP Imidan 70 WP Avaunt 30 WDG Ambush 25 WP Asana XL Baythroid Danitol 2.4 EC Decis 1.5 EC Mustang Max Pounce 25 WP Pounce 3.2 EC Proaxis 0.5 EC Renounce 20WP Warrior 1 CS Leverage 2.7 SE Voliam Flexi 40 WDG	0.5 - 0.75 lb 0.75 - 1 lb 2 - 5.8 fl oz	2 - 3 lb 2.1 - 5.3 lb 5 - 6 oz 6.4 - 25.6 oz 4.8 - 14.5 fl oz 2.0-2.8 fl oz 16 - 21.3 fl oz 0.9 - 1.9 fl oz 1.28 - 4 fl oz 6.4 - 12.8 oz 4 - 8 fl oz 2.5 - 5.1 fl oz 2.5 - 4 fl oz 2.5 - 5.1 fl oz 3.6 - 5.1 fl oz 4.0 - 7.0 oz	Peak hatch of redbanded leafroller usually coin- cides with petal fall. Control at this time helps prevent late-season problems. If plum curculio has been severe, increase Guthion or Imidan to high end rates. Use of pyrethroids (Asana Ambush, Danitol, Decis, Pounce, Proaxis, and Warrior) is likely to trigger mite outbreaks because these insec- ticides are persistent and they kill predaceous mites that feed on European red mite and two- spotted spider mite.
Leafrollers	Products listed above for three species combined Intrepid 2 F Confirm 2 F Esteem 35 WP SpinTor 2 SC Entrust 80 WP Proclaim 5SG Rimon 0.83EC Altacor 35 WDG Delegate 25 EG Belt 4 SC	2 - 4 fl oz 5 fl oz 1.25 - 2.5 oz 0.7 - 1.0 oz 0.8 - 1.2 oz	8 - 16 fl oz 20 fl oz 4 - 5 oz 5-10 fl oz 2 - 3 oz 3.2 - 4.8 oz 20 - 50 fl oz 2.5 - 4.5 oz 4.5 - 7.0 oz 3.0 - 5.0 fl oz	
Plum Curculio	Products listed above for three species combined Calypto 4 F Assail 30 SG Clutch 50 WDG Actara 25 WDG Surround	1 - 2 fl oz 25 - 50 lb	4 - 8 fl oz 8 oz 3 oz 4.5 - 5.5 oz	
Oriental Fruit Moth	Products listed above for three species combined Assail 30 SG Calypto 4 F Clutch 50 WDG Intrepid 2 F SpinTor 2 SC Entrust 80WP Rimon 0.83EC Altacor 35 WDG Delegate 25 WG	 1 - 2 fl oz 3 - 4 fl oz 1.25 - 2.5 fl oz 0.7 - 1.0 oz	5.0 - 8.0 oz 4 - 8 fl oz 3 - 6 oz 12 -16 fl oz 5 - 10 oz 2 - 3 oz 20 - 40 fl oz 2.5 - 4.5 oz 4.5 - 7.0 oz	Oriental fruit moth is not present in many Mid- western apple orchards.

Pest/Problem	Material	Rate/100 gal	Rate/ Acre	Comments
APPLE PETAL FALL (cont.)				
Spotted	Provado 1.6 F	2 fl oz	8 fl oz	Use Provado as soon as pollination is complete. Ambush and Pounce should not be used after petal fall. Use of Lannate, or pyrethroids (Ambush, Asana, Danitol, Decis, Pounce, Proaxis, or Warrior) may disrupt mite control because they kill predatory mites.
Tentiform	Assail 30 SG		2.5 - 4.0 oz	
Leafminer	Calypto 4 F	0.5 - 1 fl oz	2 - 4 fl oz	
(larvae), White	Clutch 50 WDG		2 - 3 oz	
Apple	Actara 25 WDG		2 - 5.5 oz	
Leafhopper,	Endosulfan 50 WP	1 lb	4 lb	
Aphids	Endosulfan 3 EC	0.7 qt	2.7 qt	
	Lannate LV (2.4 SL)	0.75 pt	3 pt	
	Lannate 90 SP	0.25 lb	1 lb	
	Ambush 25 WP		6.4 - 25.6 oz	
	Asana XL 0.66 EC	2 - 5.8 fl oz	4.8 - 14.5 fl oz	
	Danitol 2.4 EC		10.7 - 21.3 fl oz	
	Decis 1.5 EC		0.9 - 1.9 fl oz	
	Pounce 25 WP		6.4 - 12.8 oz	
	Pounce 3.2 EC		4 - 8 fl oz	
	Proaxis 0.5 EC		2.56 - 5.12 fl oz	
	Warrior 1 CS		2.56 - 5.12 fl oz	
	Mustang Max		1.28 - 4 fl oz	
	Baythroid		2.0 - 2.4 fl oz	
	Leverage 2.7 SE		3.0 - 5.1 fl oz	
	Voliam Flexi 40 WDG		4.0 - 7.0 oz	
Spotted	Products listed above for three pests combined			Treat if miners 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 or SpinTor with horticultural oil or a penetrating surfactant.
Tentiform	Agri-Mek 0.15 EC	2.5 - 5 fl oz	10 - 20 fl oz	
Leafminer	SpinTor 2 SC	1 - 2.5 fl oz	4 - 10 fl oz	
(larve)	Entrust 80 WP	0.5 - 1.0 oz	1.5 - 3 oz	
	Esteem 35 WP		3 - 5 oz	
	Carzol 92 SP	4 - 5 oz	1 - 1.25 lb	
	Renounce 20WP		2.5 - 3.0 fl oz	
	Rimon 0.83EC		15 - 40 fl oz	
	Baythroid		2.0 - 2.4 fl oz	
	Altacor 35 WDG		2.5 - 4.5 oz	
	Delegate 25 WG		4.5 - 7.0 oz	
White Apple	Products listed above for three pests combined			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.
Leafhopper	Carzol 92 SP	2 - 4 oz	0.5 - 1 lb	
	Admire 2F		16 - 24 fl oz	
	Admire Pro		7.0 - 10.5 fl oz	
	FujiMite 5 EC		1 - 2 pt	
	Agri-Mek 0.15 EC	2.5 - 5 fl oz	10 - 20 fl oz	
	Centaur 70WP		34.5 oz	
	Renounce 20WP		1.8 - 2.5 oz	
Aphids	Products listed above for three pests combined			Rosy apple aphid is best treated at pink, but there is some chance to control it at petal fall if infestations are noticeable.
	Esteem 35 WP		3 - 5 oz	
	Admire 2F		16 - 24 fl oz	
	Admire Pro		7.0-10.5 fl oz	
	Beleaf 50 SG		2.0-2.8 oz	
	Movento 2		6.0 - 9.0 fl oz	
Mites	Apollo SC	1 - 2 fl oz	4 - 8 fl oz	For Nexter, use low rate for European red mite or high rate for 2-spotted mite. For Acramite use low rate for 2-spotted mite or high rate for European red mite. AgriMek is most effective if applied before leaves harden off.
	Savey 50 W		3 - 6 oz	
	Agri-Mek 0.15 EC	2.5 fl oz	10 fl oz	
	Nexter 75 WP		4.4 - 5.2 oz	
	FujiMite 5 EC		1 - 2 pt	
	Carzol 92 SP	4 - 5 oz	1 - 1.25 lb	

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
APPLE PETAL FALL (cont.)				
Acramite 50 WS	0.75 - 1 lb			
Zeal 72 WP	2 - 3 oz			
Envidor 2 SC	16 - 18 fl oz			
Kanemite 15 SC	21 - 31 fl oz			
For Thinning Summer Varieties	Refer to section on thinning (page 44)			
Nutrient level	Solubor (boron)	1 lb	4 lb	May be added to insecticide/fungicide spray solutions, but check for compatibility, order of mixing, etc.
	AND/OR Feed Grade Urea	2 lb	8 lb	

APPLE FIRST AND SECOND COVER

7 to 10 days after petal fall and 7 to 10 days later

Scab and Fruit Rots	¹ Captan 50 WP	1.5 lb	6 lb	¹ See note on Captan on page 16.
	Ziram 76 DF	2 lb	6 - 8 lb	
	Mancozeb 75 DF or	12 oz	3 lb	² 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.
	Polyram 80 DF or	12 oz	3 lb	
	² Topsin-M 70 WSB	4 - 6 oz	1 - 1.5 lb	
	<i>plus</i> Captan 50 WP or	1 lb	4 lb	
	Mancozeb 75 DF or	12 oz	3 lb	
Polyram 80 DF or	12 oz	3 lb		
Ziram 76 DF	1.5 - 2 lb	6 - 8 lb		
Scab, Rust, Powdery Mildew and Fruit Rots	Bayleton 50 WP	0.5 - 2 oz	2 - 8 oz	³ The sterol-inhibiting fungicides do not provide adequate control of fruit scab when applied alone. They should be combined with a protectant fungicide. The sterol-inhibiting fungicides do not control fruit rots.
	³ Nova 40 WP	1.25 - 2 oz	5 - 8 oz	
	³ Rubigan EC	3 fl oz	8 - 12 fl oz	
	³ Procure 50 WP	3 - 4 oz	12 - 16 oz	⁴ See note on Inspire MP on page 3.
	⁴ Inspire Super MP		6 - 8 fl oz	
	Indar 2F		4 - 6.4 oz	
	Sovran 50 WG	1 - 1.6 oz	2 - 2.5 oz	
	Flint 50 WG		14.5 - 18.5 oz	⁵ See note on Mancozeb and Polyram below.
	Pristine 38 WG			
	<i>Plus</i> Captan 50 WP or	1.5 lb	6 lb	Sprays after second cover for powdery mildew control should be based on previous field history and orchard scouting.
³ Mancozeb 75 DF or	12 oz	3 lb		
³ Polyram 80 DF or	12 oz	3 lb		
Ziram 76 DF	1.5 - 2 lb	6 - 8 lb		
				Fungicide Resistance Management: See note comments on page 16.

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 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 lbs 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.

Pest/Problem	Material	Rate/100 gal	Rate/ Acre	Comments
APPLE FIRST AND SECOND COVER (cont.)				
Blister Spot on Mutsu	Streptomycin 17 W	0.5 lb	2 lb	
Codling moth, Oriental fruit moth	Guthion, Imidan, Mustang Max, Renounce, Assail, Calypso, Clutch, Asana, Baythroid, Danitol, Decis, Proaxis, Warrior, Leverage, or Voliam Flexi as listed at petal fall for plum curculio (page 6) OR Rimon 0.83 EC Cyd-X Virosoft CP4 Carpovirusine Confirm 2F Intrepid 2F Altacor 35 WDG Belt 4 SC	1 pt	20 - 40 fl oz 1-6 fl oz 1.3 fl oz 20 fl oz 12 - 16 fl oz 2.5 - 4.5 oz 3.0 - 5.0 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 15. Virus products (Cyd-X, Virosoft, Carpovirusine) are for codling moth only. Virus products should be applied at weekly intervals. Belt is not labeled for Oriental fruit moth.
Plum curculio	Guthion, Imidan, Avaunt, Actara Asana, Avaunt, Calypso, Clutch, Baythroid, Danitol, Decis, Mustang Max, Proaxis, Renounce, Warrior, Surround, Leverage, or Voliam Flexi, as listed at petal fall (page 6)			Timing for plum curculio usually extends through first cover.
Leafrollers	Guthion, Imidan, Asana, Baythroid, Danitol, Decis, Mustang Max, Proaxis, Renounce Warrior, Altacor, Leverage, Delegate, Spintor, Entrust, Confirm, Intrepid, Rimon, or Voliam Flexi as listed at petal fall (page 6)			
Mites	Same as for mites at petal fall (page 7) except do not use Carzol.			See miticide section on page 15.
San Jose Scale (crawlers)	Diazinon 50 WP Esteem 35 WP Provado 1.6 F Assail 30SG Centaur 70 WP Renounce 20 WP Baythroid Movento 2	1 lb 2 fl oz 3.0 - 3.5	4 lb 4 - 5 oz 8 fl oz 8 oz 34.5 oz 2.4 - 2.8 fl oz 6.0 - 9.0 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
Green Apple Aphid	Same as for aphids at petal fall (page 7)			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 44).			
Cork Spot, Bitter Pit and Jonathan Spot	Calcium chloride	2 lb	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.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
APPLE THIRD COVER				
10 days after second cover				
Scab, Fruit Rots, Sooty Blotch and Flyspeck	¹ Captan 50 WP Ziram 76 DF Topsin-M 70 WSB <i>plus</i> ¹ Captan 50 WP or Ziram 76 DF Sovran 50 WG Flint 50 WG Pristine 38 WG	1.5 lb 1.5 - 2 lb 4 - 6 oz 1.5 lb 1.5 - 2 lb 1 - 1.6 oz	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	¹ See note on Captan on page 16. 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.
Codling Moth, Leafrollers, Oriental Fruit Moth	Same as for first and second cover (page 9)			
White Apple Leafhopper	Same as for petal fall (page 7) except do not use Ambush or Pounce OR Sevin XLR(4 EC)	0.5 qt	0.5 - 1.5 qt	Delay use of Sevin until at least 30 days after full bloom to avoid fruit thinning.
Apple Maggot	Guthion 50 WP Imidan 70 WP Sevin XLR(4EC) Calypso 4 F Assail 30 SG Clutch 50 WDG Asana XL Baythroid Danitol 2.4 EC Decis 1.5 EC Proaxis 0.5 EC Warrior 1 CS Avaunt 30 WDG Entrust 80 WP Mustang Max Provado 1.6F Renounce 20 WP Altacor 35 WDG Leverage 2.7 SE Delegate 25 WG	0.5 - 0.75 lb 0.75 - 1 lb 0.75 qt 1 - 2 fl oz 2 - 5.8 fl oz	2 - 3 lb 2.1 - 5.3 lb 3 qt 4 - 8 fl oz 8 oz 3 oz 4.8 - 14.5 fl oz 2.4 - 2.8 fl oz 16 - 21.3 fl oz 0.9 - 1.9 fl oz 2.5 - 5.1 fl oz 2.5 - 5.1 fl oz 6 oz 2 - 3 oz 1.28 - 4 fl oz 8 fl oz 3.0 - 3.5 oz 2.5 - 4.5 oz 4.4 - 5.1 fl oz 6.0 - 7.0 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. Use of pyrethroids (Asana, Ambush, Pounce, Danitol, Proaxis, and Warrior) or Sevin is likely to trigger mite outbreaks because these insecticides kill predaceous mites that feed on European red mite and two-spotted spider mite.
Aphids	Same as for petal fall (page 7)			
Mites	Same as for first cover (page 9) OR Vydate L		2 - 4 pt	Refer to miticide section on page 15. 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 9)			
Cork Spot, Bitter Pit, and Jonathan Spot	Same as for first cover (page 9)			

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
APPLE SUMMER COVER SPRAYS				
Depending on rainfall, apply at intervals of 10 to 14 days				
Scab, Fruit Rots, Sooty Blotch and Flyspeck	Same as for third cover			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.
Codling Moth	Same as for first and second cover (page 9)			Apply Intrepid or Confirm at the initiation of egg hatch for the second generation, 1200 degree days after biofix.
Apple Maggot	Same as for third cover (page 10)			
Mites	Same as for third cover (page 10)			Refer to the miticides on page 15.
Leafhoppers	Same as for third cover (page 10)			
Spotted Tentiform Leafminer	Same as for petal fall (page 7) except do not use Ambush or Pounce OR Vydate 2 L	1 - 2 pt	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 9) OR <i>Bacillus thuringiensis</i> (Agree, Biobit, Dipel Javelin, 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 EC) Neemix 4.5 Assail 30 SG Warrior 1CS Proaxis 0.5 EC Mustang Max	0.75 - 1 lb 0.75 qt	2.1 - 5.3 lb 3 qt 7 - 16 fl oz 5.0 - 8.0 oz 2.5 - 5.1 fl oz 2.5 - 5.1 fl oz 1.28 - 4 fl oz	
Woolly Apple Aphid	Diazinon 50 WP Endosulfan 3 EC Endosulfan 50 WP Admire 2F Admire Pro Movento 2	1 lb 0.7 qt 1 lb	4 lb 2.7 qt 4 lb 16 -24- fl oz 7 - 10.5 fl oz 6.0 - 9.0 fl oz	Admire is only for soil application
Aphids	Same as for petal fall (page 7)			
Cork Spot, Bitter Pit and Jonathan Spot	Same as for first cover (page 8)			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	Mode of Action Group (IRAC)	Predator Mites	Codling 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	Two spotted Mite	Apple rust Mite
Organophosphates																					
Diazinon	1 B	ST	F	F	G	G	G	F	P	-	F	G	G	F	-	F	-	G	-	-	-
Guthion	1 B	ST	F	F	F	F	G	G	P	P	P	P	P	P	P	-	F	F	-	-	-
Imidan	1 B	ST	G	G	F	F	G	G	P	P	P	P	P	P	P	-	-	F	-	-	-
Lorsban	1 B	MT	-	-	-	-	G	G	G	-	G	P	-	-	-	-	G	F	-	-	-
Supracide	1 B	MT	-	-	-	-	F	-	F	-	F	F	-	-	-	-	-	F	-	-	-
Neonicotinoids																					
Actara	4A	MT	-	G	-	-	-	-	G	-	F	F	-	F	-	G	-	-	-	-	-
Admire	4A	-	-	-	-	-	-	-	-	-	F	F	-	-	-	-	-	-	-	-	-
Assail	4A	ST	F	G	G	F	-	-	G	G	F	F	-	F	-	F	G	G	-	-	-
Calypso	4A	MT	F	G	G	G	-	-	G	-	F	F	-	F	-	F	-	-	-	-	-
Clutch	4A	MT	G	G	-	-	-	-	-	-	F	F	-	F	-	F	-	-	-	-	-
Provado	4A	MT	-	-	-	-	-	-	F	-	F	F	G	F	-	F	F	G	-	-	-
Insect Growth Regulators																					
Centaur	16	ST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	G	-	-	-
Confirm	18 A	ST	F	-	-	P	F	F	-	-	-	-	-	-	-	F	-	F	-	-	-
Esteem	7 C	ST	F	-	-	-	-	-	-	-	E	-	-	-	-	G	-	F	-	-	-
Intrepid	18 A	ST	G	-	-	G	F	F	-	-	-	-	-	-	-	G	-	-	-	-	-
Neemix, AzaDirect	18 B	ST	-	-	-	-	-	-	-	-	-	G	-	-	-	-	G	-	-	-	-
Rimon	15	ST	E	-	-	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrethroids																					
Asana	3	HT	E	G	G	E	E	G	E	E	G	F	P	G	E	O	E	O	-	-	-
Baythroid	3	HT	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-	-	-	-	-
Danitol	3	HT	E	G	G	E	E	G	E	E	F	F	P	G	E	P	E	P	F	F	-
Decis	3	HT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Permethrin	3	HT	-	G	-	E	E	G	E	-	G	G	P	G	E	P	-	P	-	-	-
Proaxis	3	HT	E	G	G	G	E	G	E	-	G	G	P	E	E	E	E	P	-	-	-
Warrior	3	HT	E	E	F	E	E	F	E	-	G	G	P	E	E	P	E	P	-	-	-
Carbamates																					
Carzol	1 A	HT	-	-	-	-	-	-	G	-	-	-	-	E	G	-	-	-	G	G	-
Lannate	1 A	HT	G	F	F	G	F	F	G	G	-	G	P	E	G	F	F	F	-	-	-
Sevin	1 A	HT	G	G	G	G	F	F	-	G	F	G	P	G	-	F	F	F	-	-	-
Vydate	1 A	HT	-	-	-	-	-	-	G	G	G	G	P	G	-	G	-	-	G	G	-
Other																					
Avaunt	22	MT	F	G	F	G	G	F	G	-	-	-	-	G	-	P	-	-	-	-	-
B.T. (Dipel, etc.)	11 B2	NT	F	-	-	F	-	G	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyd-X, Virosoft	-	NT	F	-	-	F	-	G	-	-	-	-	-	-	-	-	-	-	-	-	-
Proclaim	6	-	F	-	-	F	E	E	-	-	-	-	-	-	-	-	-	-	-	-	-
SpinTor/Entrust	5	ST	G	P	F	F	G	G	-	-	-	-	-	-	-	E	-	-	-	-	-
Surround	-	MT	P	F	P	F	-	-	-	-	-	-	-	G	-	-	-	-	-	-	-
Endosulfan, Thionex	2A	ST	F	F	F	E	G	F	G	-	G	G	F	F	G	P	-	F	-	-	-
Altacor	-	-	E	-	-	E	E	E	-	-	-	-	-	-	-	-	-	-	-	-	-
Belt	-	-	E	-	-	E	E	E	-	-	-	-	-	-	-	-	-	-	-	-	-
Movento	-	-	-	-	-	-	-	-	-	-	G	G	G	-	-	-	-	G	-	-	-
Miticides																					
Acramite	25	ST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	F	G	G
Agri-Mek	6	MT	-	-	-	-	-	-	-	-	-	-	-	G	-	F	-	-	-	-	-
Apollo	10 A	ST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	F	F	G
Envidor	23	MT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	F	F	G
FujiMite	21	MT	-	-	-	-	-	-	-	-	-	-	-	E	-	-	-	-	F	F	G
Kanemite	20 B	ST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	F	F	G
Kelthane	-	HT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	F	F	G
Nexter	21	HT	-	-	-	-	-	-	-	-	-	-	-	G	-	-	-	-	F	F	F
Savey	10 A	ST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	F	F	F
Vendex	12 B	ST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	F	F	F
Zeal	10 B	MT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	F	F	F

- = 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

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 EC 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 EC will not revitalize trees showing moderate to severe crown rot symptoms. Mix 0.5 pint of Ridomil Gold EC 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 the 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 or spray bare roots with solutions containing Ridomil Gold EC.

(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 3 or 4 times at 5 lb/100 gal on a 60-day spray interval, or 6 to 8 times at 2.5 lbs/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 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, Pro Phyt, 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 1/4- to 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 1/4- to 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. 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.

Special Problems and Pests of Apple (cont.)

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 non-ionic 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. Mode of action groups are shown in the table on page 12.

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, Decis, 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, will also 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 75 WG at a rate of 2 lb per 100 gallons of spray, or Lorsban 50 W at a rate of 3 lb 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.

Special Problems and Pests of Apple (cont.)

Periodical Cicadas

Periodical cicadas are orange to black, about 1 1/2 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 1 1/2 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, preferable 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 seven to 10 days later. Pyrethroids are recommended to control periodical cicada, but these applications may lead to mite outbreaks.

Pyrethroid Insecticides

Use of pyrethroid insecticides (Ambush, Asana, Danitol, Decis, Pounce, Proaxis, or Warrior) is likely to cause mite outbreaks. These materials are highly toxic to predatory mites that feed on spider mites and have a long residual activity. Danitol is a pyrethroid that is toxic to spider mites. Use of Danitol is less likely to lead to spider mite outbreaks than other pyrethroids.

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 100 Gal.	Rate Per Acre	Days to Harvest	MOA Group ^f
"Superior oil"	2 gal	-----	(Before pink)	
Acramite 50 WS		0.75 - 1 lb	7	25
AgriMek 0.15 EC ^a	2.5 fl oz	10 fl oz	28	6
Apollo SC	1 - 2 fl oz	4 - 8 fl oz	45	10A
Carzol 92 SP	4 - 5 oz	1 - 1.25 lb	(By petal fall)	1A
Dicofol 1.6 EC	1.5 qt	4 - 10 qt	14	UN
Envidor 2 SC		16 - 18 fl oz	7	23
FujiMite 5 EC		1 - 2 pt	14	21
Kanemite 15 SC		21 - 31 fl oz	14	20B
Kelthane 50 W*	0.75 - 1.5 lb	3 - 6 lb	7	UN
M-Pede ^{b,c}	1 - 2%	1.2 gal	++	
Nexter 75 WP ^d		4.4 - 10.67 oz	25	21
Saf-T-Side ^b	1 - 2%	-----	++	
Savey 50 WP		3 oz	28	10A
SunSpray ^b	1 - 2%	1 - 2 gal	++	
Vendex 50 W	4 - 8 oz	1 - 2 lb	14	12B
Vydate L ^e		2 - 4 pt	14	1A
Zeal 72 WP		2 - 3 oz	14	10B

++ Apply before waxy bloom forms on fruit.

^a Apply within 2 weeks after petal fall.

^b Do not use with Captan, Sevin, or other sulfur containing products.

Do not apply when temperatures exceed 90°F.

^c Not very effective alone. Enhances efficacy of other miticides.

^d Allow at least 30 days between sequential applications.

^e Vydate may cause fruit thinning if used within 30 days of bloom.

* Not permitted for use in Wisconsin.

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

Special Problems and Pests of Apple (cont.)

Timing of First^a Insecticide Spray for Codling Moth Control on Apple and Pear

Degree-days (base 50 F) after biofix ^b	Insecticide Products
50 – 75	Dimilin Rimon
100 – 200	Intrepid Confirm
150 – 250	Calypso Assail Clutch
250	Guthion Imidan Avaunt Pyrethroids (Asana, Baythroid, Danitol, Decis, Mustang Max, Proaxis, Renounce, Warrior) Virus (Cyd-X, Carpovirusine, Virosoft CP4)

^a A second spray should be made 10 - 14 days later.

^b Biofix is defined as the date on which pheromone traps detect sustained flight of moths.

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 leafhopper 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 nonbearing 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 and Procure) and the strobilurin fungicides (Sovran, Pristine and Flint). 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 also 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 and the strobilurin 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

About 400 gallons of dilute spray are required to adequately cover an acre of mature pear trees in full leaf, 16 to 18 feet in height, and in rows 30 feet apart.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
PEAR DORMANT TO SILVER TIP				
Apply before growth starts in spring and when temperatures are above 45 F				
Fire Blight	Fixed copper fungicides (Copper hydroxide) (Copper oxychloride) (Basic copper sulfates)			If fire blight was severe last year, a fixed copper spray at silver tip is suggested. Do not apply copper after 1/4-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 pears. Fixed coppers can be mixed with oil. However, never combine copper sulfate alone with dormant oil.
PEAR LATE DORMANT				
Before buds break into green tip in the spring				
Scale Insects, European Red Mite eggs	Superior oil	2 gal		Apply when temperatures are above 40 F - never during freezing weather . Do not apply within 2 weeks of a sulfur spray, within 7 days of a Captan spray, or later than delayed dormant.
European Red Mite eggs	Apollo SC Savey 50 WP	1 - 2 fl oz	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 Decis 1.5 EC Pounce 25 WP Pounce 3.2 EC Proaxis 0.5 EC Warrior 1 CS Calypso 4 F Actara 25 WDG Assail 30 SG Esteem 35 WP Dimilin 25 W Dimilin 2 L Surround Lorsban Mustang Max Delegate 25 WG	7.3 -12.8 fl oz	12.8 - 25.6 oz 9.6 - 19.2 fl oz 16 - 21.3 fl oz 1.9 fl oz 12.8 - 25.6 oz 8 - 16 fl oz 2.5 - 5.1 fl oz 2.5 - 5.1 fl oz 2 fl oz 8 fl oz 5.5 oz 4.0 - 8.0 oz 4 - 5 oz 2.5 - 3 lb 40 - 48 fl oz 50 lb 0.33 - 0.67 lb 1.28 - 4 fl oz 6.0 - 7.0 oz	Ambush and Pounce may be combined with 2 to 8 gallons of oil per acre for dormant through delayed dormant periods only. Apply this rate of Asana only during dormant to pre-bloom (white bud) stage only. Apply Surround every 7 to 14 days, beginning no later than green tip.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments	
PEAR PRE-BLOOM					
When blossom buds are separated in the cluster before bloom					
Pear Scab	Topsin-M WSB	4 oz	1 lb	¹ Rubigan and Procure will also control powdery mildew. Refer to the label for further information on recommended rates for use.	
	Ferbam 76 WP	1.5 lb	6 lb		
	¹ Rubigan EC	3 - 4 fl oz	8 - 12 fl oz		
	¹ Procure 50 WP	2 - 4 oz	8 - 16 oz		
	² Mancozeb 75 DF	Ziram 76 DF	0.75 - 1.5 lb	3 - 6 lb	² See Note on EBDC products, page 3 of apple schedule, for directions on use of Mancozeb.
		Ziram 76 DF	2 lb	6 - 8 lb	
	³ Sovran 50 WG	1 - 1.6 oz	2 - 2.5 oz	³ Sovran, Flint and Pristine also will control powdery mildew. Refer to the label for further information.	
	³ Flint 50 WG		2 - 2.5 oz		
	³ Pristine 38 WG		14.5 - 18.5 oz		
	Scala 5 SC		7 - 10 fl oz		
Vanguard 75 WG		5 oz			
⁴ Inspire Super MP			⁴ See comments on page 3		
Pear Psylla (adults)	Same as for late dormant (page 17)				

PEAR BLOOM

Pear Scab	Same as for pre-bloom (above)			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	4 - 8 oz	1.5 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).
	Streptomycin 17 W	4 oz	1 lb	
	<i>plus</i>			
	Regulaid	1 pt	1 pt	
	Mycoshield 17 WP		1 lb	
	Flame Out 17 WP		1 lb	
Insects or Mites	SAVE THE BEES! Do not use insecticides during bloom.			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.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
PEAR PRE-BLOOM				
When blossom buds are separated in the cluster before bloom				
Pear Scab	Same as for pre-bloom (page 18)			Continue sprays for fire blight until the last petals have fallen.
Fire Blight	Same as for bloom (page 18)			
Plum Curculio, Tarnished Plant Bug, Stink Bugs	Guthion 50 WP	0.5 - 0.75	2 - 3 lb	
	Imidan 70 WP	0.75 - 1 lb	2.13 - 5.3 lb	
	Danitol 2.4 EC		16 - 21.3 fl oz	
	Warrior 1 CS		2.5 - 5.1 fl oz	
	Proaxis 0.5 EC		2.5 - 5.1 fl oz	
	Capture 2 E		2.6 - 12.8 fl oz	
	Decis 1.5 EC		0.9 - 1.9 fl oz	
	Baythroid		2.0 - 2.8 fl oz	
	Mustang Max		1.28 - 4 fl oz	
	Renounce		2.5 - 3.5 oz	
	Voliam Flexi 40 WDG		6.0 - 7.0 oz	
Pear Psylla (nymphs)	Actara, AgriMek Assail, Calypso, or Esteem as at late dormant (page 17) OR			
	Provado 1.6 F	5 fl oz	20 fl oz	
	Clutch 50 WDG		4 - 6 oz	
	Nexter 75 WP		6.6 - 10.7 oz	
	Fujimite 5 EC		1 - 2 pt	
	Centaur 70 WP		34.5 oz	
	Movento 2		6.0 - 9.0 fl oz	
	Delegate 25 WG		6.0 - 7.0 oz	
	Voliam Flexi 40 WDG		7.0 oz	
	Pear Rust Mite	Agri-Mek 0.15 EC	2.5 - 5 fl oz	10 - 20 fl oz
Nexter 75 WP			5.2 - 10.7 oz	
Envidor 2 SC			16 - 18 fl oz	
Carzol 92 SP		4 oz	1.0 - 1.25 lb	
Endosulfan 50 WP		1 lb	4 - 5 lb	
Endosulfan 3 EC		0.7 qt	2.7 - 3.3 qt	

PEAR FIRST AND SECOND COVER

10 to 14 days after petal fall and 10 to 14 days later

Pear Scab	Same as for pre-bloom (page 18)			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 - 75 degree-days after codling moth biofix (see page 16).
Codling Moth, Plum Curculio	Same as for plum curculio at petal fall. (above) OR			
	Assail 30 SG		4.0 - 8.0 fl oz	
	Dimilin 25 W		0.75 - 1 lb	
	Dimilin 2 L		12 - 16 fl oz	
	Altacor 35 WDG		2.5 - 4.5 oz	
	Belt 4 SC		3.0 - 5.0 fl oz	
Pear Psylla	Same as at petal fall. (above) OR			Psylla control required for first cover only; not required for second cover. Best results found when psylla is in adult or young nymphal stage. Agri-Mek at 10 oz rate gives 3-4 weeks of control; 20 oz rate gives season-long control.
	Agri-Mek 0.15 EC	2.5 - 5 fl oz	10 - 20 fl oz	

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
PEAR SUMMER COVERS				
Apply at 10 to 14 day intervals observing harvest restrictions and limitations				
Pear Scab, Sooty Blotch and Flyspeck	Same as for pre-bloom except for Vanguard ¹ , Scala ¹ and Mancozeb ² . (page 18)			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	Guthion 50 WP	0.5 - 0.75 lb	2 - 3 lb	¹ Vanguard and Scala have a 72-day PHI. ² See note on Mancozeb on page 3. All Mancozeb products have a 77-day PHI.
	Imidan 70 WP	0.75 - 1 lb	2.1 - 5.3 lb	
	Calypso 4 F	1 - 2 fl oz	4 - 8 fl oz	
	Assail 30 SG		4 - 8 oz	
	Clutch 50 WDA		3 - 6 oz	
	Intrepid 2 F	4 fl oz	16 fl oz	
	Confirm 2 F	0.75 qt	20 fl oz	
	Dimilin 25 W		0.75 - 1 lb	
	Dimilin 2 L		12 - 16 fl oz	
	Asana XL	2 - 5.8 fl oz	4.8 - 14.5 fl oz	
	Capture 2 E		2.6 - 12.8 fl oz	
	Danitol 2.4 EC	5 fl oz	16 - 21.3 fl oz	
	Decis 1.5 EC		0.9 - 1.9 fl oz	
	Proaxis 0.5 EC		2.5 - 5.1 fl oz	
	Warrior 1 CS		2.5 - 5.1 fl oz	
	Sevin XLR(4EC)	0.75 qt	3 qt	
	SpinTor 2 SC	1.25 - 5.0 fl oz	5 - 10 fl oz	
	Entrust 80 WP	0.7 - 1.0 oz	2 - 3 oz	
	Mustang Max		1.28 - 4 fl oz	
	Renounce 20 WP		2.5 - 3.5 oz	
Avaunt 30 WDG		5 - 6 oz		
Baythroid		2 - 2.4 fl oz		
Altacor 35 WDG		2.5 - 4.5 oz		
Voliam Flexi 40 WDG		4.0 - 7.0 oz		
Delegate 25 WG		4.5 - 7.0 oz		
Belt 4 SC		3.0 - 5.0 fl oz		
Pear Psylla (if a problem)	Same as at first cover (page 19)			
San Jose Scale (crawlers)	Esteem 35 WP		4 - 5 oz	
	Diazinon 50 W	1 lb	4 lbs	
	Provado 1.6 F	2 fl oz	8 fl oz	
	Assail 30 SG		8 oz	
	Centaur 70 WP		34.5 oz	
	Renounce		3.0 - 3.5 oz	
	Movento 2		6.0 - 9.0 fl oz	
European Red Mite	Savey 50 DF		3 - 6 oz	
	Apollo 1 SC		4 - 8 fl oz	
	Agri-Mek 0.15 EC	2.5 - 5 fl oz	10 - 20 fl oz	
	Acramite 50 WS		0.75 - 1 lb	
	FujiMite 5 EC		1 - 2 pt	
	Kanemite 15 SC		21 - 31 fl oz	
	Envidor 2 SC		16 - 18 fl oz	
Nexter 75 WP		4.4 - 5.2 oz		
Mealybug	Provado 1.6 F	5 fl oz	20 fl oz	
	Actara 25 WDG		4.5 - 5.5 fl oz	
	Calypso 4 F	1 - 2 fl oz	4 - 8 fl oz	
	Assail 30 SG		4 oz	
	FujiMite		1 - 2 pt	
	Movento 2		6.0 - 9.0 fl oz	

CHERRY

About 300 gallons of dilute spray are required to adequately cover an acre of mature cherry trees in full leaf, 14 to 16 feet in height, and in rows 30 feet apart.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
CHERRY DORMANT				
Before buds break in the spring				
European Red	Superior oil	2 gal		
Mite eggs	Apollo SC	0.5 - 2 fl oz	2 - 8 fl oz	

CHERRY EARLY BLOOM

Brown Rot (Blossom Blight) <i>plus</i>	¹ Topsin-M 70 WSB	8 oz	1.5 lb	¹ 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). ² See note for Captan on page 16. ³ No more than two sprays of Rovral may be applied per season, and Rovral cannot be applied after petal fall on any stone fruit. ⁴ 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. ⁵ Apply Indar and Orbit in a minimum of 50 gallons of water per acre.
	² Captan 50 WP	1.3 lb	4 lb	
	² Captan 50 WP	1.3 lb	4 lb	
	³ Rovral 50 WP	5 - 10.5 oz	1 - 2 lb	
	Wettable sulfur 95%	6 lb	18 lb	
	⁴ Rally 40 WSP	1.25 - 2 oz	2.5 - 6 oz	
	⁵ Indar 75 WSP		2 oz	
	Elite 45 DF	2 oz	6 oz	
	⁵ Orbit 41.8 L		4 fl oz	
	Procure 50 WS	3 - 4 oz	9 - 12 oz	
	Pristine 38 WG	3.5 - 4.8 oz	10.5 - 14.5 oz	
	Elevate 50 WG		1 - 1.5 lb	
	Captevate 68 WDG		3.75 lb	
	Adament 50 WG		4 - 8 oz	
Quash 50 WDG		2.5 - 3.5 oz		

CHERRY FULL BLOOM

Brown Rot (Blossom Blight)	Same as for early bloom (above)
Insects or Mites	SAVE THE BEES! Do not apply insecticides during bloom.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
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CHERRY FIRST COVER SPRAY

10 days after shuck-fall

Leaf Spot	Same as for shuck-fall except not Bravo (page 22)		Do not apply Bravo after shuck-fall.	
Powdery Mildew and Leaf Spot	*Same as for petal fall or a copper fungicide (page 22)		*See comments on the use of copper for leaf spot control on page 24.	
Plum Curculio and Cherry	Guthion 50 WP	0.5 lb	1.5 lb	Note: Lorsban may be used on tart cherries only. It is phytotoxic on sweet cherries.
Fruit Fly	Imidan 70 WP	0.75 lb	2.1 - 2.5 lb	
	Lorsban 50 WP	1 lb	3 lb	
	Lorsban 75 WG		2 lb	
	Asana XL 0.66 EC	2 - 5.8 fl oz	4.8 - 14.5 fl oz	
	Warrior 1CS		2.5 - 5.1 fl oz	
	Baythroid		2.4 - 2.8 fl oz	
	Mustang Max		1.28 - 4 fl oz	
	Proaxis 0.5 EC		2.56 - 5.12 fl oz	
	Renounce 20 WP		3.0 - 3.5 oz	
	Assail 30 SG		5.3 - 8.0 oz	
	Voliam Flexi 40 WDG		6.0 - 7.0 oz	
	Leverage 2.7 SE		4.4 - 5.1 fl oz	
Cherry Fruit Fly	Products listed above for two pests			
	Provado 1.6 F	2 fl oz	4 - 8 fl oz	
	Entrust 80 WP	0.4 - 0.8 oz	1.25 - 2.5 oz	
	Delegate 25 WG		4.5 - 7.0 oz	

CHERRY SECOND COVER SPRAY

10 days after first cover

Leaf Spot	Same as for shuck-fall, except not Bravo (page 22)		Do not apply Bravo after shuck-fall.
Powdery Mildew	Same as for petal fall (page 22)		
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

Brown Rot	Same as for early bloom, except not Rovral (page 21)		Do not apply Rovral after petal fall.	
Leaf Spot	Same as for shuck-fall, except not Bravo (page 22)		Do not apply Bravo after shuck-fall.	
Powdery Mildew	Same as for petal fall (page 22)			
Cherry Fruit Fly	Guthion, Imidan, Proaxis, Renounce, Asana, Provado, Mustang Max, Baythroid, Warrior, Entrust, Assail, Voliam Flexi, Delegate, or Leverage, same as first cover (page 23) OR			
	Diazinon 50 WP	1 lb	3 lb	Note: Lorsban may be used on tart cherries only. It is phytotoxic on sweet cherries.
	Diazinon AG 600	6.5-12.7 fl oz	19.5-38.2 fl oz	
	Sevin XLR (4EC)	1 qt	3 qt	
	Lorsban 50 WP	1 lb	3 lb	
	Lorsban 75 WG		2 lb	
Borer Control				Refer to section on borers of peach and stone fruit trees on pages 33-34.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
CHERRY PRE-HARVEST SPRAYS				
Beginning 3 to 4 weeks before harvest				
Brown Rot	Topsin-M 70 WSB	8 oz	1.5 lb	Pre-harvest use restrictions and limitations are variable according to product; refer to label for details. ¹ See note on Captan on page 16. ² Gem provides excellent control of cherry leaf spot, but is weak on brown spot
	<i>plus</i>			
	¹ Captan 50 WP	1.3 lb	4 lb	
	Captan 50 WP	1.3 lb	4 lb	
	Indar 75 WSP		2 oz	
	Elite 45 DF	2.6 oz	8 oz	
	Orbit 41.8 L		4 fl oz	
	Procure 50 WS	4 - 5.3 oz	12 - 16 oz	
	Pristine 38 WG	3.5 - 4.8 oz	10.5 - 14.5 oz	
	Elevate 50 WDG		1 - 1.5 lb	
	Captevate 68 WDG		3.75 lb	
² Gem 25 WG		4 - 8 oz		
Adament 50 WG		4 - 8 oz		

CHERRY POST-HARVEST SPRAYS

Leaf Spot	¹ Bravo	1 - 1.4 pt	3 - 4 pt	¹ 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.
	Syllit 65 WP	5.2 - 11 oz	1 - 2 lb	
	Rally 40 WSP	0.8 - 2 oz	2.5 - 6 oz	
	Elite 45 DF	2.6 oz	8 oz	
	Adament 50 WG		4 - 8 oz	
	Orbit 41.8 L		4 oz	
Leaf Spot and Powdery Mildew	Rally 40 WSP	0.8 - 2 oz	2.5 - 6 oz	
	Indar 75 WSP		2 oz	
	Elite 45 DF	2.6 oz	8 oz	
	Pristine 38 WG	3.5 - 4.8 oz	10.5 - 14.5 oz	
	Adament 50 WG		4 - 8 oz	

Integrated Copper/Sterol Inhibitor/Strobilurin Program for Cherry Leaf Spot Management

(rates per acre; spray on 10- to 14-day interval)

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.

Late Petal Fall or Shuck Split Stage: Bravo WeatherStik 4 pt

1st Cover: Copper (e.g., Kocide 2000 5 lb)

2nd Cover: Gem 4 oz **OR** Pristine 14.5 oz

3rd Cover: Copper (e.g. Kocide 2000 5 lb)

4th Cover: Elite 6 oz

5th Cover (if needed before harvest): Pristine 10.5 oz

Post-harvest: Bravo WeatherStik 4 pt

Comments on copper integrated program:

- Copper fungicides can cause leaf bronzing and russetting. Research is on-going to determine if this affects photosynthesis. It does not noticeably affect yield or fruit quality. Adding lime to COCS (copper oxychloride) is recommended on the label to prevent plant injury.
- Trees under drought stress may be more susceptible to premature defoliation from copper injury. Therefore, irrigate copper-treated trees in dry weather.

- 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.
- 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.
- 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 under dry conditions when temperatures are predicted to exceed 80°F.

PEACH

About 300 gallons of dilute spray are required to adequately cover an acre of mature peach trees in full leaf and 10 to 12 feet in height in rows 25 feet apart.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
PEACH DORMANT				
After leaves drop in the fall or before buds swell in spring				
Peach Leaf Curl	Bravo	1 - 1.4 pt	3 - 4 pt	To effectively control peach leaf curl, fungicide must be applied before bud swell.
	Carbamate 76 WDG	1.5 lb	4.5 lb	
	Ziram 76 DF	1.25 - 2.7 lb	3.75 - 8 lb	
	Copper hydroxide (Kocide)	4 lb	8 - 16 lb	
	Copper oxychloride (COCS)	4 lb	8 - 16 lb	
	Bordeaux mixture	6-6-100		
Mites	Superior oil	2 gal		
San Jose Scale	Esteem 35 WP		4 - 5 oz	Apply Assail with horticultural oil.
	Assail 30 SG		5.3 - 8.0 oz	

PEACH PINK

Brown Rot (Blossom Blight)	¹ Topsin-M 70 WSB	8 oz	1.5 lb	¹ 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 is also available in a flowable formulation (4.5 FL).
	<i>plus</i>			
	² Captan 50 WP	1.3 lb	4 lb	
	Bravo	1 - 1.4 pt	3.1 - 4.1 pt	² See note on Captan on page 16.
	² Captan 50 WP	2.6 lb	8 lb	
	³ Rovral 50 WP	5 - 10.5 oz	1 - 2 lb	³ No more than two applications of Rovral can be made per season, and Rovral may not be applied after petal fall on stone fruit.
	Wettable sulfur 95%	6 lb	18 lb	
	Ziram 76 DF	1.5 - 2.7 lb	4.5 - 8 lb	
	Rally 40 WSP	0.8 - 2 oz	2.5 - 6 oz	⁴ Apply Orbit and Indar in a minimum of 50 gallons of water per acre.
	⁴ Orbit 41.8 L	1.3 fl oz	4 fl oz	
	⁴ Indar 75 WSP		2 oz	
	Elite 45 DF	2 oz	6 oz	
	Pristine 38 WG	3.5 - 4.8 oz	10.5 - 14.5 oz	
	Elevate 50 WDG		1 - 1.5 lb	
	Scala 5 SC		9 - 18 fl oz	
Vanguard 75 WG		5 oz		
Adament 50 WG		4 - 8 oz		
Quash 50 WDG		3.5 - 4 oz		

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
PEACH PINK (cont.)				
Tarnished Plant Bug and Stink Bug	Ambush 25 WP		6.4 - 19.2 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, or Proaxis) can cause mite outbreaks because they are persistent and kill mite predators. Beleaf is not labeled for stink bug control.
	Asana XL 0.66 EC		4.8 - 14.5 fl oz	
	Pounce 3.2 EC		4 - 12 fl oz	
	Pounce 25 WP	2.1 - 8.5 oz	6.4 - 25.6 oz	
	Warrior 1 CS		2.5 - 5.1 fl oz	
	Proaxis 0.5 EC		2.5 - 5.1 fl oz	
	Baythroid		2.0 - 2.4 fl oz	
	Sevin XLR (4EC)	1 qt	3 qt	
	Endosulfan 50 WP	1 lb	4 - 5 lb	
	Endosulfan 3 EC	0.7 qt	2.7 - 3.3 qt	
	Carzol 92 SP	4 oz	1 - 1.25 lb	
	Provado 1.6 F	2 fl oz	4 - 8 fl oz	
	Actara 25 WDG		4.5 - 5.5 oz	
	Mustang Max		1.28 - 4 fl oz	
	Renounce 20 WP		2.5 - 3.0 oz	
Beleaf 50 SG		2.0 - 2.8 oz		
Assail 30 SG		5.3 - 8.0 oz		
Leverage 2.7 SE		3.6 - 4.4 fl oz		
Oriental Fruit Moth (monitoring)	Refer to petal fall			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		100 - 150 dispensers	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 33.
	CheckMate - OFM		108 - 150 dispensers	
	3M Sprayable Pheromone		1.7 - 2.5 fl oz	

PEACH FULL BLOOM

Brown Rot (Blossom Blight)	Same as for pink (above)			
Insects or Mites	SAVE THE BEES! Do not apply insecticides during bloom.			

PEACH PETAL FALL

Brown Rot	Same as for pink (above)			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 33-34.
Oriental Fruit Moth, Plum Curculio, Catfacing	Ambush, Asana, Baythroid, Renounce, Pounce, Actara, Mustang Max, Warrior, Proaxis, or Assail.			
Insects (Tarnished Plant Bug, Stink Bugs)	as at pink (above) OR			
	Imidan 70 WP	0.75 - 1 lb	2.13 - 4.25 lb	
	Voliam Flexi 40 WDG		4.0 - 7.0 oz	
	Leverage 2.7 SE		3.6 - 5.1 fl oz	Catfacing is worst where weed control is poorest. Keep weeds mowed regularly. See comments at pink about the use of pyrethroids.
Oriental Fruit Moth	Products listed above for three species combined OR			
	Entrust 80 WP	0.4 - 0.8 oz	1.25 - 2.5 oz	
	Intrepid 2 F		10 - 16 fl oz	
	Altacor 35 WDG		3.0 - 4.5 oz	
	Delegate 25 WG		6.0 - 7.0 oz	
Plum Curculio	Products listed above for the three species combined OR			
	Avaunt 30 WDG		5.6 oz	

Pest/Problem	Material	Rate/ 100 gal	Rate/ Acre	Comments
PEACH SHUCK-SPLIT				
Brown Rot and Scab	Topsin-M 70 WSB	8 oz	1.5 lb	
	<i>plus</i>			
	¹ Captan 50 WP	1.3 lb	4 lb	¹ See note on Captan on page 16.
	Bravo	1 - 1.4 pt	3.1 - 4.1 pt	
	Captan 50 WP	2.6 lb	8 lb	
	Wettable sulfur 95%	6 lb	18 lb	
	Ziram 76 DF	1.5 - 2.7 lb	4.5 - 8 lb	
Powdery Mildew	Pristine 38 WG	3.5 - 4.8 oz	10.5 - 14.5 oz	
	² Gem 25 WG		4 - 8 oz	² Gem provides excellent control of peach scab, but is weak on brown rot.
	Adament 50 WG		4 - 8 oz	
	Bacterial Spot	Mycoshield 17 WP	12 oz	See notes about bacterial spot on page 33.
		Flame Out 17 WP	12 oz	
Plum Curculio, Catfacing Insects	Same as for petal fall (page 26)		Do not apply Rovral after petal fall.	
Oriental Fruit Moth	Same as for petal fall (page 26)			
European Red Mite	Acramite 50 WS		0.75 - 1 lb	
	Vendex 50 WP	4 - 8 oz	1 - 2 lb	
	Apollo SC		2 - 8 oz	
	Nexter 75 WP		4.4 - 5.2 oz	
	Savey 50 WP		3 - 6 oz	
	Envidor 2 SC		16 - 18 fl oz	

PEACH FIRST COVER

7 to 10 days after shuck-split

Brown Rot and Scab	Topsin-M 70 WSB	8 oz	1.5 lb	
	<i>plus</i>			
	¹ Captan 50 WP	1.3 lb	4 lb	¹ See note on Captan on page 16.
	Captan 50 WP	2.6 lb	8 lb	
	Wettable sulfur 95%	6 lb	18 lb	Do not apply Bravo after shuck-split.
	Ziram 76 DF	1.5 - 2.7 lb	4.5 - 8 lb	
	Pristine 38 WG	3.5 - 4.8 oz	10.5 - 14.5 oz	
Powdery Mildew	Adament 50 WG		4 - 8 oz	
	Quash 50 WDG		3.5 - 4.0 oz	
	Rally 40 WSP	0.8 - 2 oz	2.5 - 6 oz	Rally can be applied on a 10- to 14-day interval for powdery mildew control until terminal growth stops.
	Elite 45 DF	2.6 oz	8 oz	
Plum Curculio, Catfacing Insects	Wettable sulfur 95%	6 lb	18 lb	
	Pristine 38 WG	3.5 - 4.8 oz	10.5 - 14.5 oz	
Oriental Fruit Moth	² Gem 25 WG		4 - 8 oz	² Gem provides excellent control of peach scab, but is weak on brown rot.
	Same as for petal fall (page 26)			Do not apply Bravo after shuck-split.
European Red Mite	Same as for shuck-split (above)			

Pest/Problem	Material	Rate/ 100 gal	Rate/ Acre	Comments
PEACH FIRST COVER (cont.)				
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 33-34).
PEACH SECOND COVER 10 days after first cover				
Brown Rot and Scab	Same as for first cover (page 27)			
Powdery Mildew	Same as for first cover (page 27)			
Plum Curculio, Oriental Fruit Moth, Catfacing Insects	Same as for petal fall (page 26)			
Mites	Same as for shuck-split (page 27)			
PEACH THIRD, FOURTH, AND ADDITIONAL COVERS Apply at 10- to 14-day intervals				
Brown Rot and Scab	Same as for first cover (page 27)			Scab requires control until fruit is within 40 days of harvest.
Powdery Mildew	Same as for first cover (page 27)			
Oriental Fruit Moth	Same as for petal fall (page 26)			
Mites	Same as for shuck-split (page 27)			
San Jose Scale	Esteem 35 WP Diazinon 50 W Centaur 70 WP Movento 2 Assail 30 SG	4 - 5 oz 4 lb 34.5 oz 6.0 - 9.0 oz 5.3 - 8.0 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 33-34).

Pest/Problem	Material	Rate/100 gal	Rate/ Acre	Comments
PEACH PRE-HARVEST				
Apply according to label directions beginning 3 weeks before harvest				
Brown Rot	Topsin-M 70 WSB	8 oz	1.5 lb	Pre-harvest use, restrictions, and limitations are variable according to product; refer to label for details. ¹ See note on Captan on page 16.
	<i>plus</i>			
	¹ Captan 50 WP	1.3 lb	4 lb	
	Captan 50 WP	2.6 lb	8 lb	
	Ziram 76 DF	1.5 - 2.7 lb	4.5 - 8 lb	
	Wettable sulfur 95%	6 lb	18 lb	
	Orbit 41.8 L		4 fl oz	
	Indar 75 WSP		2 oz	
	Elite 45 DF	2 oz	6 oz	
	Pristine 38 WG	3.5 - 4.8 oz	10.5 - 14.5 oz	
Adament 50 WG		4 - 8 oz		
Quash 50 WDG		3.5 - 4 oz		
Oriental Fruit Moth, Japanese Beetle, and Green June Beetle	Sevin XLR (4EC)	1 qt	3 qt	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.
	Provado 1.6 F	2 fl oz	4 - 8 fl oz	
	Assail 30 SG		5.3 - 8.0 oz	
	Leverage 2.7 SE		3.6 - 4.4 fl oz	

PLUM

About 300 gallons of dilute spray are required to adequately cover an acre of mature trees in full leaf and 12 to 14 feet in height, in rows spaced 25 feet apart.

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
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PLUM DORMANT

Before buds break in the spring

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.
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European Red Mite and Scale Insects	Superior oil	2 gal		Apply when temperatures are above 40 F — never during freezing weather.
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PLUM PRE-BLOOM

Brown Rot (Blossom Blight) <i>plus</i> and Black Knot	Topsin-M 70 WSB	8 oz	1.5 lb	Topsin-M should always be combined with another fungicide, such as Captan, to minimize the development of resistance.
	¹ Captan 50 WP	1.3 lb	4 lb	
	Bravo	1 - 1.4 pt	3.1 - 4.1 pt	
	Captan 50 WP	2 lb	6 lb	

¹See note on Captan on page 16.

Brown Rot (Blossom Blight) <i>plus</i>	Topsin-M 70 WSB	4 - 5.3 oz	0.75 - 1 lb	² No more than two applications of Rovral can be made per season, and Rovral cannot be applied after petal fall on stone fruit.
	¹ Captan 50 WP	1.3 lb	4 lb	
	Bravo	1 - 1.4 pt	3.1 - 4.1 pt	
	Captan 50 WP	2 lb	6 lb	
	² Rovral 50 WP	5 - 10.5 oz	1 - 2 lb	
	Wettable sulfur 95%	6 lb	18 lb	
	Orbit 41.8 L		4 fl oz	
	Pristine 38 WG	3.5 - 4.8 oz	10.5 - 14.5 oz	
	Elevate 50 WDG		1 - 1.5 lb	
	Scala 5 SC		9 - 18 fl oz	
Vanguard 75 WG		5 oz		
Indar 75 WP		2 oz		

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
PLUM FULL BLOOM				
Brown Rot (Blossom Blight) and Black Knot	Same as for pre-bloom (page 30)			
Brown Rot (Blossom Blight)	Same as for pre-bloom (page 30)			
Insects or Mites	SAVE THE BEES! Do not apply insecticides during bloom.			

PLUM PETAL FALL				
Brown Rot (Blossom Blight) and Black Knot	Same as for pre-bloom (page 30)			
Brown Rot (Blossom Blight)	Same as for pre-bloom (page 30)			
Plum Curculio and Oriental Fruit Moth	Imidan 70 WP	0.75 - 1 lb	2.13 - 4.25 lb	Failure to control plum curculio may result in an increase in brown rot.
	Asana XL	2 - 5.8 fl oz	4.8 - 14.5 fl oz	
	Warrior 1CS		2.5 - 5.1 fl oz	
	Baythroid		2.0 - 2.8 fl oz	
	Proaxis 0.5 EC		2.5 - 5.1 fl oz	
	Mustang Max		1.28 - 4.0 fl oz	
	Renounce 20 WP		2.5 - 3.5 oz	
	Avaunt 20 WDG		5 - 6 oz	
	Assail 30 SG		5.3 - 8.0 oz	
	Voliam Flexi 40 WDG		4.0 - 7.0 oz	
	Leverage 2.7 SE		3.6 - 5.1 fl oz	
Oriental Fruit Moth	Products listed above for plum curculio OR			
	Intrepid 2 F		10 - 16 fl oz	
	Entrust 80 WP	0.4 - 0.8 oz	1.25 - 1.5 oz	
	Altacor 35 WDG		3.0 - 4.5 fl oz	
	Delegate 25 WG		6 - 7.0 oz	

PLUM SHUCK-SPLIT				
Brown Rot and Black Knot	Same as for pre-bloom (page 30)			Rovral cannot be applied after petal fall.
Brown Rot	Topsin-M 70 WSB	8 oz	1.5 lb	
	<i>plus</i>			¹ See note on Captan on page 16.
	¹ Captan 50 WP	1.3 lb	4 lb	
	Captan 50 WP	2 lb	6 lb	
	Wettable sulfur 95%	6 lb	18 lb	
	Bravo	1 - 1.4 pt	3.1 - 4.1 pt	
	Pristine 38 WG	3.5 - 4.8 fl oz	10.5 - 14.5 fl oz	
Plum Curculio and Oriental Fruit Moth	Same as for petal fall (above)			
Mites (if present)	Acramite 50 WS		0.75 - 1.0 lb	
	Nexter 75 W		4.4 - 5.2 oz	
	Vendex 50 WP	4 - 8 oz	1 - 2 lb	Limit one application of Savey per year.
	Savey 50 WP		3 - 6 oz	
	Envidor 2 SC		16 - 18 fl oz	
	Agri-Mek 0.15 EC	2.5 - 5 fl oz	10 - 20 fl oz	
			31	

Pest/Problem	Material	Rate/100 gal	Rate/Acre	Comments
FIRST PLUM COVER SPRAY				
7 to 10 days after shuck-split				
Black Knot	Same as shuck-split (page 31)			Bravo cannot be applied after shuck-split.
Brown Rot	Same as for pre-bloom except Bravo and Rovral (page 30) OR same as shuck-split (page 31)			Rovral cannot be applied after petal fall.
Plum Curculio and Oriental Fruit Moth	Same as for petal fall (page 31)			
Peachtree Borers				Refer to section on peachtree borers below and on page 34.

SECOND AND ADDITIONAL PLUM COVER SPRAYS

2 weeks after first cover spray and 10- to 14-day intervals thereafter

Brown Rot	Same as shuck-split			
Plum Curculio and Oriental Fruit moth	Same as for petal fall			
Japanese Beetle	Sevin XLR (4 EC)	1 qt	3 qt	
	Provado 1.6 F	2 fl oz	4 - 8 fl oz	
	Warrior 1 CS		2.5 - 5.1 fl oz	
	Assail 30 SG		5.3 - 8.0 oz	
	Leverage 2.7 SE		3.6 - 4.4 fl oz	

PLUM PRE-HARVEST SPRAYS

Beginning 3 to 4 weeks before harvest

Brown Rot	Topsin-M 70 WSB	8 oz	1.5 lb	Pre-harvest use, restrictions, and limitations are variable according to product; refer to label for details. ¹ See note on Captan on page 16.
	<i>plus</i>			
	¹ Captan 50 WP	1.3 lb	4 lb	
	Captan 50 WP	2 lb	6 lb	
	Orbit 41.8 L	1.3 fl oz	4 fl oz	
	Pristine 38 WG	3.5 - 4.8 fl oz	10.5 - 14.5 fl oz	
	Indar 75 WP		2 oz	

Special Problems and Pests of Peach and Other Stone Fruit

Bacterial Spot 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. Captan and Syllit are also labeled for control of bacterial spot; see Syllit label for further information (Dodine, formerly known as Cyprex, is currently marketed as Syllit). Copper sprays, applied for peach leaf curl at leaf drop, may also 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, Pro Phyt, 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 shothole 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 "Table of Insecticides Used to Manage Borers of Peach, Cherry, and Plum Trees" on page 34.

Periodical Cicadas—See note on page 15.

Table of Insecticides Used to Manage Borers of Peach, Cherry, and Plum Trees

Borer	Material	Rate/100 gal	Rate/Acre	Comment
Lesser Peachtree Borer	¹ Lorsban 4 EC	1.5 - 3 qt		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 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).
	² Endosulfan 3 EC	1.5 qt		
	² Endosulfan 50 WP	1.5 lb		
	Asana XL 0.66 EC	2 - 5.8 fl oz	4.8 - 14.5 fl oz	
	Ambush 25 WP		6.4 - 19.2 oz	
	Pounce 25 WP		6.4 - 25.6 oz	
	Pounce 3.2 EC		4 - 12 fl oz	
	³ Lorsban 50 WP		2 - 3 lb	
	Warrior 1 CS		2.5 - 5.1 fl oz	
	Baythroid		1.4 - 2.0 fl oz	
Peachtree Borer	¹ Lorsban 4 EC	3 qt		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.
	² Endosulfan 50 WP	1.5 lb		
	² Endosulfan 3 EC	1 qt		
	³ Lorsban 50 WP		2 - 3 lb	
	Asana XL 0.66 EC	2 - 5.8 fl oz		
	Warrior 1 CS		2.5 - 5.1 fl oz	
Peachtree Borer, Preplant Dip	⁴ Isomate-P		100 - 250 dispensers	
	Lorsban 75 WG	4 lb		
	Lorsban 4 E	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.

¹Lorsban 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.

²Thiodan 3 EC or 50 WP: Do not make more than two applications during the fruiting period, nor within 21 days of harvest of peach, nectarine, or cherry.

³Lorsban 50 W is labeled for borer control on sour cherry, but not on sweet cherry, peach, or nectarine.

⁴See Mating Disruption, page 33.

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	
Adament	tebuconazole <i>plus</i>							
	trifloxystrobin	11 + 3	—	—	1*	1*	—	24
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
Captan	captan	M	0	—	0	0	0	****
Captivate	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
Elite	tebuconazole	3	—	—	0	0	—	12
Flint	trifloxystrobin	11	14***	14***	—	—	—	12
Gem	trifloxystrobin	11	—	—	1	1	1	12
Indar	fenbuconazole	3	14***	—	0	0	0	12
Inspire Super MP	difenconazole + cyprodinil	3	72	72	—	—	—	12
Manzate 200	mancozeb	M	77***	77***	—	—	—	24
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	quinoxifin	13	—	—	—	7***	—	12
Rally	myclobutanil	3	14	—	7***	7***	—	24
Ridomil	mefenoxam	4	***	—	0	0	0	12
Rovral	iprodione	2	—	—	***	***	***	24
Rubigan	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	—	15***	0	—	48
Topsin-M	thiophanate-methyl	1	0	1***	1	1	1	12
Vanguard	cyprodinil	9	72	72	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 16.

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), myclobutanil (Rally), propiconazole (Orbit), and fenarimol (Rubigan).

Benzimidazole fungicide: thiophanate-methyl (Topsin-M).

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

The following fungicides are broad spectrum protectants and are not considered at risk for fungicide resistance development: captan (Captan), 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 Blotch	Flyspeck
Bayleton*	P	E	E	O	O	O	O
Captan	G	O	O	G	E	F-G	F-G
Flint	E	G	G	G	E	E	E
Indar	E	E	E	O	O	G	G
Inspire Super MP	E	E	E	—	—	G	G
Mancozeb (Dithane, Manzate, Penncozeb)	G	O	G	G	E	E	E
Polyram	G	O	G	G	E	E	E
Pristine	E	E	E	G	G	E	E
Procure*	E	E	E	O	O	O	O
Rally*	E	E	E	O	O	O	O
Rubigan*	E	E	E	O	O	O	O
Scala	G	—	—	—	—	—	—
Sovran	E	G	E	G	G	E	E
Sulfur	F	G	O	F	—	P	P
Syllit*	E	O	P	P	O	P	P
Topsin M*	E	E	O	G	P	E	G
Vangard	G	—	—	—	—	—	—
Ziram	F	O	G	P	E	F-G	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 to 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	—	—	—	—	—
Elite*	E	E	—	—	G	G**	—
Fixed copper	—	—	G	—	F	G	P
Gem	—	—	—	E	G	E	—
Indar*	E	E	—	—	G	E**	—
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*	—	—	—	—	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	—	—	O	G	—
Topsin M*	E	E	—	G	F	G	F
Vangard	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 to 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

Trade Names	Common Names	Pre-Harvest Interval—Days						REI* Hours
		Apple	Pear	Peach	Cherry	Plum		
Acramite	bifenazate	7	7	3	3	3	12	
Actara	thiamethoxam	14/35	14/35	14	14	14	12	
Admire	imidacloprid	21	21	21	21	21	12	
Agri-Mek (RUP)	abamectin	28	28	—	—	21	12	
Altacor	chlorantraniliprole	14	14	10	10	10	4	
Ambush (RUP)	permethrin	*	*	14*	3*	—	12	
Apollo	clofentezine	45	21	21	21	—	12	
Asana (RUP)	esfenvalerate	21*	28*	14*	14*	14*	12	
Assail	acetamiprid	7	7	7	7	7	12	
Avaunt	indoxacarb	14	28	14	14	14	12	
Azinphosmethyl (RUP)	azinphosmethyl	14-21	14-21	—	15	—	14-16 days	
Baythroid 2EC (RUP)	cyfluthrin	7	7	7	7	7	12	
Baythroid XI (RUP)	beta-cyfluthrin	7	7	7	7	7	12	
Beleaf 50 SG	flonicamid	21	21	14	14	14	12	
Belt	flubendiamide	14	14	7	7	7	12	
Brigade/Capture	bifenthrin	—	14	—	—	—	12	
Calypso	thiacloprid	30	30	—	—	—	12	
Carzol	formetanate hydrochloride	UPF*	UPF*	UPF*	—	—	4-16 days	
Centaur	buprofezin	14	14	14	—	—	12	
Clutch	clothianidin	7	7	—	—	—	12	
Confirm	tebufenozide	14	14	—	—	—	4	
Cyd-X	codling moth granulovirus	0	0	—	—	—	4	
Danitol (RUP)	fenpropathrin	14	14	—	—	—	24	
Decis (RUP)	deltamethrin	21	21	—	—	—	12	
Delegate	spinetoram	7	7	7	7	7	4	
Dimethoate	dimethoate	—	28	—	—	—	48	
Dimilin* (RUP)	diflubenzuron	—	14	UPF	UPF	UPF	12	
Diazinon 50 W (RUP)	diazinon	21	21	21	21	21	24	
Dipel (OMRI)	Bacillus thuringiensis	0	0	0	0	0	4-12	
Endosulfan, Thionex	endosulfan	21-30*	7*	21-30	21*	7*	24	
Entrust (OMRI)	spinosad	7	7	14	7	7	4	
Envidor	spiroticlofen	7	7	7	7	7	12	
Esteem	pyriproxyfen	45	45	14	14	14	12	
Fujimite	fenpyroximate	14	14	—	—	—	12	
Imidan	phosmet	7	7	14	7	7	4	
Intrepid	methoxyfenozide	14	14	—	—	—	12	
Kanemite	acequinocyl	14	14	—	—	—	12	
Kelthane	dicofol	7-14	7	—	—	—	12	
Lannate (RUP)	methomyl	14	7	4	—	—	*	
Leverage	imidacloprid + cyfluthrin	7	7	7	7	7	12	
Lorsban (RUP, EC only)	chlorpyrifos	prebloom*	*	14*	14-21	—	4 days	
Malathion	malathion	—	—	7	3	—	12-24	
Movento	spirotetramet	7	7	7	7	7	24	
M-Pede	potassium salts of fatty acids	0	0	0	0	0	12	
MSR Spray Con (RUP)	oxydemetonmethyl	*	30	*	*	*	48*	

RUP = Restricted-use pesticide. OMRI = Organic Materials Review Institute-approved for use in organic production. UPF = Until Petal Fall. — Not registered or recommended.

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

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

Trade Names	Common Names	Pre-Harvest — Days					REI* Hours
		Apple	Pear	Peach	Cherry	Plum	
Mustang Max (RUP)	zetacypermethrin	14	14	14	14	14	12
Neemix (OMRI)	azadirachtin	0	0	0	0	0	4
Nexter	pyridaben	25	7	7	300	7	12
Pounce (RUP)	permethrin	*	*	14*	3*	—	12
Proaxis (RUP)	gamma cyhalothrin	21	21	14	14	14	24
Proclaim (RUP)	emametin benzoate	14	14	—	—	—	48
Provado	imidacloprid	7	7	0	7	7	12
Renounce (RUP)	cyfluthrin	7	7	7	7	7	12
Rimon	novaluron	14	—	—	—	—	12
Saf-T-Side	horticultural oil	0	0	0	0	0	12
Savey	hexythiazox	28	28	28	28	28	12
Sevin	carbaryl	3	3	3	3	3	12
SpinTor	spinosad	7	7	14	7	7	4
Sunspray		0	0	0	0	0	12
Superior Oil (some OMRI)		*	*	*	*	*	12
Supracide (RUP)	methidathion	*	*	*	*	*	48
Surround (OMRI)	kaolin	0	0	0	0	0	4
Vendex (RUP)	fenbutatin-oxide	14	14	14	14	14	48
Voliam Flexi	thiamethoxam + chlorantraniliprole	35	35	14	14	14	12
Vydate (RUP)	oxamyl	14	14	—	—	—	48
Warrior (RUP)	lambda-cyhalothrin	21	21	14	14	14	24
Zeal	etoxazole	14	14	—	7	—	12

RUP = Restricted-use pesticide. OMRI = Organic Materials Review Institute-approved for use in organic production. — Not registered or recommended.
 * Specific pre-harvest intervals or restricted entry intervals vary for different formulations, application rates, crops or geographical locations. See product labels for details.

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

Preemergence

	Trade Name	Common Name	HRAC code	Risk of Resistance	Signal Word	Restricted Use	Pre-Harvest Interval
apple, pear, cherry	Casoron 4G	dichlobenil	L	Medium	Caution		
apple, pear	Chateau 51 WDG	flumioxazin	E	Medium	Caution		60 d
peach,	Devrinol 50DF	napropamide	K3	Low	Caution		35 d
nectarine,	Goal 2 XL	oxyfluorfen	E	Medium	Warning		
plum, cherry	Karmex 80 DF	diuron	C2	Medium	Caution		
	Kerb 50 WP	pronamide	K1	Low	Caution	Yes	
	Princep 4L	simazine	C1	Medium	Caution		
	Solicam 80 DF	norflurazon	F1	Medium	Caution		14 d
	Surflan 4AS	oryzalin	K1	Low	Caution		
apple, peach	Sinbar 80WP	terbacil	C1	Medium	Caution		60 d
peach, plum	Treflan HFP 4EC	trifluralin	K1	Low	Caution		
non-bearing	Gallery 75DF	isoxaben	L	Medium	Caution		
	Prowl 3.3EC	pendimethalin	K1	Low	Caution		
	Showcase 2.5TG	trifluralin + isoxaben + oxyfluorfen	E,K1,L	Medium	Caution		1 yr
	Snapshot 2.5TG	trifluralin + isoxaben	L,K1	Medium	Caution		
	XL 2G	benefin + oryzalin	K1	Low	Caution		1 yr

Postemergence

	Trade Name	Common Name	HRAC code	Risk of Resistance	Signal Word	Restricted Use	Pre-Harvest Interval
apple, pear, peach, nectarine, plum, cherry	Aim 2EC	cargentraxone	E	Medium	Caution		3 d
	Amine4	2,4-D amine	O	Low	Danger		14 d
	Fusilade DX 2 EC	fluazifop-P	A	High	Caution		1 yr
	Goal 2XL	oxyfluorfen	E	Medium	Warning		
	Gramoxone	paraquat	D	Medium	Poison	Yes	
	Karmex 80DF	diuron	C2	Medium	Caution		
	Poast 1.5EC	sethoxydim	A	High	Warning		14 d
	Recoil 3.2E	2, 4-D + glyphosate	G,O	Low	Danger		40 d
	Roundup 5.5L	glyphosate	G	Low	Caution		14 d
Scythe 4.2E	pelargonic acid	-	-	Warning			
apple	Rely 1L	glufosinate	H	Low	Warning		14 d
peach, plum nectarine, cherry	Stinger 3EC	clopyralid	O	Low	Caution		30 d
	Weedax1.8E	2, 4-D amine	O	Low	Warning		40 d
non-bearing	Basagran 4L	bentazon	C3	Medium	Caution		1 yr
	MSMA6 Plus	MSMA	Z	Low	Caution		1 yr
	Reglone 2L	diquat	D	Medium	Warning		
	Select 2 EC	clethodim	A	High	Warning		

Generic Insecticides

Common name	Original brand name (and current manufacturer)	Other brand names and manufacturers
abamectin	Agri-Mek 0.15 EC (Syngenta)	Abba 0.15 EC (Makhteshim) Epi-Mek 0.15 EC (Syngenta) Reaper 0.15 (UAP) 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 (United Phosphorous) Discipline 2 EC (Amvac) Fanfare 2 EC (Makhteshim) Sniper 2 EC (UAP/Loveland) Tundra 2 EC (Agrilience)
carbaryl	Sevin XLR 4EC (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) Warhawk 4 E (UAP/Loveland) Whirlwind (Helena) Yuma 4 E (Agrilience)
cyfluthrin	Baythroid (Bayer)	Tombstone (UAP)

Generic Insecticides (cont)

Common name	Original brand name (and current manufacturer)	Other brand names and manufacturer
deltamethrin	Decis 1.5 EC (Bayer)	Battalion 0.2 EC (Arysta) Delta Gold 1.5 EC (Agrilience)
dimethoate	Cygon 4 EC (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)
esfenfalerate	Asana XL (Dupont)	Adjourn (Makhteshim)
esfenvalerate	Asana XL 0.66 EC (Dupont)	Adjourn 0.66 EC (Makhteshim)
gamma cyhalothrin	Proaxis (UAP/Loveland)	Proaxis (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) Impulse 1.6 , Macho 2 F (Albaugh) Macho 2 FL (Albaugh) Malice 75 WSP (VAP/Loveland) Montana 2 F (Rotam North America) Nuprid 1.6 F, 2 F (Nufarm) Prey 1.6 F (UAP/Loveland) Torrent 2 F (Sipcam Agro) Widow 2 F (UAP)
kaolin	Surround (Engelhard)	Snow Plus (WilburEllis)
lambda-cyhalothrin	Warrior 1 EC (Syngenta)	Lambda-CY (United Phosphorus) Lambda T (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)

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 will also 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 in some states (check your state regulations) 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% control. Therefore, some voles survive the pre-harvest control and enter into boxes of fruit on the ground which will be carried into cold storage.

Orchard Vole Control (cont.)

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

Ethephon on Apples

Ethephon, which is available as a 21.3% formulation of 2-chloroethylphosphonic acid (ETHREL or CEPHA), 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. Ethephon 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. Ethephon 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. Ethephon 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 1000 ppm (3.33 pt per 100 gal of water). For spur-type trees, the rate should be reduced to 500 ppm (1.66 pts. 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.

Naphthaleneacetic Acid or NAA (Fruitone N) 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.

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

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, aminotheoxy-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 can also 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 30-60%. Reduced shoot growth, following Apogee treatment, can reduce susceptibility to fire blight. See page 13 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 gallon 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), is also 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 A₃. 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 fluid ounces 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 A₄ and A₇, 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% of the spray volume to the upper two-thirds of the tree.

Stayman Cracking

ProVide 10 SG applications should start 2-3 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-(phenylmethyl)-1 H-purine-6-amine and 1.8% gibberellins A₄ and A₇. A single application to 'Delicious' during the period from full bloom to early petal fall of the king bloom elongates the fruit and encourages development of more prominent calyx lobes. The rate of application is 1 pint per acre in 50 to 200 gal of spray mixture. Some thinning may occur from the use of Promalin,

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 Accel (benzyl-adenine) 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 pint 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.

Recommended Chemical Thinners for Apple¹

Cultivars	NAD ^{2,3,4} (PPM)	NAA ^{2,4} (PPM)	NAA ² + WA ⁵ (PPM)	Sevin XLR Plus ^{2,6,7} (qts/100 gal)	MaxCel ^{2,8}	Combinations ^{2,3,7,8} (PPM + qts/100 gal)
Summer Varieties	35-50				E	NAA 5-10+Sevin 1/2-1
Paulared		5-10	3-5	1/2-1	M	
Gala		5-10	3-5	1/2-1	E	
Jonamac		5-10	3-5	1/2-1	M	
McIntosh	35-50	7 1/2-12	3-5	1/4-1/2	E	
Jonathan	35-50	7 1/2-12	3-5	1/4-1/2	E	
Spartan		10-15	5-7 1/2	1/2-1	?	
Cortland	35-50	7 1/2-12	3-5	1/4	E	
Grimes Golden	35-50	5-10	5-7 1/2		?	NAD 25-50+Sevin 1/2-1
Red Delicious/non-spur		5-10	3-5	1/2-1	E	
Red Delicious/spur		10-15	5-7 1/2	1/2-1	M	
Honeycrisp		3-5		1/4-1/2	?	N.R.
Empire		10-15	5-7 1/2	1/2-1	E	
Golden Delicious		10-20	5-10	1/2-1	M	NAA 5-10+Sevin 1/2-1
Blushing Golden				1/4-1/2	?	
Firmgold				1/4-1/2	?	
Idared				1/2-1	E	
Winesap	35-50	7 1/2-10	3-5	1/2-1	E	
Stayman & Turley	35-50	7 1/2-10	3-5	1/2-1	M	
Rome & Gallia	50-60	15-20	7 1/2-10	N.R. ⁹	E	
Fuji ⁸		N.R. ⁹			H	Accel 35.5 fl oz/acre + Sevin 1

¹ See: Apple Thinning Guide by P. Schwallier, Great Lakes Publishing (616) 887-9008.

² Lower concentrations suggested when conditions are favorable for thinning.

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

⁴ 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.

⁵ WA=Wetting Agent: Tween 20, Regulaid or Amway Wetting Agent at 0.75 to 1 pint per 100 gallons.

⁶ 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.

⁷ 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.

⁸ Variety ease of thinning with MaxCel, E=Easy; M=Moderate; H=Hard. See MaxCel Recommendation Table for suggested rates of Maxcel and Sevin for thinning.

⁹ N.R. = not recommended

Chemical Thinning of Apples (cont.)

Wetting agents other than “Tween 20” that have been used successfully in tests in Illinois and Indiana include Regulaid and Amway Wetting Agent or Ortho X 77.

MaxCel 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) 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 65F on the day of application and the following 2-3 days. Generally, only one application is sufficient.

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 1qt/100 gallons applied at petal fall will effectively defruit Jonathan, Red Delicious and McIntosh. For other cultivars, use NAA at the recommended rate + Sevin XLR at 1qt/100 gallons. 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

Use	Application	Spray Volume	Spray Timing
For fruit thinning, sizing, and enhanced return bloom	Apply 75 to 200 ppm spray concentration Refer to dilution table on label for assistance	Use sufficient volume to ensure complete tree coverage	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

Thinning Difficulty	Desired Thinning Strength		
	Aggressive	Moderate	Slight
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

¹See Recommended Chemical Thinners for Apples table for variety thinning difficulty rating.

NAA Formulations for Chemical Thinning of Apples

Trade Name	Chemical	Formulation	Acid equivalent (% of active ingredient)	Amount of formulation per 100 gallons o make 10 ppm.
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
Kling-Tite 256	1-Naphthaleneacetate, potassium salt (8.3%)	liquid	8.6	1.9 fluid oz
K-salt Fruit Fix 800	1-Naphthaleneacetic acid,potassium salt (24.2%)	liquid	20.2	0.63 fluid oz
K-salt Fruit Fix 200	1-Naphthaleneacetic acid,potassium salt (6.25%)	liquid	5.18	2.47 fluid 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 assure 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 on 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 which 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
Preemergence		
Annual and perennial grasses and broadleaves	Casoron 4G (granular) (dichlobenil 4% ai) at 100-150 lb	<p>Perennial Weeds: Apply from Nov. 15 to Feb. 15 as a soil surface application at 150 lb. No need to remove old weed growth before application. May also be incorporated in late fall or early spring before May 1 and incorporated immediately.</p> <p>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 when soil has completely settled.</p>
Annual broadleaves and suppression of grasses	Chateau 51 WDG (flumioxazin 51% ai) at 6-12 oz in 15-75 gal of water	The preferred timing is in the fall to maximize the potential of rainfall to activate and set the herbicide. Do not apply to trees less than 1 yr old, or to mature trees after bloom through final harvest, unless with hooded or shielded application. 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. Max. rate is 24 oz per season. Min. 30 days between applications. PHI = 60 days.
Annual grasses and broadleaves	Devrinol 50DF (napropamide 50% ai) at 8 lb in min. 20 gal of water	Apply from late fall prior to soil freeze-up to early spring prior to weed emergence. If no rainfall occurs within 24 hours after treatment, cultivate or irrigate 1" to activate. Apply alone to weed-free soil or in tank mix with Roundup or Gramoxone. Do not allow spray to contact fruit or foliage. Max. 1 application per season. PHI = 35 days.
Annual broadleaves and suppression of grasses	Goal 2XL (oxyfluorfen 2 lb ai/gal) at 2-8 pt in min. 40 gal of water	Dormant Application Only: Effective both preemergence (5-8 pt) and postemergence (2-8 pt) as directed spray on weeds >4". Do not apply from bud swell until harvest completion. Can be mixed with other preemergence herbicides or with Roundup or Gramoxone. Max. rate is 8 pt per yr.
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 yr. Do not treat trees grafted on full-dwarf rootstocks. Max 1 application per year. Apple only: 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. Max. 1 application per yr and 8 lb per acre per yr. Kerb has early postemergence activity also. Restricted use pesticide.
Annual grasses and broadleaves	Princep 4L (simazine 4 lb ai/gal) at 2-4 qt in min. 40 gal of water	Apply under trees established at least 1 yr. Apply in spring before weeds emerge avoiding contact with fruit, foliage, or stems.
Annual grasses and broadleaves	Sinbar 80 WP (terbacil 80% ai) at 2-4 lb in min 20 gal of water	<p>Apple Only: 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.</p> <p>Non-Bearing (young, newly-planted) Apple and Pear: 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 1-2 applications per season. Max. rate is 1 lb per yr. Do not use on soils with <1% OM.</p>

Herbicide Recommendations for Apple and Pear (cont.)

Weed Problem	Material & Rate	Notes and Comments
Preemergence		
Annual grasses and broadleaves and suppression of yellow nutsedge	Solicam 78 DF (norflurazon 78.6% ai) at 5 lb in min. 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 0.5" 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. Apple: Can be applied immediately after planting. Pear: min. 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 vines before weeds emerge. Apply alone to weed-free soil or postemergence mixed with Roundup or Gramoxone. Rainfall or irrigation 0.5" is required for activation. Min 2.5 months between applications. Max. rate is 12 qt per yr.
Postemergence		
Annual broadleaves	Aim 2EC (carfentrazone 2 lb ia/gal) at 2 fl.oz. in 20 gal of water	Apply any time during the season. Always add non-ionic surfactant 0.25% v/v or crop oil 1% v/v. Mix with Roundup or Gramoxone for broader weed control. Max. 7.9 fl.oz. per yr. Min. 14 days between applications. PHI = 3 days. Sucker control: 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 to annuals 1-2" 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 yr. On bearing trees, Do not apply during bloom or after or before irrigation. Do not apply to bare ground. Max. 2 applications per year and 75 days between applications. PHI=14 days.
Annual broadleaves and suppression of grasses	Chateau 51 WDG (flumioxazin 51% ai) at 6-12 oz in 15-75 gal of water	The preferred timing is in the fall to maximize the potential for rainfall to activate and set the herbicide. Do not apply to trees less than 1 yr old, or to mature trees after bloom through final harvest, unless with hooded or shielded application. 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. Max. rate is 24 oz per season. Min. 30 days between applications. PHI = 60 days.
Most annual and perennial grasses	Fusilade DX 2EC (fluazifop-P 2 lb ai/gal) at 16-24 fl.oz. in 25 gal of water	Non-bearing only: Apply as a directed spray to actively growing grasses before tilling. Always add crop oil 1% v/v or non-ionic surfactant 0.25% v/v. Avoid contact with foliage. Rainfast in 1 hour. Max. rate is 72 fl. oz. per yr. Min. 5 days between applications. PHI = 1 year.
Annual broadleaves	Goal 2XL	See 'Preemergence' section above for details.
Most annual grasses and broadleaves weeds and top kill of perennial weeds	Gramoxone Inteon 2L (paraquat 2 lb ai/gal) at 2.5-4 pt in min. 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. Max. 5 applications per yr. Restricted use pesticide.
Annual grasses and broadleaves	Karmex 80 DF	See 'Preemergence' section for details.
Annual and perennial grasses	Poast 1.5EC (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 tilling. Always add crop oil 1.25% v/v. Max. rate is 2.5 pt per application and 7.5 pt per season. PHI = 14 days.

Herbicide Recommendations for Apple and Pear (cont.)

Weed Problem	Material & Rate	Notes and Comments
Preemergence		
Annual and perennial grasses and broadleaves	Recoil 3.65E (glyphosate + 2,4-D) at 1-4 qt in 15-100 gal of water	Use on non-bearing (well-established, 1 yr or older) and bearing trees before and after bloom. Max. 2 applications per season. Min. 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 5-7 days after application.
Annual and perennial grasses and broadleaves	Rely 1L (glufosinate 1 lb ai/gal) at 3-6 qt in min. 20 gal of water	Apple Only: Do not apply within 1 yr of transplanting. Apply as a directed spray to actively growing weeds. Do not apply on desirable foliage or drift on foliage, green or uncallused bark. Max. 18 qt per year for bearing and 12 qt per year for non-bearing grape. Max. rate is 4.5 gal per year. PHI = 14 days. Sucker Control: a split application approximately 4 wk apart at 4 qt/acre is recommended or spot spray with 3 oz/gal of water. Suckers should not exceed 12" long.
Annuals and some perennial grasses and broadleaves	Roundup WeatherMax 5.5EC (glyphosate 5.5 lb ai/gal) at 0.5-5 qt in 10-40 gal of water	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. Does not provide residual control; can be mixed with labeled preemergence herbicides. PHI = 14 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 Peach, Nectarine, Plum, and Cherry

Weed Problem	Material & Rate	Notes and Comments
Preemergence		
Annual and perennial grasses and broadleaves	Casoron 4G (granular) (dichlobenil 4% ai) at 100-150 lb	Cherry only: For perennial weeds, apply from Nov. 15 to Feb. 15 as a soil surface application at 150 lb. There is no need to remove old weed growth before application. Can also 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 grasses and broadleaves	Devrinol 50DF (napropamide 50% ai) at 8 lb in min. 20 gal of water	Apply from late fall prior to soil freeze-up to early spring prior to weed emergence. If no rainfall occurs within 24 hours after treatment, cultivate or irrigate 1" to activate. Apply alone to weed-free soil in tank mix with Roundup or Gramoxone. Do not allow spray to contact fruit or foliage. Max. 1 application per season. PHI = 35 days.
Annual broadleaves and suppression of grasses	Goal 2XL (oxyfluorfen 2 lb ai/gal) at 5-8 pt in min. 40 gal of water	Dormant application only: Effective both preemergence (5-8 pt) and postemergence (2-8 pt) as a directed spray on weeds <4". Do not apply from bud swell until harvest completion. Can be mixed with other preemergence herbicides or with Roundup or Gramoxone. Max. rate is 8 pt per yr.
Annual grasses and broadleaves	Karmex 80DF diuron (80% ai) at 2-5 lb in 25-40 gal of water	Peach only: Effective both preemergence and postemergence (min 70F with high humidity). Apply under trees established at least 3 years. Max. 1 application per year. PHI = 3 months. For IL and MO, PHI = 20 days. May be tank mixed with Sinbar (2 lb each) in orchards established at least 2 yr. 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. Max. 1 application per year and 8 lb per yr. Kerb has early postemergence activity also. Restricted use pesticide.
Annual grasses and broadleaves	Princep 4L (simazine 4 lb ai/gal) at 1.6-4 qt in min. 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. Peach only: use only in AR, MO and states east of the Mississippi River. Plum and sweet cherry only: 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 min. 20 gal of water	Peach only: 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. Non-bearing (young, newly-planted) stone fruits: 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 1-2 applications per season. Max. 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 min. 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 0.5" 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. Peach, Nectarine: min. 6 months; Plum: min. 12 months, Cherry: min. 18 months after planting before first application. PHI = 60 days.

Herbicide Recommendations for Peach, Nectarine, Plum, and Cherry (cont.)

Weed Problem	Material & Rate	Notes and Comments
Preemergence		
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. Min. 0.5" rainfall or irrigation is required for activation. Min. 2.5 months between applications. Max. rate is 12 qt per yr
Annual grasses and broadleaves	Treflan HFP 4EC (trifluralin 4 lb ai/gal) at 1.5-4 pt in 5-40 gal of water	Peach, plum only: Incorporate within 24 hours to reduce loss of activity. New plantings: apply 1.25-2 pt and incorporate before transplanting. Established plantings: apply 2-4 pt and incorporate prior to period of weed germination or after removal of weeds with tillage of herbicides.
Postemergence		
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 non-ionic surfactant (2 pt/100 gal) or crop oil concentrate (1 gal/100 gal). Mix with Roundup or Gramoxone for broader weed control. Max. 7.9 fl.oz. per year. Min. 14 days between applications. PHI = 3 days. Sucker management: Apply when suckers are green. Do not allow spray to contact fruit, foliage, or green bark.
Annual and some perennial broadleaves	Amine4 (2,4-D) or Saber at 3 pt in 5-25 gal of water	Apply as directed spray when annuals are 1-2" 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. Max. 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 non-ionic surfactant 0.25% v/v or crop oil 1% v/v. Rainfast in 1 hour. Avoid contact with foliage. Max. rate is 72 fl.oz./yr. Min. 5 days between applications. PHI = 14 days.
Annual broadleaves	Goal 2XL	See 'Preemergence' section above for details.
Most annual grasses and broadleaves weeds and top kill of perennial weeds	Gramoxone Inteon 2L (paraquat 2 lb ai/gal) at 2.5-4 pt in min. 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 non-ionic surfactant 0.25% v/v or crop oil 1% v/v. Do not allow spray to contact leaves, fruit, or green stems. Max. 3 applications per year. PHI = 14 days (peach), 28 days (nectarine, plum, cherry). Restricted use pesticide.
Annual grasses and broadleaves	Karmex 80DF	See 'Preemergence' section above for details.
Annual and perennial grasses	Poast 1.5E (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 tilling. 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 3.65EC (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 5-7 days after application. Make up to 2 applications through the dormant or growing season as needed. PHI = 40 days.








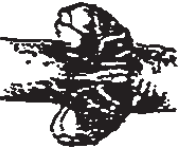












Herbicide Recommendations for Peach, Nectarine, Plum, and Cherry (cont.)

Weed Problem	Material & Rate	Notes and Comments
Postemergence		
Annuals and some perennial grasses and broadleaves	Roundup UltraMax II 5.5 EC (glyphosate 5.5 lb ai/gal) at 0.5-5 qt in 10-40 gal of water. Touchdown Total 4EC at 0.7-3.6 qt in 10-30 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. Does not provide residual control; can be mixed with labeled preemergence herbicides. PHI = 14 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.
Annual and perennial broadleaves	Stinger 3EC (clopyralid 3 lb ai/gal) at 0.3-0.6 pt in min. 10 gal of water	Make 1-4 applications per crop per year, not to exceed a total of 2/3 pt. For control of Canada thistle, apply after majority of basal leaves have emerged but prior to bud stage and at least 30 days before harvest. Stinger may be tank mixed with other herbicides labeled on stone fruits. PHI = 30 days.

Herbicide Recommendations for Non-Bearing Fruit Trees Only

Weed Problem	Material & Rate	Notes and Comments
Postemergence		
Annual broadleaves and yellow nutsedge	Basagran 4L (bentazon 4 lb ai/gal) at 1.5-2 pt in min. 20 gal of water.	Apply as a directed postemergence. Always add crop oil 1% v/v. Avoid spraying stems, bark, or foliage. Max. 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 min. 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 0.5" is needed within 21 days of application. Not effective on germinated weeds. Min. 60 days between applications. Max. 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. Max. 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 min. 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 min. 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 yr 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 actively growing grasses before tilling. Do not use crop oil. Always add non-ionic 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 hr. Max. rate is 32 fl.oz. per yr.
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 2.5 TG (isoxaben + trifluralin 2.5% ai) at 100-200 lb	Apply preemergence on weed-free clean soil. For best results 0.5" rain or irrigation is needed within 3 days of application. Not effective on germinated weeds. Min. 60 days between applications. Max. rate is 600 lb per yr.
Annual grasses and broadleaves	XL 2G (granular) (benfen+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. A 0.5" rainfall or irrigation is needed within 21 days of applications for herbicide activation. Min 4. months between applications. Max rate is 900 lb per yr.

Table 1. Floral Development States for Fruit Crops and Critical Temperatures for Flower Bud Kill

Stage	°F	Apple	°F	Pear	°F	Peach	°F	Tart Cherry	°F	Plum and Prune
1	10%		90%		90%		90%		90%	
	Kill		Kill		Kill		Kill		Kill	
		Dormant		Dormant		Dormant		Dormant		Dormant
	15°		15°		18°		17°		14°	
2										
	15°	Silver Tip	1°	Swollen bud	2°	Swollen bud	5°	Bud burst	14°	Swollen bud
3										
	18°	Green tip	7°	Bud burst	5°	Half-inch green	25°	Green tip	18°	Bud burst
4										
	23°	Half-inch green	15°	Green cluster	18°	Pink	26°	Tight cluster	26°	Green cluster

5



27° Tight cluster

21°



26° White bud

22°



27° Bloom

24°



27° Swollen bud

24°



26° White bud

21°

6



28° Pink

25°



28° Bloom

23°



28° Petal fall

25°



27° Bloom

25°



27° Bloom

23°

7



28° Bloom

25°



28° Petal fall

24°



28° Fruit set—shucks on 25°

28°



25° Petal fall

28°



24° Petal fall

24°

8



28° Petal fall

25°



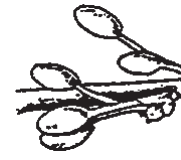
28° Fruit set

24°



28° Fruit set — shucks off 25°

28°



25° Fruit set

28°



24° Fruit set

24°

9



28° Fruit set

25°

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 continued herein does not supercede the label directions. To protect yourself, others, and the environment, always read the label before applying any pesticides.

*Restricted use pesticides

1: REI = Restricted Entry Interval
SL = See Label. Some REIs vary by crop, always check the label.

2: 1= high, 2=intermediate, 3=low. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties Database: www.wcc.nrcs.usda.gov/pestmgt/winpst.html

3: The REI for most formulations of Captan is 24 hours; however, some product labels still have a 4 day REI. See note on Captan REI for tree fruit on page 16.

Adapted from Michigan Extension Bulletin e-154 (used with permission).

Fungicides/Bactericides

Trade Name	Common Name	Manufacturer	EPA Registration #	REI (hours)	Runoff/Leach Potential	Oral LD50	Dermal LD50	Class
Abound	azoxystrobin	Syngenta	100-1098	4	1/3	>5000	>4000	strobilurin
Agri-Mycin 17 Ag	streptomycin	Syngenta	100-899	12	-/-	>5000	>2000	antibiotic
Aliette 80 WDG	fosetyl-Al	Aventis	264-516	12	3/3	2860	>2000	organophosphorus
Armicarb 100	potassium bicarbonate	Helena	5905-541	4	-/-	2700	>5000	salt/inorganic
Auxigro	GABA+L-Glutamic Acid	Emerald Bio	70810-1	4	-/-	>5000	>5000	organic
Bayleton 50 DF	triadimefon	Bayer	264-737	12	3/2	812-1470	>2000	conazole
Botran 75 W	dicloran	Gowan	10163-189	12	2/3	>4640	>6320	aromatic
Bravo WeatherStik	chlorothalonil	Zeneca	50534-188-10182	48	2/3	9000	>2000	aromatic
Bravo WeatherStik	chlorothalonil	Syngenta	50534-188-100	48	2/3	9000	>2000	aromatic
BSP Sulfurix	lime sulfur	BSP	66196-3	48	-/-	820	>2000	inorganic
Cabrio	pyraclostrobin	BASF	7969-187	12-24	-/-	>2000	>2000	strobilurin
Captan 50 WP	captan	Micro-Flo	51036-166	24	3/3	>5000	>2000	phthalimide
Captan 80 WP	captan	Micro-Flo	51036-168	24	3/3	>5000	>2000	phthalimide
Captan 80 WDG	captan	Arvesta	66330-29	24-72 ²	3/3	>2000	>5000	phthalimide
Captan 80 WDG	captan	Micro Flo	66222-58-51036	24-72 ²	3/3	>2000	>5000	phthalimide
Captec 4 FL	captan	Micro Flo	51036-181	24-96	3/3	>5000	>2000	phthalimide
Captevate	fenhexamid+captan	Arvesta	66330-48	24-72	3/3	>2000	>5000	analide phthalimide
Champ Formula 2	copper hydroxide	Agrol/NuFarm	55146-64	24	1/3	1630	>5000	copper
Champ DP	copper hydroxide	Agrol/NuFarm	55146-57	24	1/3	1346	>5000	copper
Copper Sulfate	copper sulfate	ChemOne Ltd	56576-1	24	1/3	300	-	copper
Cuprofix Dispers	basic copper sulfate	Cerexagri	4581-396	24	1/3	>2000	>4000	copper
Dithane M-45	mancozeb	DowAgrosciences	62719-387	24	1/3	>5000	>5000	dithiocarbamate
Elevate	fenhexamid	Arvesta	66330-35	12	3/3	>2000	>2000	analide
Elite 45 DF	tebuconazole	Bayer	264-749	12	1/2	2593-4865	>2000	conazole
Endura	boscalid	BASF	7969-197	12	-/-	>2000	>2000	pyridine
Flint	trifloxystrobin	Bayer	264-777		2/3	>5050	>2000	strobilurin
Indar	fenbuconazole	DowAgrosciences	62719-421	12	1/3	4000	>2000	conazole
JMS Stylet Oil	paraffinic oil	JMS Flower Farms	65554-1	12	-/-	10000	-	organic
Kocide 101	copper hydroxide	Griffin	1812-288	4	1/3	833	>5000	copper
Lime Sulfur Solutions	lime sulfur	Miller	72-19	24	-/-	820	>2000	inorganic
Kumulus DF	sulfur	Micro-Flo	51036-352	48	1/1	>2200	>2000	inorganic
Maneb 75 DF	maneb	Cerexagri	4581-371	24	1/3	>5000	>2000	dithiocarbamate
Maneb 80 W	maneb	Cerexagri	4581-255	24	1/3	>5000	>2000	dithiocarbamate
Mertect 340-F	thiabendazole	Syngenta	100-889	24	1/3	>5000	>2000	thiazole
Messenger	harpin protein	Eden Bioscience	69834-2	12	-/-	>5000	>6000	organic
Microthiol Dispers	sulfur	Cerexagri	4581-373	4	1/1	>2000	>2000	inorganic
Mycoshield Ag Terramycin	oxytetracycline	Syngenta	100-900	24	3/2	>5000	>2000	organic
Nova 40 W	myclobutanil	DowAgrosciences	62719-411	12	2/2	1870-2090	>5000	conazole
Orbit	propiconazole	Syngenta	100-702	24	1/2	1310	>5000	conazole
Oxidate	hydrogen dioxide	Biosafe Systems	70299-2	24	-/-	330	1410	organic
Penncozeb 80 WP	mancozeb	Cerexagri	4581-358	0	1/3	>5000	>2000	dithiocarbamate
Penncozeb 75 DF	mancozeb	Cerexagri	4581-370	24	1/3	>4470	>2000	dithiocarbamate
Phostrol	phosphoric acid	NuFarm	55146-83	24		>5000	>5000	-
Polyram 80 DF	metiram	UAP Platte	7969-105-34704	4	2/3	>5000	>2000	dithiocarbamate
Pristine	boscalid+pyraclostrobin	BASF	7969-199	24	-/-	>2000	>2000	pyridine/strobilurin
Procure 50 WS	triflumizole	Uniroyal	400-431	12-24	3/2	2230	>2000	conazole
ProPhyt	potassium salts	Helena	42519-22-5905	12		>5000	>4000	-
Quintec	quinoxifen	DowAgrosciences	62719-375	4	-/-	>2000	>2000	quinoline
Ridomil Gold GR	metalaxyl-M	Syngenta	100-798	12	-/-	>5000	>2000	anilide
Ridomil Gold EC	metalaxyl-M	Syngenta	100-801	48	2/1	1172	>2020	anilide
Ridomil Gold MZ	metalaxyl-M	Syngenta	100-803	48	2/1	>5000	>2000	anilide/dithiocarbamate
Ridomil Gold/Copper	metalaxyl-M/copper	Syngenta	100-804	48	1/1	550	>2020	anilide/copper
Rovral 50 WP	iprodione	Aventis	264-453	48	2/1	>5000	>2000	dicarboximide
Rovral 4 F	iprodione	Aventis	264-482	24-48	3/3	1170	>2000	dicarboximide
Rubigan 1 EC	fenarimol	Gowan	10163-273	24-48	3/3	1057-1270	>2000	pyrimidine
Scala	pyrimethanil	Bayer	264-788	12	2/1	4150-5971	>5000	pyrimidine
Scholar	fludioxonil	Syngenta	100-969	12-24	-/-	>5050	>2020	pyrrole
Serenade	Bacillus subtilis	Agraquest	69592-7	12	-/-	>5000	<2000	-
Sovran	kresoxim-methyl	BASF	7969-1 54	4	-/-	>5000	>2000	strobilurin
Switch	cyprodinil+fludioxonil	Syngenta	100-953	12	3/3	>5000	>2000	pyrimidine/pyrrole
Syllit 65 W	dodine	Platte	55260-5-34704	12	-/-	2330	>5000	aliphatic nitrogen
Thiram Granuflor	thiram	Taminco, Inc.	45728-21	48	2/3	2400	>2000	dithiocarbamate
Thiram 65 WSB	thiram	Taminco, Inc.	45728-24	24	3/3	2400	>2000	dithiocarbamate
Topsin-M 70 WP	thiophanate-methyl	Cerexagri	4581-403	24	3/3	>5000	>2000	benzimidazole
Vanguard WG	cyprodinil	Syngenta	100-828	12	2/3	>5000	>2000	pyrimidine
Wettable Sulfur 90 WP	sulfur	Micro-Flo	51036-14	12	1/3	>5000	>2000	inorganic
Ziram 76 DF	ziram	Cerexagri	4581-140		1/1	1889	>5000	dithiocarbamate
Ziram Granuflor	ziram	Taminco Inc.	45728-12		3/2	2700	>2000	dithiocarbamate

Insecticides/Miticides

Trade Name	Common Name	Manufacturer	EPA Registration #	REI ¹ (hours)	Runoff/Leach Potential ²	Oral LD50	Dermal LD50	IRAC Group
Acramite 50WS	bifenazate	Crompton-UniRoyal	400-503	1-5 d	2/3	>5000	>5000	25
Actara 25WG	thiamethoxam	Syngenta	100-938	12	2/1	>5000	>2000	4A
*Agri-Mek 0.15 EC & abamectin	avermectin B1	Syngenta	100-898	12	2/3	300	>1800	6
Altacor	chlorantraniliprole	DuPont	352-730	4	-/-	>5000	>5000	28
*Ambush 2 EC	permethrin	Syngenta	100-985	12	2/3	2305	1912	3
*Ambush 25 WP	permethrin	Amvac	5481-502	12	2/3	>5000	>2000	3
Apollo SC	clofentezine	Makhteshim-Agan	66222-47	12	1/3	>5000	>2400	10A
*Asana XL	esfenvalerate	DuPont	352-515	12	2/3	458	>2000	3
Assail 30SG	acetamiprid	Aventis	264-609	12	3/2	1064	>2000	4A
Avaunt 30WG	indoxacarb	DuPont	352-597	12	1/3	687-1867	>5000	22
Aza-Direct	azadirachtin	Gowan	71908-1-10163	4	2/1	>5000	>2000	26
*Azinphos-methyl 50	azinphos-methyl	Micro-Flo	51036-1 64	7-15 d	2/3	14	>2000	1B
Belt	flubendiamide	Bayer	264-1025	12	-/-	>2000	>2000	28
Biobit HPWP	Bt var kurstaki	Valent	73049-54	4	-/-	>5000	>2500	11B
*Brigade WSB	bifenthrin	FMC	279-3108	12	2/3	335	>2000	3
Calypso	thiocloprid	Bayer	264-806	12	-/-	300-500	>4000	4A
*Capture 2EC	bifenthrin	FMC	279-3069	12	2/3	262	>2000	3
Carbaryl 4 L	carbaryl	Platte	34704-447	12	3/3	590	2000	1A
Carbaryl 80	carbaryl	Drexel	19713-50	12	3/3	281	>2000	1A
Confirm 2F	tebufenozide	DowAgrosciences	62719-420	4	2/1	>5000	>5000	18
*Danitol 2.4 EC	fenpropathrin	Valent	59639-35	24	2/3	66	>2000	3
Deliver	Bt Kurstaki	Certis	70051-69	4	-/-	>5000	-	11B
*Diazinon 50 WP	diazinon	Platte	100-460-34704	24	1/3	1960	>2020	1B
*Diazinon AG 500	diazinon	Platte	100-784-34704	24	1/3	1600	>2020	1B
*Diasinon 50 W	diazinon	Micro-Flo	51036-108	24	1/3	>2000	>2000	1B
Dimethoate 400	dimethoate	Platte	34704-207	48	3/2	425	2020	1B
Dimethoate 267 EC	dimethoate	Micro-Flo	51036-198	48	3/2	750	>2000	1B
Dipel	Bt var kurstaki	Valent	73049-17	4	-/-	>5050	>5050	11B
Ecozin	azadirachtin	Amvac	5481-476	12	2/1	>5050	>5050	26
Entrust	spinosad	DowAgrosciences	62719-282	4	2/3	>5000	>2000	-
Endosulfan 50 WSB	endosulfan	Microflo	51036-91	24	1/3	50	150	2A
Esteem 35 WP	pyriproxyfen	Valent	59639-115	12	2/3	>5000	>5000	7C
Evergreen	pyrethrin+ piperonyl butoxide	MGK	1021-1770	12	2/3	>5000	>2000	3
GF-120 NF	spinosad	DowAgrosciences	62719-498	4	2/3	>5000	>5000	5
GuthionSolupak	azinphos-methyl	Bayer	3125-102	2-21 d	2/3	55-75	350	1B
*GuthionSolupak50WP	azinphos-methyl	Bayer	3125-301	2-21d	2/3	12.3-24.7	>2000	1B
Imidan 70 WP	phosmet	Gowan	10163-169	24 hrs	3/3	126-681	>4.64	1B
Intrepid 2F	methoxyfenozide	DowAgrosciences	62719-442	4 hrs	-/-	>5000	>2000	
Javelin WG	Bt kurstaki	Certis	70051-66	4 hrs	-/-	>5100	>5000	11B
Kelthane MF	dicofof	DowAgrosciences	62719-405	12hrs	1/3	1835-5022	>5000	2C
*Lannate 90 SP	methomyl	DuPont	352-342	2-7 d	3/1	30-34	>2000	1A
*Lannate 2.4 LV	methomyl	DuPont	352-384	2-7 d	3/1	49-89	>2000	1A
Leverage	imidacloprid+ cyfluthrin	Bayer	264-770	12 hrs	-/-	200	>5000	4A+3
Lorsban 50 WP	chlorpyrifos	Gowan	62719-221-10163	1-4 d	2/3	382	>2000	1B
*Lorsban 4 EC	chlorpyrifos	DowAgrosciences	62719-220	1-4 d	2/3	340-776	>5000	1B
Malathion 8	malathion	Gowan	10163-21	12-24 hrs	3/3	370	4100	1B
Malathion 57EC	malathion	UAP Platte	34704-108	12 hrs	3/3	550	>2000	1B
Movento	spirotetramet	Bayer	264-1050	24 hrs	-/-	>2000	>4000	23
M-Pede	fatty acids	Mycogen	53219-6	12 hrs	-/-	>5000	>2000	-
Neemix 4.5	azadirachtin	Certis	70051-9	12 hrs	2/1	>5000	-	26
Nexter	pyridaben	BASF	7969-106	12 hrs	1/3	1930	>2000	21
*Pounce 25 WP	permethrin	FMC	279-3051	12 hrs	2/3	1100	>2000	3
*Pounce 3.2 EC	permethrin	FMC	279-3014	12 hrs	2/3	1030	>2000	3
Provado 1.6F	imidacloprid	Bayer	3125-457	12 hrs	2/1	1858-2591	>2000	4A
Pyganic	pyrethrins	MGK	1021-1771	12 hrs	2/3	-	-	3
Pyramite 60 WP	pyridazinone	BASF	7969-125	12 hrs	-/-	1930	>2000	-
Savey	hexythiazox	Gowan	10163-250	12 hrs	2/3	>5000	>5000	10
Sevin 80 S	carbaryl	Bayer	264-316	12 hrs	3/3	281	>2000	1A
Sevin XLR Plus	carbaryl	Bayer	264-333	12 hrs	3/3	649	>2000	1A
Sevin 4 F	carbaryl	Bayer	264-349	12 hrs	3/3	590	>2000	1A
Spintor 2 SC	spinosad	DowAgrosciences	62719-294	4 hrs	2/3	>5000	>5000	5
Sunspray Ultra-fine Spray Oil	superior oil	Sun Company	862-28	4 hrs	-/-	>15000	-	-
*Supracide 25 WP	methidathion	Gowan	10163-244	2-14 d	3/3	53	>2020	1B
Surround WP	kaolin	Engelhard	70060-14	4 hrs	-/-	>5000	-	-
*Vendex 50 WP	fenbutain-oxide	Griffin	1812-413	48 hrs	1/3	>5000	>2000	12B
Voliam Flexi	thiamethoxam+chlorantraniliprole	syngenta	100-1319	-	-/-	>5000	>5000	4A+28
*Vydate L	oxamyl	DuPont	352-372	48 hrs	3/3	9-10	>5000	1A
Warrior	ambda-cyhalothrin	DuPont	100-1112	24 hrs	2/3	351	>2000	3
Zeal	etoxazole	Valent	59639-123	12 hrs	-/-	>5000	>5000	10B

Herbicides

Trade Name	Common Name	Manufacturer	EPA Registration #	REI (hours)	Runoff/Leach Potential ¹	Oral LD50	Dermal LD50	IRAC Group
2,4-D	2,4-D	Several	228-357	48	3/2	>1,000	>2,000	phenoxyacetic
Aim 2E	carfentrazone	FMC	279-3242	12	-/-	>5000	>4000	triazolinone
Basagran 4L	bentazon	BASF	7969-45	48	-/-	2063	>10000	benzothiadiazinone
Casoron 4G	dichlobenil	Uniroyal	400-168	12	2/2	>5000	--	nitrile
Chateau 51 WDG	flumioxazin	Valent	59639-119	12	-/-	>5000	>2000	nphenylphthalimides
Devrinol 50DF	napropamide	United Phosphorus	10182-258-70506	12	2/2	>5000	>2000	acetamide
Fusilade DX 2E	fluzafop-p	Syngenta	100-1070	12	2/3	>5000	>2000	FOPs
Gallery 75DF	isoxaben	DowAgroscience*	62719-115	12	1/3	>5000	>5000	benzamide
Goal2 XL	oxyfluorfen	DowAgroscience	62719-424	24	2/3	2985	>4000	diphenylether
Gramoxone Max 3L	paraquat	Syngenta	100-1074	12	-/-	283	>2000	bipyridilium
Karmex 80DF	diuron	Griffin	1812-362	12	2/2	6100	>5000	urea
Kerb 50WP	Pronamide	DowAgroscience	62719-397	24	2/1	>5000	>2000	amide
MSMA 6	MSMA	Platte Chemicals	34707-115	12	-/-	1738	2000	organoarsenicals
Poast 1.5E	sethoxydim	BASF	7969-58	12	3/3	4100	>5000	DIMs
Princep 4L	simazine	Syngenta	100-526	12	2/1	>5000	>2500	triazine
Prowl 3.3 E	pendimethalin	BASF	241-337	24	1/3	3956	>2200	dinitroaniline
Reglone 2E	diquat	Syngenta	100-1061	24	-/-	886	>5000	bipyridilium
Rely 1E	glyphosate	Bayer	264-652	12	3/3	3570	>2000	phosphinic acid
Roundup	glyphosate	Monsanto	524-512	12	-/-	>5000	>5000	glycine
Select 2E	clethodim	Valent	59639-3	24	3/3	2920-3610	>5000	DIMs
Sinbar 80WP	terbacil	Dupont	352-317	12	2/1	500-2784	>5000	terbacil
Snapshot 2.5TG	isoxaben +trifluraflin	DowAgroscience	627-174	12	1/3	>5000	--	benzamide
Solicam 80DF	norflurazon	Syngenta	100-849	12	2/2	1140	>2000	pyridazinone
Stinger	Clopyralid	DowAgroscience	62719-73	12	-/-	>5000	>5000	pyridine carboxylic acid
Surflan 4AS	oryzalin	DowAgroscience	62719-112	24	3/3	>5000	>5000	dinitroaniline
Treflan 4E		DowAgroscience	62719-250	12	-/-	3700	>5000	dinitroaniline

Plant Growth Regulators

Trade Name	Common Name	Manufacturer	EPA Registration #	REI (hours)	Runoff/Leach Potential ¹	Oral LD50	Dermal LD50	IRAC Group
Apogee	Prohexadione-Calcium	BASF	7969-188	12 hrs	3/2	>5000	>2000	unclassified
ArnidThin - W	NAD	Amvac	5481-426	48 hrs	3/2	>10000	>5000	auxin
Ethrel	ethephon	Aventis	264-267	48 hrs	2/3	>5000	>2000	ethylene
Fruitone N	NAD	Amvac	5481-427	48 hrs	3/2	>10000	>5000	auxin
K-Salt Fruit Fix 800	NAD	Amvac	5481-413	24 hrs	3/2	>5050	>2020	auxin
K-Salt Fruit Fix 800	NAD	Amvac	5481-414	24 hrs	3/2	>5050	>2020	auxin
MaxCel	6-benzyladenine	Valent	73049-407	12 hrs	-/-	>5000	>5000	cytokinin
Pro-Gibb	gibberellic acid (GA3)	Valent	73049-15	12 hrs	-/-	>5000	>2000	gibberellin
Pro-vidé	gibberellic acid	Valent	73049-3	4 hrs	-/-	2100	>2000	gibberellin
Promalin	6BA+GA4+7	Valent	73049-41	4 hrs	-/-	>5050	>5050	cytokinin+gibberellin
ReTain	AVG	Valent	73049-45	12 hrs	-/-	>7000	>5000	ethylene
Sucker-Stopper	NAD	Valent Lawn & Garden	73049-45 548 1-429	12 hrs 12 hrs	-/ 3/2	>7000 5585	>5000 >5000	ethylene auxin

Nematicides

Trade Name	Common Name	Manufacturer	EPA Registration #	REI (hours)	Runoff/Leach Potential ¹	Oral LD50	Dermal LD50	IRAC Group
*Nemacur 3 S	fenamiphos	Bayer	264-731	48 hrs	2/1	10.6-24.8	71.5-75.7	
*Nemacur 15G	fenamiphos	Bayer	264-726	48 hrs	2/1	10 - 14	>2000	
*Telone II	dichloropropene	DowAgrosciences	627 19-32	5 d	3/2	224-300	333	unclassified
*Telone C-17	dichloropropene and chloropicrin	DowAgrosciences	627 19-12	5 d	3/2	304-519	200-500	unclassified
Vapam	metam-sodium	Amvac	5481-466	48 hrs	3/2	812	>2050	unclassified
*Vydate L	oxamyl	DuPont	352-372	48 hrs	3/3	9-10	>5000	carbamate

Conversion Factors for Weights and Measures: Equivalents

	METRIC	U.S.
Length	1 Millimeter	0.039 inch
	1 Centimeter (10 mm)	0.39 inch
	1 Meter (100 cm)	39.4 inch
	1 Kilometer (1,000 m)	0.62 mile
Area	1 Square Centimeter	0.155 square inch
	1 Square Meter	1.2 square yards
	1 Hectare (10,000 sq m)	2.47 acres
	1 Square Kilometer (100 ha)	247 acres
Weight	1 Gram	0.035 ounces
	1 Kilogram (1,000 g)	2.2 pounds
	1 Ton (metric) – 1,000 kg	1.1 tons (U.S.)
Volume	1 Milliliter	0.034 fluid ounces
	1 Liter (1,000 ml)	1.056 quarts
	1 Cubic Meter (1,000 l)	264.17 gallons (U.S.)
	U.S.	METRIC
Length	1 Inch	2.54 centimeters
	1 Foot (12 inches)	30.5 centimeters
	1 Yard (3 ft)	0.91 meters
	1 Mile (5,280 ft)	1.6 kilometers
Area	1 Square Inch	5.6 square centimeters
	1 Square Foot (1.44 sq in)	930 square centimeters
	1 Square Yard (9 sq ft)	0.84 square meters
	1 Acre (43,560 sq ft)	0.405 hectares
	1 Square Mile (640 acres)	259 hectares
Weight	1 Ounce	28.3 grams
	1 Pound (16 oz.)	0.454 kilograms
	1 Ton (U.S.) - 2,000 lb	0.907 tons (metric)
Volume	1 Tablespoon (3 teaspoons)	14.79 milliliters
	1 Fluid ounce (2 tablespoons)	29.6 milliliters
	1 Cup (8 fl oz)	0.237 liters
	1 Pint (2 cups)	0.473 liters
	1 Quart (4 cups)	0.946 liters
	1 Gallon (U.S.) – 4 qts	3.8 liters
	1 Cubic Foot	28.3 liters

Metric Abbreviations

mm=millimeter
 cm=centimeter
 m=meter
 km=kilometer
 ha=hectare

mg=milligram
 g=gram
 kg=kilogram
 ml=milliliter
 l=liter

2009 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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