



Midwest Fruit Pest Management Guide 2018

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Iowa

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Ohio State University Extension
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Oklahoma

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E-987

West Virginia

West Virginia University Extension Service
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Wisconsin

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About This Guide

The *Midwest Fruit Pest Management Guide* 2018 was developed by the Midwest Fruit Workers Group.

This publication combines two longtime guides that have become familiar to countless growers: the annual *Midwest Small Fruit and Grape Spray Guide* and the annual *Midwest Tree Fruit Spray Guide*.

Members of the Midwest Fruit Workers Group decided to combine these publications in order to address the needs of many producers who grow many different crops. It is our hope that this new combined publication will make it easier for producers to find the accurate information they need for managing pests in fruit crops. **We believe this new format will provide readers with information that is concise and easy to understand. We welcome your comments. Please send your suggestions to one of your state representatives. This guide will be revised each year.**

Printed copies of this publication are available from the Purdue Extension Education Store, www.edustore.purdue.edu. A free PDF download also is available from the Education Store, or from your state's cooperative extension service.

The Midwest Fruit Workers Group also publishes companions to this guide, including the *Midwest Small Fruit Pest Management Handbook* and *Midwest Tree Fruit Pest Management Handbook*. Contact your state cooperative extension office for information about these publications.

Midwest Small Fruit Pest Management Handbook

The *Midwest Small Fruit Pest Management Handbook* is a companion publication to this guide. It contains additional information about control strategies for small fruit diseases, insect pests, and weeds. Pesticide safety, sprayer calibration, plant nutrition, and weed identification are also covered. Copies of the publication (Ohio State University Extension Bulletin 861) may be available from your state Extension office or from Ohio State University Extension Publications, 385 Kottman Hall, 2021 Coffey Road, Columbus, OH 43210-1044, (614) 292-1607. You can also order it from Ohioline, ohioline.osu.edu.

Midwest Tree Fruit Pest Management Handbook

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

Legal Responsibilities for Pesticide Use

The pesticides suggested in this publication have been registered by the Pesticides Regulation Division of the Environmental Protection Agency. At the time this publication was published, these pesticides were registered for use as indicated on the individual product labels. These registrations can change at any time.

To keep informed of the latest updates on pesticide registrations, the Web version of this publication is updated regularly, and is available from the Purdue Extension Education Store, www.edustore.purdue.edu.

It is your responsibility as a pesticide user to read and follow all current label directions for the specific pesticide being used. Strictly observe the legal limitations on the use of these pesticides to prevent excessive residues in or on harvested fruit. All growers should read product labels, follow directions carefully, and observe pre-harvest intervals and application rates. Pesticide labels are available on the following sites: CDMS.net/label-Database; Agrian.com; and through many suppliers websites.

Not all products listed in this guide are registered in every state. To be sure a product is registered in your state, check the National Pesticide Information Retrieval Service: npirspublic.ceris.purdue.edu.

Some of the pesticides suggested in this publication are on the EPA Restricted Use List, and users must be certified private applicators to purchase and apply these materials. Record-keeping requirements are more stringent for restricted use pesticides.

Remember: The pesticide label is a legal document.

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Foreword

Commercial fruit production has become a highly skilled, technical profession. Concerns about pesticide 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 Environmental Protection Agency (EPA) has designated a number of fruit pesticides as “restricted use.” Growers who plan to use these restricted materials must be certified as private applicators.

Certification requires that applicators understand the following: labels and labeling, safety factors, potential environmental concerns, identification of common pests encountered, pesticides and their use, proper equipment use, application techniques, and applicable state and federal regulations. Training programs are offered to help you in certification. Contact your county extension office for information.

The pest management recommendations in this guide have been formulated to provide you up-to-date information about pesticides and their applicability to your problem. We suggest that you use this information to set up your own spray program. You should keep accurate records of materials used, application dates, areas treated, growth stages, and weather conditions. Sample

record sheets are on pages 169-170. In case of questions, nothing beats a good set of records. The EPA requires records for Restricted Use Pesticide applications. Some states may require records for general use pesticides (e.g., Kentucky has this requirement).

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. Do not use tobacco, eat, or drink when handling or applying pesticides.
4. Stay out of drift from spray or dust.
5. Rinse liquid containers with water at least three times and pour rinsate into spray tank as it is being filled. Punch holes in metal and plastic containers and crush. Dispose of these and all other pesticide containers where there will be no contamination of crops or water supply. Do not re-use pesticide containers.
6. Use an adequate respirator and protective clothing, especially when mixing pesticides. Necessary protective equipment is listed on pesticide labels.

7. Have a “buddy” around when using acutely toxic organophosphates, just in case.
8. For maximum safety, get an appropriate blood test before the season starts and test periodically during the season.
9. Consult a doctor immediately if you develop unusual symptoms during or after spraying. Symptoms such as blurred vision, nausea, headaches, chest pains, weakness, diarrhea, or cramps indicate possible pesticide poisoning.
10. Wash hands thoroughly before eating, drinking, chewing gum, using tobacco, or using the toilet.
11. Bathe and change clothes daily, and wash contaminated clothing separate from other laundry.
12. Always store a pesticide in its original container, never in an unmarked container. Never trust your memory.
13. Always store pesticides under lock and key and keep them away from children.
14. Always use an anti-siphon device when filling the spray tank from a domestic water source.
15. The label is the law. Read and follow all label instructions carefully.
10. Comply with the Right-To-Know law. Have complete product labels readily available for workers to see. Have the Material Safety Data Sheet (MSDS) for each product you use available for workers to see and for rescue or fire personnel to use in case of emergency.
11. Provide pesticide safety training for pesticide handlers and other workers to comply with Worker Protection Standards (WPS).
12. Regularly inspect and maintain personal protective equipment used when applying pesticides.

Pesticide Use and the Law

Pesticides are developed by manufacturers, registered with EPA, and sold to the public with the assumption that users read, understand, and follow instructions found on product labels. Pesticide labels include specific information about use, personal protective equipment, environmental precautions, and storage and disposal. The purpose of the label is to provide clear directions to allow maximum product benefit while minimizing risks to human health and the environment.

Every pesticide label includes the statement, “It is a violation of federal law to use this product in a manner inconsistent with its labeling.” This language obliges purchasers or users of any pesticide to assume all legal responsibilities for the product’s use. Further, courts and regulators recognize that pesticide labels are binding contracts that require those using the products to do so exactly as directed. Terms such as “must,” “shall,” “do not,” and “shall not” mean users are responsible for specific actions when applying or handling a given product; any departure from such directions is, in the eyes of the law, an illegal use of the pesticide.

“Use” means more than just applying the pesticide. Federal and state regulations define pesticide use to include handling, mixing, loading, storing, transporting, and disposing, as well as human and environmental exposure. This all-encompassing definition covers every activity that involves a pesticide — from purchase to container disposal.

The pesticide label is more than just a piece of paper. It serves a dual function: the label instructs users how to use the product safely and effectively, and it serves as a legal measuring stick. Many statements on the label result from rigorous scientific investigations and governmental regulatory decisions. Pesticide users should read, understand,

Management Tips for Safety

1. Maintain accurate spray records. Show application rates, pesticides used, total gallonage, area treated, stage of plant development, and weather data.
2. Be prepared to show your records to the EPA or state regulatory officials if necessary.
3. Do not contaminate forage crops or pastures.
4. Do not allow animals to graze fruit plantings.
5. Prevent excess drift.
6. Maintain equipment in top condition.
7. Protect children, pets, livestock, and the environment from pesticide contamination.
8. Follow all label instructions on re-entry times for pesticides. Regulations mandate re-entry times for all pesticides. Sprayed areas must be posted so workers will not enter before the re-entry time without the required protective clothing. Re-entry times and the required protective clothing are listed on product labels and in tables in this guide.
9. Inform all workers of re-entry restrictions and information on safe pesticide use and/or training to meet OSHA requirements.

and follow pesticide label directions to ensure effective pest control, personal safety, environmental protection, and legal compliance.

Pesticide labels include two very important statements:

Re-entry or restricted entry interval (REI) statements contain re-entry precautions and state a time interval during which entry into a pesticide-treated site is not allowed. The statement indicates the length of time that must elapse after the pesticide application before individuals may enter the treated area without personal protective clothing and equipment.

Pre-harvest interval (PHI) statements indicate the time interval that must elapse after the pesticide application before the crop may be harvested. Harvesting prior to the PHI may result in dangerous and illegal pesticide residues on the crop.

Pesticide Use in Greenhouses and High Tunnels

Fruit and vegetable production in greenhouses and high tunnels has increased dramatically in the Midwest in the past few years. Although greenhouse or high tunnel environments may change the composition of the pest complex growers may face, using pesticides will often be necessary to maintain the adequate levels of control needed to produce a profitable and marketable crop.

Pesticide regulatory agencies in the Midwest vary in their interpretation of whether a high tunnel is a type of greenhouse. For example, Indiana considers a high tunnel to be a form of greenhouse. That means the pesticides one selects for high tunnel use must be appropriate for greenhouse use. Other states (not covered by this guide) consider high tunnels to be the same as fields when it comes to pesticide use. Still other states, like Missouri, take an intermediate approach: they call a high tunnel a greenhouse when the sides are closed, but call it a field when the sides are open.

It is important that you determine how your state views high tunnels. When it comes to greenhouse pesticide applications, there are three kinds of labels.

First, pesticide labels can clearly state that the products may be used in greenhouses. These products may be used according to label directions. Pesticide labels that have different instructions for greenhouse use and in-field use also fall into this category. These products also may be used in high tunnels according to label instructions.

Second, pesticide labels may clearly prohibit greenhouse use. Obviously, these products cannot be used in a greenhouse under any circumstances.

Finally, there are many pesticide labels that don't specify whether the product can be used in a greenhouse or not. When labels don't expressly prohibit greenhouse use, most state regulatory agencies interpret that to mean that the product can be used in a greenhouse as long as the treated crop is on the label and the product is used according to label directions.

Determining Spray Volume and Rate

Producers spray fruit plantings with insecticides, fungicides, growth regulators, and nutrient solutions in many different formulations and concentrations and at various stages of plant development. The principal targets in spraying may be the foliage, flowers, fruit, woody surfaces, or all these components. Obviously, the equipment and methods you use for such a diverse spraying program must be versatile, and the equipment must be properly calibrated for each type of application to produce the desired results.

Dilute Spraying

The objective of spraying is to distribute the spray material uniformly over the plants or plant parts of particular concern. Pesticide recommendations are based on the amount of dilute spray needed to wet plants thoroughly, to the point of "runoff." In typical blueberry, raspberry, or grape plantings with plants 5 to 7 feet tall and 3 to 5 feet wide and set in rows 9 to 10 feet apart, and in most strawberry plantings, 100 gallons of water per acre has been established as a standard dilute spray volume for fungicide and insecticide application. This dilute rate is considered a 1x concentration.

In a standard apple or pear orchard, with trees approximately 20 feet tall, 22 feet wide, and set on rows 35 feet apart, 400 gallons of water per acre is a standard dilute spray for fungicide and insecticide application. Recommendations may be made per 100 gallons or per acre. Dilute is considered 1x concentration. For cherry, peach, and plum, 300 gallons of water per acre is the standard dilute spray volume for full-size trees.

The Amount of Dilute Spray per Acre Required for Equivalent Coverage of Plants table lists the gallons of dilute spray per acre required to provide equivalent coverage for mature trees of different sizes and spacings.

Amount of Dilute Spray per Acre Required for Equivalent Coverage of Plants

Distance Between Rows (feet)	Plant Height (feet)	Plant Width (feet)	Maximum Plant Volume/Acre (1000 cu ft ¹)	Minimum Dilute Spray (gallons/acre ²)
30	20	15	436	300
26	16	12	354	225
24	14	10	254	180
22	14	10	272	200
20	12	10	261	185
18	10	10	242	175
16	8	8	174	125
14	6	6	149	105
12	6	6	131	90
10	6	4	105	74
10	4	4	70	49

¹Maximum plant volume/acre = plant width x plant height x running feet or row per acre. Running feet of row per acre = 43,560 divided by the distance between rows.

²Minimum dilute gallons per acre = approximately 0.7 gallon /1,000 cubic feet of plant volume.

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 about 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 is the practice of using 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 of pesticide used by 2x, 3x, 4x, or more. Thus, a 3x rate uses a 3x concentration of pesticide in only one-third the water per acre that would be used in dilute spraying.

You must apply low-volume sprays with air-assisted sprayers that use a high-velocity airstream to distribute the spray mixture. Most conventional air-assisted sprayers can be used to apply spray mixtures up to 6x concentration. Sprayers specifically designed for ultra-low-volume application should be used for applications up to 10x.

Using low-volume sprays requires less labor, less water, less time, and fewer refills than 1x or dilute mixtures. However, low volume sprays have disadvantages. Savings in gallonage and application costs decrease most rapidly down to about 50 gallons of water per acre (on tree fruit). Below that,

the savings may not be worth the additional risk of improper application and problems with wind.

Here are some precautions to follow when making low-volume pesticide applications:

1. Use extreme care in calibrating the sprayer and maintaining a constant sprayer speed. As you decrease gallonage, 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 in windy conditions (more than 5 mph).
3. Prune plants well to create an open canopy for spray penetration. Spray droplets will not penetrate dense foliage.
4. Choose pesticide formulations that will mix satisfactorily. Pay careful attention to increased operator hazards and drift problems.

Gallons of Spray per Acre (approximate) for Various Concentrates

	1x	2x	3x	4x	5x	6x
Apples	400	200	132	100	80	64
Peaches	300	150	100	75	60	50
Percent water savings over dilute		50%	67%	75%	80%	84%
		Greatest savings			Diminished savings	

Tree Row Volume Spraying

Tree row volume (TRV) is a method originally used with orchard crops to determine the dilute (1x) volume of spray solution necessary to cover the entire plant surface for any given fruit planting. TRV is an objective method for determining the spray volume required for plants of different sizes, and for changes in canopy size as plants develop during the season.

With the TRV method, you can easily calculate the volume of dilute spray needed per acre for each planting based on plant size and canopy density. To determine the TRV, you must accurately measure the between-row spacing, maximum plant height, and cross-row plant spread. See the step-by-step procedure below.

Calculate Tree Row Volume Gallonage

Step 1. Calculate feet of row/acre.

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

Step 2. Calculate cu ft of TRV/acre.

Feet of row/acre (from Step 1) x plant height (ft) x cross-row plant spread (ft) = cu ft of TRV/acre.

Step 3. Select density factor.

Select one of the following numbers that best indicates the canopy density of each separate planting.

0.70 gal/1,000 cu ft: Plants extremely open, light visible through entire canopy.

0.80 gal/1,000 cu ft: Plants well pruned, with moderate vigor, adequate light penetration into canopy, many holes in foliage where light can be seen through plant.

0.90 gal/1,000 cu ft: Plants pruned minimally, or with high vigor, poor light penetration into canopy, very few holes where light can be seen through plant.

1.00 gal/1,000 cu ft: Plants unpruned, extremely dense, no light visible anywhere through canopy

Step 4. Calculate TRV gallonage/acre.

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

= gallons of dilute solution to be applied per acre
= TRV gal/acre

Example 1:

A vineyard has rows spaced 10 feet apart, the canopy height is 6 feet, and the cross row spread is 4 feet at full canopy. The density factor is 0.90.

Step 1 43,560 sq ft ÷ 10 ft = 4,356 ft of row/acre

Step 2 4,356 x 6 ft x 4 ft = 104,544 cu ft TRV/acre

Step 3 Density has been chosen as 0.90.

Step 4 [104,544 x .90] ÷ 1,000 = 94 TRV gal/acre

Example 2:

An apple orchard on dwarfing rootstock has rows spaced 15 feet apart, the canopy height is 12 feet, and the cross row spread is 8 feet at full canopy. The density factor is 0.90.

Step 1 43,560 sq ft ÷ 15 ft = 2,904 ft of row/acre

Step 2 2,904 x 12 ft x 8 ft = 278,784 cu ft TRV/acre

Step 3 Density has been chosen as 0.90.

Step 4 [278,784 x .90] ÷ 1,000 = 251 TRV gal/acre

For additional information about calculating TRV gal/acre refer to *Orchard Spray Rates: How to Determine the Amount of Pesticide and Water to Use in Your Orchard* (C. Welty, Ohio State Extension Bulletin 892, ohioline.osu.edu).

Spraying Small Volumes

In some cases you may wish to apply small volumes of pesticides with backpack or hand-held sprayers or wipers. The following table will help convert from the rate per 100 gallons to the rate per gallon. Take care to measure pesticide amounts accurately because errors will be magnified at small volumes. (See: *Approximate Dilutions for Small Volumes of Spray Mixes* table on page 8).

Calibrating Single Nozzle and Boom Sprayers

Calibration is an essential step for using any application equipment. Early spring, right after you have reassembled the sprayer and are preparing it for early season operations is a good time to calibrate. Be sure all fittings are tight and that there are no leaks. Take the nozzles apart, clean them, and check for worn nozzle tips.

Using wettable powder sprays enlarges nozzle openings, so it is essential to calibrate each nozzle. Start the season with a calibrated sprayer, and depending on the number of gallons you spray,

Approximate Dilutions for Small Volumes of Spray Mixes

Equivalent rates for different quantities of water				
Formulation	100 gallons	5 gallons	3 gallons	1 gallon
Wettable Powder, Dry Flowable, etc.	5 pounds	15 tablespoons	9 tablespoons	3 tablespoons
	4 pounds	13 tablespoons	8 tablespoons	8 teaspoons
	3 pounds	10 tablespoons	6 tablespoons	2 tablespoons
	2 pounds	8 tablespoons	4 tablespoons	4 teaspoons
	1 pound	3 tablespoons	6 teaspoons	2 teaspoons
	1/2 pound (8 oz)	5 teaspoons	1 tablespoon	1 teaspoon
Emulsifiable Concentrate, Liquid	5 gallons	1 quart	1 1/4 pints	13 tablespoons
	4 gallons	1 1/2 pints	1 pint	10 tablespoons
	3 gallons	1 1/4 pints	3/4 pint	8 tablespoons
	2 gallons	3/4 pint	1/2 pint	5 tablespoons
	1 gallon	1/2 pint	8 tablespoons	3 tablespoons
	1 quart	3 tablespoons	2 tablespoons	2 teaspoons
	1 pint	5 teaspoons	1 tablespoon	1 teaspoon

These approximations are based on average weights of various pesticide products as described in *Dry Pesticide Rates for Hand-held Sprayers* (University of Kentucky Extension publication HO-83, www.ca.uky.edu/agcomm/pubs.asp).

calibrate the sprayer again according to intervals specified in the owner's manual (or no later than halfway through the spray season). Follow the procedure below to calibrate a single nozzle boom sprayer.

Step 1. Check your tractor/sprayer speed.

Attach the sprayer to your tractor and make test runs to determine the tractor speeds (mph) in different gears. Run the tractor at PTO speed as you will when operating the sprayer. Travel a test course and record time needed to travel a measured distance. Run the test on the same type surface in the planting (for example, sod, not pavement or gravel)

Formula

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

Your tractor sprayer speed

$$\text{MPH} = \frac{\text{ft traveled}}{\text{seconds}} \times \frac{60}{88} = \underline{\hspace{2cm}}$$

Note: The recommended tractor speed for most applications with single nozzle boom sprayers is 2-3 mph. Traveling faster may lead to poor coverage. A convenient method is to set up a calibration course in multiples of 88 feet (88 feet per minute=1 mile per hour). Set markers at 176 feet or 264 feet to correspond to 2 mph and 3 mph when the tractor speed is adjusted (gear and rpm) to cover the distance in 60 seconds (1 minute).

Step 2. Record the sprayer inputs.

	Your Figures	Example
Nozzle type on your sprayer (all nozzles should be identical)	_____	110° 04 flat fan
Recommended application volume (from manufacturer's label)	_____	20 GPA
Measured sprayer speed	_____	3 mph
Nozzle spacing/band width (in inches)	_____	20 inches

Step 3. Calculate the required nozzle output.

Formula

$$\text{GPM (per nozzle)} = \frac{\text{GPA} \times \text{MPH} \times \text{W}}{5,940 \text{ (constant)}}$$

Where

GPM=required output per nozzle in gallons per minute.

GPA=desired total carrier volume in gallons per acre.

MPH=desired ground speed in miles per hour.

W=inches between nozzles (or band width if making band applications).

Example

$$\text{GPM} = \frac{20 \text{ GPA} \times 3 \text{ MPH} \times 20 \text{ in}}{5940} = \frac{1,200}{5,940} = 0.20 \text{ GPM}$$

Your figures

$$\text{GPM} = \frac{\quad}{5,940} = \frac{\quad}{5,940} = \text{___ GPM}$$

Step 4. Operate the sprayer.

Set the correct pressure at the gauge using the pressure-regulating valve. Note that recommendations for flat fan nozzles are 15-30 psi (not more than 40 psi for spraying weeds).

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

The output of each nozzle should be the approximately the same as calculated in Step 3 above. Remember there are 128 fluid ounces in one gallon. If you calculate the output at 0.20 GPM, multiply 0.20 by 128, which equals 25.6 fluid ounces in one minute.

If the nozzle output is slightly off from what you want, change the pressure. If the nozzle output is significantly off, change the speed or nozzle size.

Compare nozzle output on multiple nozzle booms. Replace all nozzle tips that are more than 10 percent inaccurate. You will only achieve a satisfactory spray pattern if the output from individual nozzles does not differ by more than 10 percent.

Calibration of Air-blast Sprayers

Accurate calibration is the only way to ensure that a sprayer is applying the intended amount of chemical. You must know the amount of water that will be applied per unit of area in order to make a proper spray mix. If you fail to calibrate the sprayer, it can injure the crop, create a hazardous situation, and waste money. Frequent calibration identifies worn nozzles and keeps you aware of factors that can affect the application rate, including travel speed, pressure, and type of nozzle in use.

Pre-calibration Check

Before calibrating, check the sprayer carefully. Be sure the nozzle tips are clean. Replace all worn or damaged nozzles. Check all hoses and fittings for leaks and aging. Make sure the pressure is constant and the tank is free of dirt and debris.

Determining Sprayer Speed

You can determine the speed you need to travel to properly distribute the spray within the canopy by placing water-sensitive spray paper at various locations within the canopy. For proper pesticide application, the air within the canopy must be completely replaced with spray-laden air from the sprayer. In general, a travel speed of 1 to 3 miles per hour has proved satisfactory, depending on the size and density of the canopy, and capacity of the sprayer.

Before you can calibrate your sprayer, you must determine the travel speed in miles per hour (mph). To determine the travel speed, load the sprayer with clear water and make a test run in the fruit planting. Always make the test run in the fruit planting or on similar ground, because tractor speeds change dramatically from soft to firm surfaces. Set the tractor throttle at a level sufficient to operate the sprayer (PTO speed) and select an appropriate gear. Remember or mark these settings.

Calculate your speed by measuring the time required to travel any measured distance. A good conversion factor to remember is that 1 mph=88 feet/min. A convenient test length is 176 feet because it is a multiple (2x) of 88. Use the following formula to determine travel speed:

$$\text{Speed (mph)} = \frac{\text{distance (ft)} \times 60}{\text{time (sec)} \times 88}$$

For example, if it requires 60 seconds to travel a measured distance of 176 feet, the travel speed is:

$$\text{mph} = \frac{176 \times 60}{60 \times 88} = \frac{10,560}{5,280} = 2 \text{ mph}$$

Determining Nozzle Flow Rate

To select the correct nozzle and whirlplate sizes, you must determine the total gallons per minute (gpm) of output for each particular application.

To determine gpm, you must know the travel speed of the sprayer (mph), the gallons per acre (gpa) to be applied, and the spacing (W) between the rows of plants. Once you have measured or selected these three variables, you can use a simple equation to calculate the gpm. This equation is for one side of the sprayer manifold only. Double the calculated answer if you will use both sides of the sprayer. Once you determine the nozzle and whirlplate combinations, place the same size nozzles and whirlplates in both sides of the sprayer if you will use both sides.

Step 1. Calculate the total gpm required per side:

$$\text{gpm (per side)} = \frac{\text{gpa} \times \text{mph} \times W}{1,000}$$

gpm = gallons per minute (per side)

gpa = gallons per acre

mph = speed (in miles per hour)

W = spacing between rows (in feet)

Example: You have decided to apply 70 gpa while traveling 2 mph, and the rows are spaced 10 feet apart. What is the gpm per side?

$$\text{gpm} = \frac{70 \times 2 \times 10}{1,000} = \frac{1,400}{1,000} = 1.4 \text{ gpm}$$

Step 2. Select the correct nozzle-whirlplate combination and operating pressure. Air-blast sprayers normally use disk-core-type cone spray tips. The correct size nozzles and whirlplates can be selected by using a table, which indicates the nozzle size and gallons per minute output at various pressures using specific whirlplates. You can find these tables in the sprayer manufacturer's literature or in nozzle catalogs.

You should arrange nozzles in the sprayer manifold so approximately *2/3 of the total flow comes from nozzles in the upper half of the manifold, and 1/3 of the total flow comes from nozzles in the lower half.* Adjust nozzles this way to provide uniform coverage throughout the canopy. It should adequately penetrate to the top and center of the canopy while avoiding excess application in the lower outside areas.

Step 3. Install the nozzles in their proper outlets. Inspect and clean all nozzles and outlets and determine that the sprayer is operating correctly. Nozzles are a very important part of the sprayer; if the nozzles show any defects or wear, replace them.

Step 4. Measure the total gpm from all the nozzles selected in Step 2. Fill the sprayer tank at least half full. Prime the sprayer system and check all the nozzles to make sure none are clogged or partially clogged. Record the exact level of water in the spray tank. Bring the sprayer up to the desired pressure and turn the nozzles on. Use a stopwatch to record how long the sprayer is running. You should operate the sprayer for at least three minutes. Record the new level in the tank or measure the amount of water needed to refill the tank to the original level.

Example: The spray tank is filled to the 100-gallon level. It was predetermined from the manufacturer's tables that the nozzles selected would give a total

output of 4 gpm. The sprayer was operated for five minutes at 150 psi on the gauge. After the five minutes, the sight gauge read 75 gals. The actual output was:

$$100 \text{ gals (start)} - 75 \text{ gals (stop)} = 25 \text{ gal per 5 min} = 5 \text{ gpm}$$

The theoretical output from table information, however, was 4 gpm.

When actual output differs from the calculated output, make adjustments by changing the pressure (when the difference is small) or changing the nozzle sizes (when the difference is large). Experiment with the pressure to see if the output can be fine tuned. Refer to manufacturer's tables for recommended operating pressures for nozzles. Never operate above or below recommended pressures.

Repeat these calibration procedures whenever you change the speed, gallons per acre, or row spacing. Periodically check the output from the nozzles during the spraying season. Remember, the effectiveness of the spray material directly depends on your skill as an operator.

Field test to confirm calculations:

$$\text{gpa (gallons per acre)} = \frac{\text{gal. sprayed} \times 43,560 \text{ ft}^2}{\text{distance traveled (ft.)}}$$

Example: A field test is run in which 10 rows, each 200 feet long, were sprayed. Row spacing was 10 feet. It took 35 gallons to refill the sprayer to the original level. What was the gpa?

$$\frac{35 \text{ gal} \times 43,560 \text{ ft}^2}{2,000 \text{ ft} \times 10 \text{ ft}} = 76 \text{ gpa}$$

Spray Water 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, Dimethoate, Imidan, and Malathion, are examples of compounds that are especially vulnerable to alkaline hydrolysis.

Both well and pond water in the Midwest tend to be alkaline (pH above 7.0). 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 (7.0). There are many commercial buffering agents available and the list is too long to include all of them. Be aware that most adjuvants are multi-purpose adjuvants, serving as spreaders, activators, etc. Be sure to read the labels of both the pesticide

and adjuvant before using them. Granulated food grade citric acid may be the most convenient and inexpensive acidifying material. Two ounces per 100 gallons has been shown to reduce the pH of tap water from 8.3 to 5.4. Convenient granulated food grade citric acid measures are:

per 100 gal 1/4 cup, slightly rounded

per 300 gal 3/4 cup, rounded

per 500 gal 1 1/3 cups

Granulated food grade citric acid is available in 50-pound bags from suppliers that handle food grade chemicals. Do not try to acidify solutions containing phosphorous acid, Bordeaux mixture, fixed copper, or other copper compounds.

Spray Adjuvants

Several types of additives are available to improve the effectiveness of spray applications. Collectively, these products are called adjuvants. Here are some adjuvants and their functions:

Activators increase a pesticide's effect by increasing the penetration of a spray solution through leaf hairs or a waxy cuticle and into a leaf or fruit.

Acidifiers lower the pH of alkaline spray water to reduce the potential breakdown of certain pesticides in the spray tank.

Buffers change the pH of spray water, then hold it at the desired degree of acidity.

De-Foamers, when added to the spray tank, break down or prevent the formation of foam.

Elasticizers or Drift Control Agents reduce the breakup of spray droplets into very fine particles and thereby minimize drift.

Surfactants, Spreaders, and Wetting Agents are different names for products that reduce the surface tension around a spray droplet, allowing it to spread out more evenly on the surface of a leaf or fruit.

CAUTION: Some surfactants used in combination with certain pesticides can function as activators, which can injure plants. Consult labels or chemical suppliers for more information.

Stickers cause a pesticide to stick to the surface after the spray dries, thereby reducing the potential for loss from rain or overhead irrigation.

Spreader-Stickers is a term commonly misused when referring to a surfactant or spreader. A true spreader-sticker combines the characteristics of a surfactant with that of a sticker.

Caution: Do not use an adjuvant with any pesticide without first consulting the specific pesticide label. Improper selection or use can injure crops or reduce effectiveness, particularly when you mix adjuvants with emulsifiable concentrates.

Pesticide Compatibility

Because of the complex nature of pest management in fruit crops, multiple fungicides and insecticides may need to be tank-mixed together and applied at one time. Pesticide compatibility in the spray tank is usually not a problem with newer pesticides. The compatibility of some materials may depend on solvents and emulsifiers the manufacturer used. Emulsifiable concentrate formulations are more likely to cause compatibility problems than wettable powders. If you mix wettable powders with emulsifiable concentrates, there may be incompatibility issues. Compatibility problems are often noted when applicators use lime, copper (Bordeaux), or oil products in a mix. Be aware of spray tank pH as noted above.

Read the comments section in this spray guide for notes about compatibility problems and read pesticide labels before tank-mixing products. Most pesticide labels give instructions for loading, tank mixes, etc., and we recommend that growers follow the label directions closely to avoid problems.

Summary

Pesticide recommendations may seem confusing to the novice because there are so many options for materials to use for certain diseases or insect pests. For this reason, we strongly recommend that growers refer to the *Midwest Small Fruit Pest Management Handbook* or *Midwest Tree Fruit Pest Management Handbook* (see front inside cover/page 2) to develop a thorough understanding of pest management.

With fungicides in particular, a single material may control one or more diseases, but not all. So, when several diseases threaten, you may need to combine materials to achieve control. Additionally, insect pests may be a problem at the same time, so you may also need to apply insecticides. In most cases, you can tank-mix multiple fungicides and insecticides together and apply at one time. However, not all pesticides are compatible, so you should test for compatibility before tank-mixing any products.

Certain fungicides and insecticides may be phytotoxic (cause foliar damage) to certain crops and/or

varieties. For example, many grape varieties are sensitive to sulfur or copper. The Relative Disease Susceptibility and Chemical Sensitivity among Grape Cultivars table on page 99 lists variety sensitivity to these materials. Additionally, some grape varieties are sensitive to certain strobilurin fungicides, and some strawberry varieties are sensitive to Sinbar herbicide. Several apple varieties are sensitive to azoxystrobin, the active ingredient in Abound, Quilt, and Quadris Top fungicides. Always read the comments associated with the materials in this guide.

Pesticide choices can be limited by variety, disease or insect pressure, and other factors. Your preference, experience with materials, and price often influence decisions as well. Pest management in fruit crops is relatively easy as long as you understand the pests, critical periods for control, proper selection of control materials, and proper application procedures.

Always read the entire pesticide label. If you have any questions about the proper use of a pesticide, refer to other sources, such as the *Midwest Small Fruit Pest Management Handbook* or *Midwest Tree Fruit Pest Management Handbook*. If you still have questions, contact the manufacturer or your state Extension specialist for clarification.

Apple Spray Schedule

The fungi that cause apple scab, powdery mildew, and cedar apple rust attack newly emerged leaves to a greater degree than older leaves. The fungi that cause summer rots attack newly developed fruit, even though symptoms may not appear until harvest.

To protect leaves and fruit, it is essential to begin fungicide applications early to protect new growth. That said, successful growers understand the limits of what fungicides can do, and they will consider pesticide cost and the risk of disease when deciding which fungicide to use and when to use them.

With proper timing and application, captan, mancozeb, Syllit plus mancozeb or captan, or captan plus mancozeb (what we call “captozeb”) can provide very good to excellent scab control from green tip until pink, at a lower cost, and little risk of fungicide resistance. As always, the goal is to keep the number of primary scab lesions low to improve fruit protection later in the season. This is more difficult in cooler, wet years, which may require more frequent spraying.

At tight cluster through first cover (when the risk of powdery mildew, scab, and rust are highest), incorporate the broad-acting, systemic fungicides like Aprovia, Flint, Fontelis, Indar, Inspire, Luna Sensation, Pristine, Procure, Rally, or Sovran, which can improve management and best utilize the systemic nature of these fungicides.

■ Apple Dormant to Silver Tip

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

Pest/Problem	Material	Rate/Acre	Comments
fire blight	Fixed copper "fungicides/bactericides": copper hydroxide, copper oxychloride, basic copper sulfate, Bordeaux mixture, cuprous oxide	See label	If fire blight was severe last year, make fixed copper applications at silver tip. Do not apply copper after ¼-inch green leaf stage or when drying conditions are cool and slow, because that may cause severe injury. Many fixed copper fungicides/bactericides are registered for use on apple. Fixed coppers can be mixed with oil. However, never combine copper sulfate alone with dormant oil. Using copper at this stage does not eliminate the need of streptomycin at bloom.
crown rot (collar rot)	Ridomil Gold SL	2 qts. or 1.5 oz. per 1,000 sq. ft.	Apply to soil in early spring before growth starts. See Crown Rot (Collar Rot) of Apple, page 27.
primary scab	urea	5%	The suggested application rate is 40 lbs. of agricultural grade urea (46-0-0-) per 100 gals. of water. See Sanitation Methods to Aid in Apple Scab Control, page 31.

■ Apple Green Tip

Begin sprays at green tip and repeat every 5-7 days through second cover.

Pest/Problem	Material	Rate/Acre	Comments
primary scab Protectant program	Fungicide Resistance Alert: The strobilurin fungicides (Sovran, Flint), the SI fungicides (Rally, Indar, Topguard, and Procure) and the SDHI fungicide (Aprovia, Fontelis), along with premix fungicides (Pristine, Merivon, Luna Sensation, and Inspire Super MP) contain active ingredients that are all at high risk for developing resistance in fungi that cause many of the major fruit diseases such as apple scab, powdery mildew, and brown rot. Each of these fungicide groups has a different chemical mode of action for controlling fungi. To help limit the potential for fungicide resistance development, do not make more than four applications of any fungicide within each group per season, and delay using them until pink (at the earliest). In addition, do not make more than two sequential applications of any fungicide within each group without alternating to a fungicide from a different chemistry group. Many Midwest plant pathologists recommend alternating to a group of different chemistry after one application of a fungicide within each group of chemistry. For example: one application of Sovran (a strobilurin), alternated with one application of Inspire Super MP (a sterol inhibitor), alternated with one application of Fontelis (a succinase dehydrogenase inhibitor). See Fungicide Resistance Management, page 31.		

(continued)

Apple Green Tip (continued)

Pest/Problem	Material	Rate/Acre	Comments
primary scab protectant program (continued)	Captan 80WG	5 lbs.	Other formulations are available, such as 4L and 50WP. Growers may wish to avoid captan from petal fall to first cover to minimize the risk of phytotoxicity. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Captan 80WG PLUS Mancozeb 75DF	2-2.5 lbs.	This highly recommended tank-mix (often called "captozeb") can be used up to 8 times, limited by the 77-day PHI for mancozeb. Captan has a 0-day PHI, and use can be continued through summer covers.
		3 lbs.	
	Mancozeb 75DF	6 lbs.	See Note About Mancozeb and Polyram (EBDC Products), page 24.
	Omega 500F	10-13.8 fl. oz.	Omega is labeled for the control of scab, bitter rot, black rot, brooks spot, and some juniper rusts. It is not labeled for powdery mildew control.
	Polyram 80DF	6 lbs.	See Note About Mancozeb and Polyram (EBDC Products), page 24.
	Scala 55C	7-10 fl. oz.	Most effective at temperatures below 70°F.
	wetttable sulfur	See label	Sulfur is formulated as dusts, liquids, and wetttable powders (e.g., wetttable sulfur, Microthiol Disperss, Cosavet, Microfine Kumulus, Liquid Sulfur Six, and Dusting Sulfur). Formulations can vary from 80-95% elemental sulfur. Formulations with finer particles are more effective. Sulfur also is effective against plant-feeding mites but can damage predatory mite populations. Do not use within 10 days of applying oil or captan or when temperatures exceed 85°F. Certain apple varieties are sensitive to sulfur sprays under certain conditions. Do not apply unless the varieties are known to be sulfur tolerant.
	Syllit FL PLUS ONE OF THE FOLLOWING:	1.5-3 pts.	If your orchard has a long history of Syllit (Cyprex) use, fungicide resistance may be a problem.
	Captan 80WDG	2.0 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
Mancozeb 75D	2.25 lbs.		
Vanguard 75WG	5 oz.	Most effective at temperatures below 70°F.	
Ziram 76DF	6 lbs.		

(continued)

Apple Green Tip (continued)

Pest/Problem	Material	Rate/Acre	Comments
San Jose scale, European red mite eggs, aphid eggs	superior oil PLUS ONE OF THE FOLLOWING:	2%	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. Where San Jose scale is a main target of oil sprays, the best application timing is at green tip. Wait until half-inch green or pink if your primary target is European red mite or rosy apple aphid. 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. Put pheromone traps in place now to monitor adult leafminer activity.
	Lorsban Advanced 4E	1.5-4 pts	
	Lorsban 75WG	2-2.67 lbs.	
	Supracide 25WP Diazinon AG 600WBC	4-12 lbs. Must be applied as a dilute spray. See label.	

■ **Apple Half-inch Green**

Pest/Problem	Material	Rate/Acre	Comments
primary scab	Same as for Apple Green Tip, page 13.		
San Jose scale, rosy apple aphid	Same as for Apple Green Tip, page 15. OR		
	Esteem 35WP	3-5 oz.	Esteem controls scale anytime between half-inch green and second cover. 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 necessary if application is delayed until the crawler stage in early summer.
	Centaur 70WDG	34.5 oz.	
European red mite eggs	superior oil	2%	Delaying oil application until half-inch green will control mites better than earlier applications.
spotted tentiform leafminer (adults)	You can improve spotted tentiform leafminer adult control at half-inch green by spraying in the evening when moths are most active. Killing spotted tentiform leafminer adults at half-inch green is not as effective as killing hatching eggs at petal fall. The pyrethroids Ambush, Asana, Baythroid, Danitol, Mustang Maxx, Pounce, Proaxis, Voliam Xpress, and Warrior also are labeled for adult spotted tentiform leafminer control, but they are not recommended because they also kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pests.		
	Vydate L	2-4 pts.	
	Esteem 35WP	3-5 oz.	

■ Apple Tight Cluster

7 days after half-inch green.

Pest/Problem	Material	Rate/Acre	Comments
scab only Protectant program 5-7-day interval	See Fungicide Resistance Alert, page 13.		
	Captan 80WDG	5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Captan 80WG PLUS Mancozeb 75DF	2-2.5 lbs.	This tank-mix is often called "captozeb." See notes for Apple Green Tip, page 15.
		3 lbs.	
	Mancozeb 75DF	6 lbs.	See Note on About Mancozeb and Polyram (EBDC Products), page 24.
	Polyram 80DF	6 lbs.	See Note on About Mancozeb and Polyram (EBDC Products), page 24.
	Scala 5SC	7-10 fl. oz.	PHI=77-days.
	wettable sulfur	See label	See comments for Apple Green Tip, page 14.
	Syllit FL PLUS ONE OF THE FOLLOWING: Captan 80WDG	1.5-3 pts.	
		2 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
		2.25 lbs.	
	Vangard 75WG	5 oz.	
Ziram 76DF	6 lbs.		
scab, rust, powdery mildew 7-10-day interval	Aprovia	5.5-7 fl. oz.	
	Captan 80WG	5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Captan 80WG PLUS Mancozeb 75DF	2-2.5 lbs.	This tank-mix is often called "captozeb." See notes for Apple Green Tip, page 15.
		3 lbs.	
	Flint 50WG	2-2.5 oz.	Do not apply where spray drift may reach Concord grapes or crop injury may occur.
	Flint Extra	2.5-2.9 fl. oz.	This is a new, higher rate of trifloxystrobin. Do not apply where spray drift may reach Concord grapes or crop injury may occur.
	Fontelis 1.67 SC	16-20 oz.	Tank mix with another fungicide with a different FRAC code. Do not exceed 2 sequential applications.
	Indar 2F	6-8 oz.	
	Inspire Super	12 oz.	
	Luna Sensation	4-5.8 fl. oz.	A combination of two fungicides: fluopyram and trifloxystrobin (Flint). For powdery mildew control, use at 5-5.8 fl. oz. per acre.
Luna Tranquility	11.2-16 fl. oz.	A combination of two fungicides: fluopyram and pyrimethanil (Scala). Not labeled for rust control. As with Scala, protection is best when temperatures are below 70°F.	

Apple Tight Cluster (continued)

Pest/Problem	Material	Rate/Acre	Comments
scab, rust, powdery mildew 7-10-day interval (continued)	Mancozeb 75DF	6 lbs.	See Note About Mancozeb and Polyram (EBDC Products), page 24
	Polyram 80DF	6 lbs.	Does not control powdery mildew. See Note About Mancozeb and Polyram (EBDC Products), page 24.
	Merivon	4-5.5 fl. oz.	Do not use with captan or EC-formulated products.
	Omega 500F	10-13.8 oz.	Labeled for control of scab, bitter rot, and black rot. Suppresses powdery mildew.
	Pristine	14.5-18.5 oz.	Do not exceed 2 sequential applications.
	Procure 480SC	8-16 oz.	
	Rally 40WSP	5-10 oz.	Use the lower rate (5-8 oz.) for scab or rust; use the higher rate (10 oz.) for powdery mildew.
	Scala 5SC	7-10 fl. oz.	Most effective at temperatures below 70°F.
	Sercadis	3.5-4.5 oz.	Use lower rates for scab and powdery mildew; use higher rates for black rot and flyspeck. Only suppressive against rust.
	Sovran	4-6.4 oz.	
	Syllit FL PLUS ONE OF THE FOLLOWING:	1.5-3 pts.	Fungicide resistance may be a problem if your orchard has a long history of Syllit (Cyprex) use. Do not use after pink.
	Captan 80WDG	2 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Mancozeb 75DF	2.25 lbs.	
	Topguard	8-12 oz.	Do not confuse with Topguard EQ, which contains azoxystrobin, which is phytotoxic on many apple varieties.
Topsin M	1-1.5 lb	Not recommended for scab control because of fungicide resistance issues.	
Vanguard 75WG	5 oz.		
Ziram 76DF	6 lbs.		

■ Apple Pink

7-10 days after tight cluster.

Pest/Problem	Material	Rate/Acre	Comments
scab, rust, powdery mildew	Same as for Apple Tight Cluster, page 16. A critical time for controlling scab, rust, and powdery mildew. Rust diseases must be controlled with sprays at regular intervals from pink through second cover. Rally, Bayleton, Rubigan, Indar, Inspire Super, Procure, Mancozeb, Polyram, Ziram, Flint, Sovran, Topguard, and Pristine will control rust; Topsin-M and Captan will not.		
rosy apple aphid	Scout for curled leaves at early pink. Apply aphicide at pink if you find any curled leaves with rosy apple aphid inside.		
	Lorsban Advanced 4E	1.5-4 pts.	
	Lorsban 75WG	2-2.67 lbs.	
	Assail 30SG	2.5-4 oz.	
	Vydate 2L	4-8 pts.	
	Beleaf 50SG	2-2.8 oz.	
Exirel 0.83SE	13.5-20.5 fl. oz.		

(continued)

Apple Pink (continued)

Pest/Problem	Material	Rate/Acre	Comments
spotted tentiform leafminer	Vydate L	2-4 pts.	
	Assail 30SG	2.5 oz.	
	Intrepid 2F	8-12 fl. oz.	
	Altacor 35WDG	2.5-4.0 oz.	
	Esteem 35WP	3-5 oz.	
tarnished plant bug, stink bugs	Avaunt 30 WDG	5-6 oz.	
	Lannate SP	0.5-1 lb.	
	Lannate LV	1.5-3 pts.	
	Beleaf 50SG	2-2.8 oz.	
	Ambush 25W	6.4-25.6 oz.	Pyrethroids (Ambush, Asana, Baythroid, Danitol, Mustang Maxx, Pounce, Proaxis, and Warrior) will kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pests.
	Asana XL 0.66EC	4.8-14.5 fl. oz.	
	Baythroid XL 1EC	2-2.4 fl. oz.	
	Danitol 2.4 EC	10.7-21.3 fl. oz.	Use pyrethroids only if the potential for plant bug and stink bug damage is high.
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
	Pounce 25WP	6.4-16 oz.	
	Proaxis 0.5EC	2.6- 5.1 fl. oz.	
Warrior II 2.08CS	1.28-2.56 fl. oz.		
San Jose scale			Put pheromone traps in place now to monitor adult scale activity; expect crawlers 4-6 weeks after adults emerge.
nutrient level	Solubor (boron)	2 lbs.	May add Solubor to pesticide solutions, but check for compatibility, order of mixing, etc. Solubor helps prevent cork spot; see page 32 for more information. Can add urea to pesticide sprays when needed.
	AND/OR feed-grade urea (nitrogen)	3 lbs.	

■ Apple Bloom

7-10 days after pink. Bloom begins when the first blossom opens (King Bloom). Remember to protect pollinators!

Pest/Problem	Material	Rate/Acre	Comments
scab, rust, powdery mildew, summer rots	Same as for Apple Tight Cluster, page 16. Do not use Syllit after pink. Fungicide applications for effective bitter rot control begins now.		
fire blight (blossom blight)	Streptomycin 17WP	1.5 lbs.	Start fire blight sprays at 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 are necessary to provide control. If warm, wet weather occurs, it is critical to apply sprays on a tight schedule using a maximum strength of 100 ppm (8 oz. per 100 gals.) of streptomycin. You can improve timing and confidence with streptomycin by using a disease warning system such as MARYBLYT. Streptomycin is not recommended for use after petal fall.
	OR		

(continued)

Apple Bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
fire blight (blossom blight) (continued)	Streptomycin 17 WP PLUS Regulaid	1 lb. 1 pt.	Do not concentrate Regulaid. Unless streptomycin resistance has been confirmed in your orchard, streptomycin is preferable for fire blight control.
	<i>Labeled but not recommended</i> These products are registered for fire blight control, but are only needed in orchards with a history of streptomycin resistance.		
	FireLine 17WP	200 ppm (equivalent to 1 lb. per 100 gals.)	
	Kasumin 2L	64 fl. oz./100 g	Do not exceed 2 sequential treatments per year. Do not use after petal fall.
	Mycoshield	200 ppm (equivalent to 1 lb. per 100 gals.)	
fire blight (shoot blight)	Growth regulator Apogee 27.5W PLUS Regulaid	1 pt.	Apply Apogee 27.5W at petal fall on king blooms for maximum effectiveness. It will take 10 days to 2 weeks after application for plants to be less susceptible to disease. See comments on pages 28-29. Apply labeled rate only. Excessive nitrogen fertilization will make trees more susceptible to fire blight.
insects, mites	SAVE THE BEES! Do not use insecticides or miticides at bloom. Monitor for insects and use pheromone dispensers instead.		
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 29 for information about how to use traps to determine optimal insecticide timing.
codling moth (control)	See Mating Disruption for Codling Moth Control, page 30. Additional products and formulations also are available — may not be available in all states.		
	Isomate-C Plus	400 dispensers/acre	
	Isomate-CM Flex	200-400 dispensers/acre	
	Isomate-CM/OFM TT	200-400 dispensers/acre	Isomate CM/OFM TT also controls oriental fruit moth.
dogwood borer	Isomate DWB	100-200 dispensers	
Red Delicious shape	Promalin		Apply in early bloom when most of the king flowers are open and before petals fall from the king flowers. Promalin can cause fruit thinning if you do not follow guidelines for application timing.

■ **Apple Petal Fall**

7-10 days after bloom.

Pest/Problem	Material	Rate/Acre	Comments
scab, rust, powdery mildew, bitter rot	Same as for Apple Pink, page 17. Applying mancozeb at this time is recommended for orchards with a history of bitter rot (particularly on susceptible cultivars like HoneyCrisp). Growers may wish to avoid captan from petal fall to first cover to minimize the risk of phytotoxicity due to tank mixes.		
fire blight	Same as for Apple Bloom, page 18-19. Continue sprays on susceptible varieties until all petals have fallen.		

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Apple Petal Fall (continued)

Pest/Problem	Material	Rate/Acre	Comments
leafrollers	Imidan 70W	2.1-5.75 lbs.	Peak hatch of redbanded leafroller usually coincides with petal fall. Control at this time helps prevent late-season problems. If plum curculio pressure has been severe and you apply Imidan to control plum curculio, use 5.3 lbs. per acre. The pyrethroids Ambush, Asana, Baythroid, Danitol, Mustang Maxx, Pounce, Proaxis, and Warrior also are labeled for control of leafrollers, plum curculio, and oriental fruit moth. However, pyrethroids are not recommended at this stage, because they kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pest mites.
	Avaunt 30WDG	5-6 oz.	
	Intrepid 2F	8-16 fl. oz.	
	Confirm 2F	20 fl. oz.	
	Entrust 80WP	2-3 oz.	
	Entrust 2SC	6-10 fl. oz.	
	Proclaim 5SG	3.2-4.8 oz	
	Rimon 0.83EC	20-50 fl oz	
	Altacor 35WDG	2.5-4.5 oz	
	Delegate 25WG	4.5-7 oz.	
Exirel 0.83SE	8.5 - 17 fl .oz.		
plum curculio	Imidan 70W	2.1-5.75 lbs.	
	Avaunt 30WDG	5-6 oz.	
	Assail 30SG	8 oz.	
	Actara 25WDG	4.5-5.5 oz.	Use only after petal fall is complete.
	Surround	25-50 lbs.	
	Belay 2.13SC	6 fl. oz.	
	Exirel 0.83SE	13.5-20.5 fl .oz.	
oriental fruit moth	Imidan 70W	2.1-5.75 lbs.	
	Avaunt 30WDG	5-6 oz.	
	Assail 30SG	5-8 oz.	
	Intrepid 2F	12-16 fl. oz.	
	Entrust 80WP	2-3 oz.	
	Entrust 2SC	6-10 fl. oz.	
	Madex HP	0.5-3.0 fl. oz.	
	Rimon 0.83EC	20-40 fl. oz.	
	Altacor 35WDG	2.5-4.5 oz.	
	Delegate 25WG	4.5-7 oz.	
	Belay 2.13SC	6 fl. oz.	
Exirel 0.83SE	10-17 fl. oz.		
spotted tentiform leafminer (larvae), white apple leafhopper, aphids	Admire Pro 4.6EC	1.4-2.8 fl. oz.	Use Actara or Admire Pro as soon as pollination is complete but after bees are no longer foraging. The pyrethroids Ambush, Asana, Baythroid, Danitol, Mustang Maxx, Pounce, Proaxis, and Warrior also are labeled for control of these insects at petal fall. However, they are not recommended at this stage, because they kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pest mites.
	Assail 30SG	2.5-4 oz.	
	Actara 25WDG	4.5-5.5 oz.	
	Lannate LV	3 pts.	Lannate also kills predaceous mites and can trigger pest mite outbreaks.
	Lannate 90SP	1 lb.	
Belay 2.13SC	4-6 fl. oz.		
spotted tentiform leafminer (larvae)	The products listed above for all three pests OR		Treat if mines average two or more per leaf and larvae are still in the initial sap-feeding stage on the underside of the leaves.
	Agri-Mek 0.15EC	10-20 fl. oz.	Apply with horticultural oil or a penetrating surfactant.

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Apple Petal Fall (continued)

Pest/Problem	Material	Rate/Acre	Comments
spotted tentiform leafminer (larvae) (continued)	Entrust 80WP	1.5-3 oz.	
	Entrust 2SC	4-10 fl. oz.	
	Esteem 35WP	3-5 oz.	
	Rimon 0.83EC	15-40 fl. oz.	
	Altacor 35WDG	2.5-4.5 oz.	
	Delegate 25WG	4.5-7 oz.	
	Exirel 0.83SE	8.5-17 fl. oz.	
white apple leafhopper	The products listed above for all three pests OR		White apple leafhopper nymphs begin hatching at tight cluster and feed on undersides 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 per leaf is one or more.
	Portal 0.4EC	2 pts.	
	Agri-Mek 0.15EC	10-20 fl. oz.	
	Closer 2SC	1.5-2.75 fl. oz.	
	Centaur 70WDG	9-12 oz.	
	Exirel 0.83SE	8.5-17 fl. oz.	
	Sivanto Prime	7-10.5 fl. oz.	
aphids	The products listed above for all three pests OR		Rosy apple aphid is best treated at pink, but there is some chance to control it at petal fall if infestations develop.
	Azera 0.21EC	2-3.5 pts.	Not for woolly apple aphid control.
	Esteem 35WP	3-5 oz.	
	Beleaf 50SG	2-2.8 oz.	
	Closer 2SC	1.5-2.75 fl. oz.	
	Movento 2SC	6-9 fl. oz.	Toxic to honey bees and can be used only after petal fall.
	Sivanto Prime	7 – 10.5 fl. oz.	Not labeled for woolly apple aphid control.
mites	Apollo 4SC	4-8 fl. oz.	
	Savey 50DF	3-6 oz.	
	Agri-Mek 0.15EC	10-20 fl. oz.	Most effective if applied before leaves harden off.
	Nexter 75WP	6.6-10.67 oz.	Use low rate for European red mite; high rate for twospotted mite.
	Portal 0.4EC	2 pts.	
	Acramite 50WS	0.75-1 lb.	Use low rate for twospotted mite; high rate for European red mite.
	Zeal 72WP	2-3 oz.	
	Envidor 2SC	16-18 fl. oz.	
	Kanemite 15SC	21-31 fl. oz.	
	Onager 1EC	12-24 fl. oz.	
	oil	0.5-1%	Do not use oil if you apply captan, or if temperature exceeds 90°F. See Notes on Soaps and Horticultural Oils, page 31.
	Nealta 1.67L	13.7 fl. oz.	
For thinning summer varieties	See Chemical Thinning of Apples, page 76.		
nutrient level	Solubor (boron)	2 lbs.	May add to pesticide spray solutions, but check for compatibility, order of mixing, etc. Solubor helps prevent cork spot; see page 32 for more information.
	AND/OR feed-grade urea	8 lbs.	

■ Apple First and Second Cover

7-10 days after petal fall and 7-10 days later.

Pest/Problem	Material	Rate/Acre	Comments	
scab, fruit rots (for orchards with a history of fungicide resistance)	Captan 80WDG	5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.	
	Captan 80WG PLUS Mancozeb 75DF	2-2.5 lbs.	This tank-mix is often called "captozeb." See notes for Apple Green Tip, page 15.	
		3 lbs.		
	Mancozeb 75DF	3 lbs.	Do not apply within 77 days of harvest. See Note About Mancozeb and Polyram (EBDC Products), page 24.	
	Polyram 80DF	3 lbs.		
	Ziram 76DF	6 lbs.		
	OR			
	Topsin-M 70WSB PLUS ONE OF THE FOLLOWING:	1-1.5 lbs.	May cause scarf skin on Rome apples if applied within a 4-week period following petal fall. Do not use for scab control. Excellent for control of some fruit rots but is no longer effective against scab in commercial orchards.	
	Captan 80WDG	3 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.	
	Mancozeb 75DF	3 lbs.	PHI=77 days. Use may be restricted on early-harvest apples.	
	Polyram 80DF	3 lbs.		
Ziram 76 DF	6 lbs.			
scab, rust, powdery mildew, fruit rots, sooty blotch, flyspeck	For powdery mildew control after second cover, make applications based on field history and orchard scouting. Fungicide Resistance Management: See comments on page 13.			
	Bayleton 50WP	2-8 oz.	Not effective for scab control.	
	Flint 50WG	2-2.5 oz.	This is a new SDHI fungicide. Tank-mix with a fungicide with a different FRAC code.	
	Flint Extra	2.5-2.9 fl. oz.		
	Fontelis 1.67SC	16-20 fl. oz.	Tank-mix with a fungicide with a different FRAC code.	
	Indar 2F	6-8 oz.	Do not exceed 2 sequential applications.	
	Inspire Super	12 fl. oz.	See note about Inspire Super MP on page 24.	
	Luna Sensation	4-5.8 fl. oz.	A combination of two fungicides: fluopyram and trifloxystrobin (Flint). Use at 5-5.8 fl. oz. per acre for powdery mildew control.	
	Luna Tranquility	11.2-16 fl. oz.	A combination of two fungicides: fluopyram and pyrimethanil (Scala). Not labeled for rust control. As with Scala, protection is best when temperatures are below 70°F.	
	Merivon	4-5.5 fl. oz.	Only suppressive against rust. Do not apply with EC or oil-based products. Do not apply with captan.	
	Omega 500F	10-13.8 fl. oz.	Does not control powdery mildew.	
	Pristine 38WG	14.5-18.5 oz.	Do not exceed 2 sequential applications.	

(continued)

Apple First and Second Cover (continued)

Pest/Problem	Material	Rate/Acre	Comments	
scab, rust, powdery mildew, fruit rots, sooty blotch, flyspeck (continued)	Procure 480SC	12-16 oz.	The older sterol inhibiting fungicides do not provide adequate control of fruit scab when applied alone. Combine them with a protectant fungicide. A higher rate (10 oz.) is labeled for powdery mildew control.	
	Rally 40WSP	2.5-6 oz.		
	Sercadis	3.5-4.5 oz.	Use lower rates for scab and powdery mildew control; use higher rates for black rot and flyspeck. Only suppressive against rust.	
	Sovran 50WG	4-6.4 oz.	PHI=30 days.	
	wettable sulfur	See label	Do not apply in hot weather (above 80°F). Do not apply within 2 weeks of an oil spray or spreader-sticker. Can affect fruit finish of Golden Delicious.	
	Topguard	Rusts and powdery mildew: 8-12 fl. oz. Scab: 13 fl. oz.	Not labeled for sooty blotch or flyspeck.	
	Topsin M	1-1.5 lbs.	Not recommended for scab control because of fungicide resistance issues.	
	ANY OF THE ABOVE PLUS ONE OF THE FOLLOWING:			
	Captan 80WDG	2.5-5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.	
	Mancozeb 75DF	3 lbs.	PHI=77 days. Use may be restricted on early-season apples.	
Polyram	3 lbs.			
Ziram 76DF	3 lbs.			
codling moth, oriental fruit moth	Initiate codling moth control 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 Mating Disruption for Codling Moth Control, page 30. Virus products (Cyd-X, Virosoft, Carpovirusine) are for codling moth only. Apply virus products at weekly intervals.			
	Imidan 70W	2.1-5.75 lbs.		
	Assail 30SG	4-8 oz.		
	Rimon 0.83EC	20-40 fl. oz.		
	Confirm 2F	20 fl. oz.	Not labeled for oriental fruit moth.	
	Intrepid 2F	12-16 fl. oz.		
	Altacor 35WDG	2.5-4.5 oz.		
	Delegate 25WG	4.5-7 oz.		
	Exirel 0.83SE	8.5-17 fl. oz.	Also controls leafrollers, leafminers, and leafhoppers.	
	Cyd-X	1-6 fl. oz.		
	Cyd-X HP	0.5-3 fl. oz.		
	Madex HP	0.5-3 fl. oz.	Also controls oriental fruit moth.	
Virosoft CP4	1.6-3.2 fl. oz.			
plum curculio	Imidan, Avaunt, Actara, Exirel, or Surround as listed at Apple Petal Fall, page 20. Timing for plum curculio usually extends through first cover.			
leafrollers	Imidan, Altacor, Delegate, Exirel, Entrust, Confirm, Intrepid, or Rimon as listed at Apple Petal Fall, page 19.			
mites	Same as for mites at Apple Petal Fall, page 21. See Insecticide and Miticide PHIs and REIs, pages 135-137.			

(continued)

Apple First and Second Cover *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
San Jose scale (crawlers)	San Jose scale "crawlers" may be present by second or third cover.		
	Diazinon AG 600WBC	12.75 fl. oz./100 gals.	
	Esteem 35W	4-5 oz.	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 use the maximum rate if application is delayed until the crawler stage in early summer.
	Admire Pro 4.6F	2.8 fl. oz.	
	Assail 30SG	8 oz.	
	Centaur 70WDG	34.5 oz.	
	Movento 2SC	6-9 fl. oz.	
	Sivanto 200SL	10.5-14 fl. oz.	
green apple aphid	Same as for aphids at Apple Petal Fall, page 21. Do not use the AG600 formulation of Diazinon after petal fall. Treat green apple aphid when they are numerous, but before you observe excessive terminal leaf curling and honeydew deposits.		
excess crop	See Chemical Thinning of Apples, page 76.		
cork spot, bitter pit, Jonathan spot	calcium chloride	8 lbs.	Start calcium chloride sprays in the first or second cover. Do not reapply anytime during the growing season if rain has not washed off residue from previous spray. Do not exceed 4 pounds per acre for low volume spray. See Cork Spot and Bitter Pit Management in Apples, page 32. Calcium chloride is best applied dilute at 1.5-2 lbs. dry formulation per 100 gals.

Note About Mancozeb and Polyram (EBDC Products)

Mancozeb and Polyram cannot be used past bloom at the 6 lbs. per acre rate, but they are permitted at the lower rate of no more than 3 lbs. per acre. However, this lower rate may be insufficient under heavy scab pressure. In such situations, consider using captan, which you can apply at higher rates in the "transition spray."

Do not apply Mancozeb or Polyram within 77 days of harvest. Do not apply more than 24 lbs. of Mancozeb or Polyram or more than 25.6 lbs. of Penncozeb per acre per year if using for prebloom applications. Do not apply more than 21 lbs. of mancozeb or Polyram per year or more than 22.4 lbs. of Penncozeb per year.

If you use sterol inhibiting (SI) fungicides (Indar, Inspire Super, Procure, Rally, Rubigan, or Topguard) in an extended protectant program for primary scab control (tight cluster to second cover), the last spray that contains the SI fungicide is a "transition spray" — you move from using the SI fungicide to using protectant fungicides to control summer diseases and secondary scab. This "transition spray" should contain the full label rate of a protectant fungicide combined with the SI fungicide.

■ Apple Third Cover

10 days after second cover.

Pest/Problem	Material	Rate/Acre	Comments
scab, fruit rots, sooty blotch, flyspeck	Captan 80WDG	2.5-5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Ziram 76 DF	6 lbs.	Do not exceed 42.4 lbs. (32.2 lbs. a.i./A) or 7 applications per crop cycle.
	ANY OF THE ABOVE PLUS ONE OF THE FOLLOWING:		
	Flint 50WG	2-2.5 oz.	The strobilurin fungicides (Flint, Pristine, Sovran) are very effective for control of most summer fruit rots as well as sooty blotch and flyspeck.
	Flint Extra	2.5-2.9 fl. oz.	PHI=28 days.
	Fontelis	16-20 fl. oz.	PHI=28 days.
	Luna Sensation	4-5.8 fl. oz.	
	Luna Tranquility	11.2-16 fl. oz.	Protection is best when temperatures are below 70°F.
	Merivon	4-5.5 fl. oz.	Do not apply with EC or oil-based products. Do not apply with captan.
	Omega 500F	10-13.8 fl. oz.	
	Pristine 38WG	14.5-18.5 oz.	PHI=12 hours.
	Sercadis	3.5-4.5 oz.	Use lower rates for scab and powdery mildew control; use higher rates for black rot and flyspeck. Only suppressive against rust. PHI=0 days.
	Sovran 50WG	4-6.4 oz.	
	Topsin-M 70WSB	1-1.5 lbs.	Highly effective for preventing sooty blotch and flyspeck. However, excessive Topsin-M use may build up resistant strains of apple scab fungus and/or increase mite injury due to the adverse effect of this fungicide on predatory mites.
Ziram 76DF	6-8 lbs.	PHI=14 days.	
sooty blotch, flyspeck only	ProPhyt (phosphorous acid)	4-6 pts.	Recent research has shown ProPhyt plus captan has provided control of sooty blotch and flyspeck equal to captan plus Topsin-M. Captan 80WDG 5 lbs. plus the use of an acidifier may be equally effective. Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	PLUS Captan 80WDG	5 lbs.	
codling moth, leafrollers, oriental fruit moth	Same as for Apple First and Second Cover, page 23.		
white apple leafhopper	Same as for Apple Petal Fall, page 21.		
apple maggot	<p>Apple maggot flies generally begin emerging from the soil about mid-June. Monitor for the first appearance of flies each year by examining fruit and leaves in the center of trees in detail, using yellow sticky board traps baited with an attractant, hanging red or green spheres coated with a sticky substance in trees, or combining all three methods. Continue applications until late September or as long as flies are present.</p> <p>The pyrethroids Asana, Baythroid, Danitol, Mustang Maxx, Proaxis, and Warrior also are labeled for control of these insects at petal fall but are not recommended for apple maggot, because they kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pest mites.</p> <p>Sevin also kills predaceous mites and can trigger pest mite outbreaks.</p>		

(continued)

Apple Third Cover (continued)

Pest/Problem	Material	Rate/Acre	Comments
apple maggot (continued)	Imidan 70WP	2.1-5.75 lbs.	
	Sevin XLR Plus (4L)	1.5-3 qts.	
	Assail 30SG	8 oz.	
	Entrust 80WP	2-3 oz.	
	Entrust 2SC	6-10 fl. oz.	
	Admire Pro 4.6EC	2.8 fl. oz.	
	Altacor 35WDG	2.5-4.5 oz.	
	Belay 2.13SC	6 fl. oz.	
brown marmorated stink bug	The products here may be needed to control brown marmorated stink bug (BMSB) despite harm to beneficial arthropods that help control San Jose scase, wooly apple aphid, and mites. The pyrethroids Baythroid, Danitol, and Mustang Maxx are labeled for stink bugs, not specifically BMSB. However, they have shown good efficacy in trials.		
	Baythroid XL 1EC	2.0-2.4 fl. oz.	Only labeled for general stink bug control.
	Belay 2.13SC	6-12 fl. oz.	
	Danitol 2.4EC	16-21.3 fl. oz.	
	Mustang Maxx	1.28-4 fl. oz.	
	Lannate SP	0.5-1 lb.	
	Lannate LV	1.5-3 pts.	
aphids	Same as for Apple Petal Fall, page 21.		
mites	Same as for Apple Petal Fall, page 21. Agri-Mek is not as effective once leaves harden off. OR		
	Vydate L	2-4 pts.	May cause fruit thinning if used within 30 days of bloom.
San Jose scale crawlers (if present)	Same as for Apple First and Second Cover, page 24.		
cork spot, bitter pit, and Jonathan spot	Same as for Apple First and Second Cover, page 24.		

■ Apple Summer Cover Sprays

Depending on rainfall, apply at intervals of 10 to 14 days.

Pest/Problem	Material	Rate/Acre	Comments
scab, fruit rots, *sooty blotch, flyspeck	Same as for Apple Third Cover, page 25. See comments under Apple Third Cover about late-season use of Merivon, Pristine, and Topsin-M. Check preharvest interval and re-entry restrictions of various materials before making the final application. *Using a spreader-sticker adjuvant in the last one or two sprays for sooty blotch and flyspeck may improve control. Do not use Flint in combination with organosilicate surfactants.		
codling moth, oriental fruit moth	Same as for Apple First and Second Cover, page 23. Apply Intrepid or Confirm at initiation of egg hatch for the second generation codling moth, 1,200 degree days after biofix.		
apple maggot	Same as for Apple Third Cover, pages 25-26.		
mites	Same as for Apple Petal Fall, page 21.		
leafhoppers	Same as for Apple Petal Fall, pages 20, 21.		
spotted tentiform leafminer	Same as for Apple Petal Fall except do not use Ambush or Pounce, pages 20-21. Treatment is recommended if there is an average of more than 2 miners per leaf from petal fall to midsummer, and more than 3 miners per leaf for the late-summer third generation. OR		
	Vydate 2L	2-4 pts.	May cause fruit thinning if used within 30 days of bloom.

Apple Summer Cover Sprays (continued)

Pest/Problem	Material	Rate/Acre	Comments
leafrollers	Same as for Apple First and Second Cover, page 23.		
	OR		
	Azera 0.21EC	2-3.5 pts.	
	<i>Bacillus thuringiensis</i> (Agree, Dipel, Deliver, others)		<i>Bacillus thuringiensis</i> will kill only caterpillar larvae that ingest residues. Reapply at 4- to 5-day intervals. Thorough coverage is essential.
brown marmorated stink bug	Same as for Apple Third Cover, page 26.		
Japanese beetle	Imidan 70WP	2.1-5.75 lbs.	
	Surround WP	25-50 lbs.	
	Azera 0.21EC	2-3.5 pts.	Apply Neemix and Azera when Japanese beetles are first observed. Multiple applications may be necessary.
	Sevin XLR Plus (4L)	1.5-3 qts.	Sevin and the pyrethroids Asana, Baythroid, Danitol, Warrior, Proaxis, and Mustang Maxx kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pest mites.
	Neemix 4.5	7-16 fl. oz.	
	Assail 30SG	5-8 oz.	
	Danitol 2.4EC	16-21.3 fl. oz.	
	Warrior II 2.08CS	1.28-2.56 fl. oz.	
	Proaxis 0.5EC	2.5-5.1 fl. oz.	
Mustang Maxx 0.8EC	1.28-4 fl. oz.		
woolly apple aphid	Diazinon AG 600WBC	See label	
	Admire Pro 4.6F	7-10.5 fl. oz.	Apply Admire Pro through drip, trickle, or similar irrigation method into the root zone.
	Closer 2SC	2.75-5.75 fl. oz.	
	Movento 2SC	6-9 fl. oz.	
	Beleaf 50SG	2-2.8 fl. oz.	
aphids	Same as for Apple Petal Fall, page 21.		
cork spot, bitter pit, Jonathan spot	Same as for Apple First and Second Cover, page 24. During August and September, you may increase the calcium chloride rate to 3 lbs./100 gals. or 12 lbs./A.		

Special Problems and Pests of Apple

For more detailed information about disease and insect control and integrated pest management (IPM), consult the *Midwest Tree Fruit Pest Management Handbook* and use it in conjunction with this guide. Contact your state's cooperative extension service to get a copy.

Crown Rot (Collar Rot) of Apple

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

Amount of Ridomil Gold SL (diluted) to Apply for Crown Rot Control

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

Do not dip tree roots or spray bare roots with solutions containing Ridomil Gold SL.

Do not graze in or feed cover crops from treated orchards. Illegal residues may occur.

For spring and summer collar and root rot control on apples and pears: Under moderate disease pressure, apply Aliette three or four times at 2.5-5 lbs. per 100 gals. on a 30-60-day spray interval; or apply six to eight times at 2.5 lbs. per 100 gals. 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 lbs. of Aliette per acre per application. Do not exceed 20 lbs. of Aliette per acre per season.

Do not apply within 2-3 weeks of leaf color change in the fall. Foliage must be green and living for the roots

to take up and transport Aliette. Do not apply Aliette if you have applied copper based fungicides within two weeks to avoid possible phytotoxic reactions. Read the label.

Phosphorous Acid (Phosphonates and Phosphites)

Several products that contain phosphorous acid are registered for use as nutritional supplements and “plant conditioners.” Several of these products also are registered as fungicides to control root and collar rot (caused by *Phytophthora* spp.) on apple, pear, and stone fruit. Some of these products are currently labeled for control of apple scab and sooty blotch and flyspeck.

Brand names for these products include Agri-Fos, ProPhyt, Phostrol, and Topaz. Several other products also may be available or introduced in the near future. Phosphorous acid is the active ingredient in 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 foliar sprays. 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. These products are not recommended for managing apple scab or fire blight in the Midwest.

Restrictions on EBDC Products

Mancozeb and Polyram are EBDC fungicides used to manage apple scab and the summer rots. Mancozeb is marketed under many names, including Mancozeb, Penncozeb, Dithane, and Manzate. Carefully read, understand, and follow all label restrictions before using EBDC products.

EBDC products have two rate recommendations depending on how you use the fungicides. Label recommendations for Mancozeb are identical for apples and pears.

This information is 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 use this schedule if you suspect fungicide resistance may be a problem in your orchard. **DO NOT combine or integrate the two treatment schedules.**

Managing the Shoot Blight Phase of Fire Blight with Apogee

Apogee (prohexadione calcium) inhibits gibberellin biosynthesis, which stops terminal growth early. Apogee will not affect blossom blight occurrence, but when used effectively, it will reduce the occurrence of shoot blight. Shoots with inhibited growth are less susceptible to fire blight. Note that apple varieties differ in their susceptibility to damage from Apogee. Do not apply Apogee to Empire or Winesap varieties (see below).

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, you can combine Apogee with streptomycin in one of the bloom sprays.

You should apply Apogee (27.5% W) when shoot growth is 1 to 3 inches long (usually at king bloom petal fall on most varieties). Split applications have been shown to provide longer shoot suppression during the summer. When fire blight is a concern, increase the first Apogee application to help control vigor early and reduce the risk of fire blight.

Apogee is locally systemic, which means that if you spray the tops of trees, Apogee will have an effect only on the tops where it was applied. This allows growers to use Apogee in problematic areas of trees that need localized control. For example, if the bottoms of trees had frost damage that resulted in a low crop load, applying Apogee to the bottoms of trees will control the excessive growth. Tree vigor, variety (see table below), crop load, and application timing affect the efficacy of Apogee and the rate needed.

Timing. Apply Apogee 27.5W 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.

Additives. Use the nonionic surfactant Regulaid with Apogee. Follow the manufacturer’s rate recommendations. If you mix Apogee in hard water

Suggested Apogee Rates and Timing¹

Tree Size	First Application	Second Application	Third Application	Fourth Application (optional)	Season Total
Timing	king bloom petal fall	2 weeks after king bloom petal fall	2 weeks later	3 weeks later	
small <200 TRV	5	4	4	4	17
medium <200-300 TRV	6	5	5	5	21
large >300 TRV	7	6	6	6	25

¹ Rates are ounces per acre. TRV=tree row volume.

Selected Apple Variety Sensitivity to Apogee

Apogee Sensitivity	Varieties	Recommendation
very sensitive	Cortland, Gala, Ginger Gold, Northern Spy, Paula Red, Rome	Consider reducing spray rates
sensitive	Fuji, Golden Delicious, Jonamac, Spartan,	
less sensitive	Golden Supreme, Jonagold, Jonathan, IdaRed, McIntosh	Consider using an additional 1 oz. per acre
special	Red Delicious, Spur Mac	Use 4+3+2 for medium-size trees
phytotoxic	Empire, Winesap	Do not use

(water that contains high levels of calcium carbonate), add 1 lb. of spray-grade ammonium sulfate for each pound of Apogee.

Comments. Apogee's ability to control growth does not depend on concentration. There is no difference in shoot growth control between dilute and concentrate sprays, provided the total amount of chemical per acre is the same. Apogee's level of growth control is rate dependent. The recommended rate provides the greatest and quickest reduction, and the effect on growth declines as the rate is reduced. Do not tank mix Apogee with boron, calcium chloride, or calcium nitrate.

Blister Spot on Mutsu, Cortland, Fuji

Blister spot is a bacterial disease of susceptible apple varieties — most notably Mutsu (Crispin). It is caused by a bacterium in the genus *Pseudomonas*. New blister spot outbreaks have been identified on Cortland and Fuji, and outbreaks have been reported on other varieties interplanted with Mutsu.

Due to resistance issues, streptomycin is no longer suggested for disease management. Due to the severity and lack of control options for blister spot on Mutsu, the variety we recommend replacing Mutsu with Shinzuku, which is similar in color and quality to Mutsu.

Insecticide Resistance in Codling Moth Populations

Several states (including those covered by this guide) have reported codling moth populations that are suspected or confirmed to be resistant to certain insecticides. 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 in other locations.

Resistance is not the only cause for control failures, so always consider whether the cause of poor control was due to other issues, including inadequate rates, inadequate spray volumes, spray timing, or wash-off due to rainfall. Where these factors do not appear to explain poor control, then resistance — particularly to the organophosphates (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 resistance development.

See Efficacy of Selected Insecticides and Acaricides Against Apple Insects and Mites, page 34.

Insect populations that are resistant to the organophosphates exhibit resistance to all the organophosphates that are labeled for codling moth control in apples (Diazinon, Imidan), 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, Danitol, Mustang Maxx, Baythroid, or Proaxis may not provide adequate control.

Altacor, Assail, Delegate, Exirel and Rimon, are effective against organophosphate-resistant codling moth populations. Consult your state extension specialists in entomology to plan effective seasonlong 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, Isomate-CM Flex, Isomate-CM/OFM TT, No-Mate CM, and CheckMate CM dispensers are registered for codling moth control of. These products dispense the codling moth sex attractant and are designed to prevent male moths from locating females for mating. Sprayable formulations also are available.

These products use a strategy called mating disruption, which is most likely to succeed in blocks of at least 5 acres where initial populations of codling moth are low. If you attempt a mating disruption program for codling moth control in blocks smaller than 5 acres or where codling moth infestations are greater, it will be necessary to also make border sprays or at least one or two cover sprays. Controlling codling moth by mating disruption will not control other insect pests that cover sprays control (for example, plum curculio and apple maggots).

Apple Borers

The dogwood borer and American plum borer are caterpillars that attack burr knot tissue on apple trunks. Flat-headed and round-headed apple borers are beetle larvae that attack tree trunks, often trees that have received mechanical, cold, or other injury or are generally weakened.

You can treat any of these borers with Lorsban Advanced at a rate of 1.5 qts. per 100 gals. of spray, or with Lorsban 4E at a rate of 1.5 qts. per 100 gals. 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. Isomate DWB can be used starting at bloom.

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, and soak the bark. *Do not* apply Lorsban to the fruit or foliage. Only one application of Lorsban (of any formulation) is allowed each year. Do not use for borers if already used pre-bloom.

Periodical Cicadas

Periodical cicadas are orange to black, about 1 ½ inches long, have 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.

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. 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 ½ to 2 feet beneath the soil. With their sucking mouthparts, they immediately begin to suck juices from the roots.

Females prefer oak, hickory, apple, peach, and pear trees, and grape vines for laying eggs. Females damage plants when they make slits in branches and twigs to deposit their eggs. These small twigs and branches turn brown and die and sometimes break off. The damage may be severe in newly planted orchards or on new 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 them with a protective netting, such as cheesecloth. Cover a tree and tie the netting to the trunk below the lower branches. Remove the covering when egg-laying is over. If netting is not an option, you may apply insecticides when egg-laying begins, and repeat 7 to 10 days later. Pyrethroids are recommended to control periodical cicada, but using these products may lead to mite outbreaks.

Sanitation Methods to Aid in Apple Scab Control

Especially in the years after a high incidence of apple scab developed in the orchard, sanitation is important because apple scab overwinters only in fallen leaves. The sanitation methods described below can reduce the amount of apple scab inoculum (ascospores) by as much as 50 percent.

Applying 5% urea to the orchard floor (40 lbs. per acre in 100 gals. of water) provides nitrogen to help microorganisms decompose leaves, killing the overwintering apple scab fungus.

Flail mowing the orchard also has been reported to reduce apple scab inoculum by as much as 50 percent.

You can flail mow or apply nitrogen in the fall and/or spring. Each method has been reported to reduce the number of scab ascospores by as much as 50 percent; however, the combined effects will not provide complete control. Using both methods will probably not reduce ascospore more than 50 percent. Be sure to recognize that urea provides nitrogen, and modify your fertilization program appropriately.

Notes on Soaps and Horticultural Oils

SunSpray UFO (UFO = “ultrafine” oil), Saf-T-Side, and M-Pede (a potassium salt of fatty acids, previously called an insecticidal soap) are relatively new insecticides that may be used in certified organic production systems. Summer oils and M-Pede are only effective against insects the sprays contact 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 1-2 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 you apply oil 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 you apply multiple sprays. 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

Timing of First Insecticide Spray for Codling Moth Control on Apple and Pear¹

Degree-days (base 50°F) after biofix ²	Insecticide Products
50-75	Dimilin Rimon
100-200	Intrepid Confirm
150-250	Altacor Assail Belay Delegate Exirel
250	Imidan Avaunt Pyrethroids (Asana, Baythroid, Danitol, Mustang Max, Proaxis, Warrior) Virus (Cyd-X, Carpovirusine, Virosoft CP4)

¹ A second spray should be made 10-14 days later.

² Biofix is defined as the date on which pheromone traps detect sustained flight of moths.

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 whether 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 russeting, some authorities suggest that insecticidal soaps should be used only in nonbearing orchards. Applicators must mix oils and soaps at the proper dilution (1-2 percent); concentrated sprays will be less effective and more phytotoxic. Deposits of large droplets or the coalescing of droplets on fruit or foliage also increases the likelihood of leaf damage and fruit blemishes.

Fungicide Resistance Management

Many of our most effective fungicides have a high risk for resistance development in the fungi they control. These include Topsin-M, Scala, Vangard, the sterol-inhibiting fungicides (Rally, Rubigan, Indar, Inspire Super, and Procure); the strobilurin fungicides (Sovran, Cabrio, Pristine, and Flint); and the succinase dehydrogenase inhibiting fungicides (Fontelis, Luna

Sensation, Luna Tranquility, and Merivon). Because they all have very specific modes of action, fungi such as the apple scab and the powdery mildew pathogens can rapidly develop resistance to them. Fungicide resistance, or at least reduced sensitivity, has been observed for apple scab and powdery mildew to both the sterol-inhibitor and strobilurin fungicides in the United States and throughout the Midwest.

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

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

Notes on the Use of Pre-mixes

Many chemical manufacturers provide pre-mixes (pre-formulated tank mixtures). Take care when using these pre-mixes so that your rotation partners are not in the same chemical family as the premix. For example, if you use Pageant (a pre-mix of a strobilurin and SDHI fungicide), avoid using Sovran, Cabrio, Flint, the Luna series, and Merivon, (all of which contain either a strobilurin or an SDHI), or Fontelis and Aprovia (which are SDHI fungicides).

Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI)

Most captan formulations (Captan 50W, Captan 80WDG, Captan 4L) are currently available with a 24-hour REI. The REI was reduced from 4 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 4-day REI. Check the label of the captan product you plan to purchase to be sure it has a 24-hour REI.

Cork Spot and Bitter Pit Management in Apples

Cork spot and bitter bit are related to low levels of calcium and high levels of nitrogen in the fruit. However, low calcium is not the only cause of these disorders. Excessive tree vigor and a light fruit crop increase cork spot and bitter pit. Bitter pit is primarily a storage disorder and calcium treatments before and after harvest can reduce this.

No one cultural practice eliminates these disorders and you need a multifaceted approach for control. For example:

1. Apply lime to raise the soil pH to around 6.5 to make calcium more available for tree uptake.
2. Balance tree nutritional levels by analyzing soil and tissue. Keep nitrogen, potassium, and magnesium levels from becoming excessive and avoid low levels of calcium, boron, and zinc. If tissue analysis boron levels are low, apply Solubor at 2 lbs./acre at pink and again at petal fall.
3. Work to moderate tree vigor. Avoid excessive pruning and tree overcrowding and make moderate nitrogen applications. Summer pruning of water sprouts between mid-July and mid-August also helps minimize cork spot.
4. Adjust fruit density by chemically thinning fruit in heavy cropping years to avoid a light crop and calcium disorders the following year.
5. Apply calcium in 6-8 sprays starting at first cover. Calcium chloride is most commonly used; it is inexpensive but can be hard on pumps. Calcium nitrate (Nutrical) is an alternative. Calcium chloride is sold as dry formulations (such as DowFlake Xtra 83-87% and Cor-Clear 28%) and as liquid formulations with 10 percent calcium (such as EezyCal 8-0-0-10 and Loveland 10% Calcium). Applying calcium at a low rate every 7 days is more effective than a higher rate every 14 days. Application between first cover and third cover is most critical, but later sprays also help. You can apply higher rates after mid-July.

Managing Cork Spot in Honeycrisp

Honeycrisp is one of the most susceptible cultivars to corking. Affected cells start to show damage around two weeks after petal fall, but visual symptoms usually show up in mid to late June. When the disorder starts, damaged cells usually have higher rates of protein synthesis, respiration, and cell division, but these cells become brown and die

shortly thereafter. As fruit development progresses, severely damaged fruit become cracked and deformed with deep brown, cork-like areas scattered throughout the flesh.

Calcium and boron deficiencies are suspected as the main reasons for cork spot development. The flesh and peels of honeycrisp apples have less calcium than some other varieties, so keeping up with the

calcium sprays is essential for managing cork spot. Calcium moves very slowly into the tissue, so more water and good coverage are essential for better uptake.

The recommended application rate is about 4 pounds of calcium chloride dissolved in 400 gallons or more of water per acre. Begin applying calcium in the first cover spray.

Efficacy of Selected Fungicides Against Apple Diseases¹

Fungicide	scab	powdery mildew	rust	black rot, white rot	bitter rot	sooty blotch, flyspeck
Aprovia	G-E	G-E	P	O	O	O
Bayleton ²	P	F	E	O	O	O
Captan	G	O	O	G	G-E	F-G
Flint ²	E	G	G	G	E	E
Flint Extra ²	E	E	E	G	G	E
Fontelis	E	E-G	G	—	—	—
Indar	E	G	G	O	O	G
Inspire Super	E	E	E	—	—	G
Luna Sensation	E	E	G	G	G	G
Luna Tranquility	E-G	E	—	—	—	—
Mancozeb (Dithane, Manzate, Penncozeb)	G	O	G	G	E	E
Merivon	E	E	F-G	G	G	G
Omega ³	E-G	—	F ⁴	G-E	G-E	E
Polyram	G	O	G	G	G	E
Pristine	E	E	E	G	G	E
Procure ²	E	E	E	O	O	O
Rally ²	E-P	E-P	E	P-E	P-E	O
Vintage ²	F	G	F	O	O	O
Scala	G	—	—	—	—	—
Sercadis	E-G	E-G	—	F ⁴	E-G	E
Sovran ²	E	G	E	G	G	E
Sulfur	F	G	O	F	—	P
Syllit ²	E	O	P	P	O	P
Topguard	E	E	E	—	—	—
Topsin-M ²	P	G	O	G	P	E
Vanguard	G	—	—	—	—	—
Ziram	F	O	G	P	G	F-G

¹ — = unknown or doesn't apply. O = none. P = poor. F = fair. G = good. E = excellent.

² Many areas of the Midwest may contain strains of apple scab and powdery mildew fungi tolerant of these chemicals. Therefore, these fungicides may not be effective in some areas.

³ Also effective against two-spotted spider mite. Only suppressive against bitter rot and rusts.

⁴ Suppressive only.

Efficacy of Selected Insecticides and Acaricides Against Apple Insects and Mites¹

Products ²	Mode of Action Group (IRAC)	predator mite toxicity	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	twospotted Mite	apple rust mite
Organophosphates																					
Diazinon	1 B	ST	F	F	G	G	G	F	P	—	F	G	G	F	—	F	—	G	—	—	—
Imidan	1 B	ST	G	G	E	E	G	G	F	P	P	F	P	F	P	—	G	F	—	—	—
Lorsban	1 B	MT	—	—	—	—	G	—	G	—	G	P	—	—	—	—	—	E	—	—	—
Supracide	1 B	MT	—	—	—	—	E	—	F	—	E	F	—	—	—	—	—	E	—	—	—
Neonicotinoids																					
Actara	4 A	MT	—	G	—	—	—	—	G	—	E	E	—	E	—	G	—	—	—	—	—
Admire Pro	4 A	MT	—	—	—	—	—	—	—	—	E	E	G	E	—	E	F	F	—	—	—
Assail	4 A	ST	E	G	G	E	—	G	G	E	E	—	E	—	E	G	F	—	—	—	—
Belay	4 A	MT	G	G	—	—	—	—	—	—	E	E	—	E	—	E	—	—	—	—	—
Closer	4 C	HT	—	—	—	—	—	—	G	—	E	E	G	E	—	—	—	—	—	—	—
Sivanto	4 D	—	—	—	—	—	—	—	—	—	G	G	P	G	—	—	—	G	—	—	—
Insect Growth Regulators																					
Centaur	16	ST	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—
Confirm	18	ST	F	—	—	P	E	F	—	—	—	—	—	—	—	F	—	—	—	—	—
Esteem	7 C	ST	F	—	—	—	—	—	—	—	E	—	—	—	—	G	—	E	—	—	—
Intrepid	18	ST	G	—	—	G	E	E	—	—	—	—	—	—	—	G	—	—	—	—	—
Neemix, AzaDirect	un	ST	—	—	—	—	—	—	—	—	—	F	—	—	—	—	F	—	—	—	—
Rimon	15	ST	E	—	—	G	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pyrethroids																					
Asana	3 A	HT	E	G	G	E	E	G	E	E	G	F	P	G	E	P	E	P	—	—	—
Azera	3 A	MT	—	—	—	—	—	—	G	—	—	G	—	G	—	—	G	—	—	—	—
Baythroid	3 A	HT	E	G	G	E	E	G	E	—	—	—	—	E	E	—	E	—	—	—	—
Danitol	3 A	HT	E	G	G	E	E	G	E	E	F	F	P	G	E	P	E	P	F	F	—
Mustang Maxx	3 A	HT	E	G	G	E	E	G	E	—	—	—	—	E	E	—	E	—	—	—	—
Permethrin	3 A	HT	—	G	—	E	E	G	E	—	G	G	P	G	E	P	—	P	—	—	—
Proaxis	3 A	HT	E	G	G	G	E	G	E	—	G	G	—	E	E	—	E	P	—	—	—
Warrior	3 A	HT	E	E	F	E	E	F	E	—	G	G	P	E	E	P	E	P	—	—	—
Carbamates																					
Lannate	1 A	HT	G	F	F	G	E	E	G	G	—	G	P	E	G	E	F	F	—	—	—
Sevin	1 A	HT	G	G	G	G	F	F	—	G	F	F	P	G	—	F	E	F	—	—	—
Vydate	1 A	HT	—	—	—	—	—	—	G	G	G	G	P	G	—	G	—	—	G	G	—
Other																					
Altacor	28	ST	E	—	—	E	E	E	—	—	—	—	—	—	—	—	—	—	—	—	—
Avaunt	22	MT	F	G	F	G	G	F	G	—	—	—	—	G	—	P	—	—	—	—	—
B.t. (Dipel, etc.)	11 B	NT	F	—	—	F	—	G	—	—	—	—	—	—	—	—	—	—	—	—	—
Cyd-X, Virosoft	—	NT	F	—	—	F	—	G	—	—	—	—	—	—	—	—	—	—	—	—	—
Delegate	5	MT	E	—	F	E	E	E	—	—	—	—	—	—	—	E	—	—	—	—	—
Exirel	28	ST	E	G	—	E	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Movento	23	—	—	—	—	—	—	—	—	—	G	G	G	—	—	—	—	G	—	—	—
Proclaim	6	—	F	—	—	F	E	E	—	—	—	—	—	—	—	—	—	—	—	—	—
Entrust	5	ST	G	P	F	F	G	G	—	—	—	—	—	—	—	E	—	—	—	—	—
Surround	—	MT	P	F	P	—	—	—	—	—	—	—	—	G	—	—	G	—	—	—	—
Miticides																					
Acramite	un	ST	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	F	G	G
Agri-Mek	6	MT	—	—	—	—	—	—	—	—	—	—	—	G	—	E	—	—	G	F	G
Apollo	10 A	ST	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	E	P
Dicofol	un	HT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	F	F	—
Envidor	23	MT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	E	G
Kanemite	20 B	ST	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	G	G
Nealta	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nexter	21 A	MT	—	—	—	—	—	—	—	—	—	—	—	G	—	—	—	—	G	F	E
Portal	21 A	MT	—	—	—	—	—	—	—	—	—	—	—	E	—	—	—	—	E	G	G
Savey	10 A	ST	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	E	P
Vendex	12 B	ST	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	F	F	—
Zeal	10 B	MT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	E	F

¹ — = 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.

² See list of generic products on pages 139-140.

Pear Spray Schedule

■ Pear Dormant to Bud Swell

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

Pest/Problem	Material	Rate/Acre	Comments
fire blight	Fixed copper fungicides/ bactericides: copper hydroxide, copper oxychloride, basic copper sulfate, Bordeaux mixture	See label	If fire blight was severe last year, a fixed copper spray at swollen bud stage is suggested. Do not apply copper after swollen bud stage or when drying conditions are cool and slow, because severe injury can occur. Many fixed copper products are registered for use on pear. Label recommendations may vary; refer to individual label for specific application timing. Fixed coppers can be mixed with oil. <i>However, never combine copper sulfate alone with dormant oil.</i>

■ Pear Late Dormant

Before buds break into green tip in the spring.

Pest/Problem	Material	Rate/Acre	Comments
scale insects, European red mite eggs	superior oil	2%	Apply when temperatures are above 40°F — never during freezing weather. Do not apply within 2 weeks of a sulfur spray or later than delayed dormant.
European red mite eggs	Apollo 4SC	4-8 fl. oz.	Do not exceed 1 application per year.
	Savey 50DF	3-6 oz.	
pear psylla (adults)	Ambush 25WP	12.8-25.6 oz.	Insecticide may be combined with oil during dormant and delayed dormant periods only. Oil on wood inhibits egg laying. Apply oil as soon as first eggs are laid and again 7 days later if adults are still present. Apply dilute. Use 3% at dormant, 2% at budburst, and 1% up to whitebud.
	Asana XL 0.66EC	9.6-19.2 fl. oz.	Apply this rate only during dormant to pre-bloom (white bud) stage.
	Danitol 2.4EC	16-21.3 fl. oz.	
	Pounce 25WP	12.8-25.6 oz	
	Proaxis 0.5EC	2.56-5.1 fl. oz.	
	Warrior II 2.08CS	1.28-2.56 fl. oz.	
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
	Delegate 25WG	6-7 oz.	
	superior oil	1-3 gals.	
	Sivanto Prime	10.5-14 fl. oz.	
Surround	50 lbs. per 100 gals. of water		Apply every 7-14 days beginning no later than green tip.

■ Pear Pre-bloom

Pest/Problem	Material	Rate/Acre	Comments
pear scab	Aprovia	5.5-7.0 fl. oz.	
	Flint	2-2.5 oz.	Also controls powdery mildew. Refer to label for rates.
	Flint Extra	2.5-2.9 fl. oz.	Most effective at later sprays.
	Fontelis	16-20 fl. oz.	
	Inspire Super	12 fl. oz.	See comments about Inspire Super in Apple Green Tip, page 13.
	Luna Sensation	4-5.8 fl. oz.	Do not tank mix with horticultural oils due to injury potential.
	Luna Tranquility	11.2-16 fl. oz.	
	Mancozeb 75DF	3-6 lbs.	Use either the Pre-bloom (6 lbs.) or Extended Application (3 lbs.) schedule. See Restrictions on EBDC Products, page 28.
	Merivon	4-5.5 fl. oz.	Do not apply with EC or oil-based products.
	Pristine 38WG	14.5-18.5 oz.	Also controls powdery mildew. Refer to label for rates.
	Procure 50WP	8-16 oz.	Also controls powdery mildew. Refer to label for rates.
	Scala 5SC	7-10 fl. oz.	PHI=77-days.
	Sovran 50WG	2-2.5 oz.	Also controls powdery mildew. Refer to label for rates.
	Syllit FL PLUS Mancozeb 75DF	1.5-3 pts. 2.25 lbs.	Pre-Bloom/Bloom: Begin applications at 1/4- to 1/2-inch green tip and continue on a 7- to 10-day schedule through bloom.
	Topsin-MWSB	1 lb.	
	Vanguard 75WG	5 oz.	
Ziram 76DF	6 lbs.		
pear psylla (hatching eggs)	Esteem 35WP	4-5 oz.	
	Dimilin 25W	2.5-3 lbs.	
	Dimilin 2L	40-48 fl. oz.	
	Portal 0.4EC	2 pts.	
	Centaur 70WDG	34.5-46 oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Sivanto Prime	10.5 - 14 fl. oz.	
	Surround	50 lbs. per 100 gals.	

■ Pear Bloom

Pest/Problem	Material	Rate/Acre	Comments
pear scab	Same as for Pear Pre-bloom except do not use Syllit, page 36. Past bloom, Mancozeb may not be applied at a rate greater than 3 lbs./acre. Do not apply within 77 days of harvest. Luna Tranquility has a 72-day PHI.		
fire blight	Streptomycin 17W OR	1.5 lbs.	Start fire blight sprays at 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 maximum rate of streptomycin of 100 ppm (0.5 lb./100 gals.).
	Streptomycin 17W PLUS Regulaid	1 lb.	
			1 pt.

(continued)

Pear Bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
fire blight (continued)	<i>Labeled but not recommended</i> These products are registered for fire blight control, but are only needed in orchards with a history of streptomycin resistance.		
	Mycoshield 17WP	16 oz.	
	FireLine	16 oz.	
	Kasumin 2L	64 oz. per 100 gals.	Do not exceed 2 sequential treatments per year. For use to manage streptomycin-resistant fire blight bacteria.
insects or mites	SAVE THE BEES! Do not use insecticides during bloom.		

■ Pear Petal Fall

7-10 days after bloom.

Pest/Problem	Material	Rate/Acre	Comments
pear scab	Same as for Pear Pre-bloom except Mancozeb and Syllit, page 36.		
fire blight	Same as for Pear Bloom, pages 36-37. Continue sprays for fire blight until the last petals have fallen.		
plum curculio, tarnished plant bug, stink bugs	Imidan 70WP	2.13-5.75 lbs.	
	Danitol 2.4EC	16-21.3 fl. oz.	For plant bugs and stink bugs.
	Warrior II 2.08CS	1.28-2.56 fl. oz.	
	Proaxis 0.5EC	2.5-5.12 fl. oz.	
	Brigade 2E	2.6-12.8 fl. oz.	
	Baythroid XL 1EC	2-2.8 fl. oz.	
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
pear psylla (nymphs)	Esteem 35WP	4-5 oz.	
	Agri-Mek 0.15EC	10-20 fl. oz.	Apply with 1% oil. Control is 3-4 weeks at 10 oz. rate. Control is seasonlong at 20 oz. rate.
	Azera 0.21EC	2-3.5 pts.	
	Portal 0.4EC	2 pts.	
	Actara 25WDG	5.5 oz.	
	Assail 30SG	4-8 oz.	
	Centaur 70WDG	34.5-46 oz.	
	Admire Pro 4.6F	7 fl. oz.	
	Belay 2.13SC	6-12 fl. oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Sivanto 200SL	10.5-14 fl. oz.	
	Surround	50 lbs. per 100 gals.	

■ Pear First and Second Cover

10-14 days after petal fall and 10-14 days later.

Pest/Problem	Material	Rate/Acre	Comments
pear scab	Same as for Pear Pre-bloom, page 36. Where <i>Fabraea</i> leaf spot is a problem, use Flint, Flint Extra, Sovran, or Ziram until July. Observe preharvest interval requirements.		
pear rust mite	First cover is the best time to control pear rust mite.		
	Agri-Mek 0.15EC	10-20 fl. oz.	
	Nexter 75WP	6.6-10.7 fl. oz.	Will also suppress pear psylla.
	Envidor 2SC	16-18 fl. oz.	
	Portal 0.4EC	2 pts.	
	Movento 2SC	6-9 fl. oz.	

(continued)

Pear First and Second Cover (continued)

Pest/Problem	Material	Rate/Acre	Comments
codling moth, plum curculio	Same as for plum curculio at Pear Petal Fall, page 37 OR		
	Assail 30SG	4-8 oz.	Used at first cover for psylla, also controls codling moth and plum curculio. Dimilin, Delegate, and Altacor are effective against codling moth but not plum curculio. Apply Dimilin 50-75 degree-days after codling moth biofix (see Timing of First Insecticide Spray for Codling Moth Control on Apple and Pear, page 31). Assail is for plum curculio only.
	Dimilin 25W	0.75-1 lb.	
	Dimilin 2L	12-16 fl. oz.	
	Altacor 35 WDG	2.5-4.5 oz.	
	Delegate 25 WG	4.5-7 oz.	
Exirel 0.83 SE	8.5-20.5 fl. oz.		
pear psylla	Same as at Pear Petal Fall, page 37. Psylla control required for first cover only. Best results occur when psylla is in adult or young nymphal stage.		

■ Pear Summer Covers

Apply at 10- to 14-day intervals observing harvest restrictions and limitations.

Pest/Problem	Material	Rate/Acre	Comments
pear scab, sooty blotch, flyspeck	Same as for Pear Pre-bloom except for Vanguard, Scala, and Mancozeb, page 36. Rubigan and Procure will not control sooty blotch or flyspeck, and they should not be used past second cover. Flint, Merivon, and Pristine provide excellent control of summer fruit rots, sooty blotch, and flyspeck. Vanguard and Scala have a 72-day PHI. See Note About Mancozeb and Polyram (EBDC Products), page 24. All Mancozeb products have a 77-day PHI.		
codling moth	Belay 2.13SC	6-12 fl. oz.	
	Imidan 70WP	2.1-5.75 lbs.	
	Assail 30SG	4-8 oz.	
	Intrepid 2F	16 fl. oz.	
	Confirm 2F	20 fl. oz.	
	Dimilin 25W	0.75-1 lb.	
	Dimilin 2L	12-16 fl. oz.	
	Asana XL 0.66EC	4.8-14.5 fl. oz.	
	Brigade 2EC	2.6-12.8 fl. oz.	
	Danitol 2.4EC	16-21.3 fl. oz.	
	Proaxis 0.5EC	2.5-5.1 fl. oz.	
	Warrior II 2.08 CS	1.28-2.56 fl. oz.	
	Sevin XLR PLUS (4L)	3 qts.	
	Entrust 80WP	2-3 oz.	
	Entrust 2SC	6-10 fl. oz.	
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
	Avaunt 30WDG	5-6 oz.	
Baythroid XL 1EC	2-2.4 fl. oz.		
Altacor 35WDG	2.5-4.5 oz.		

(continued)

Pear Summer Covers (continued)

Pest/Problem	Material	Rate/Acre	Comments
codling moth (continued)	Delegate 25WG	4.5-7 oz.	
	Exirel 0.83SE	8.5 - 17 fl. oz.	
	Cyd-X	1-6 fl. oz.	
	Cyd-X HP	0.5-3 fl. oz.	
pear psylla	Actara, Assail, Belay, Exirel, Sivanto, or Admire Pro as listed at Pear Petal Fall, page 37 OR		Make 2 applications, 10-12 days apart to target second generation young nymphs. The first new summer adults appear about 3 weeks after full bloom. Second generation adults are found on terminals and water sprouts.
	Delegate 25WG	6-7 oz.	
	Portal 0.4EC	2 pts.	
San Jose scale (crawlers)	Esteem 35WP	4-5 oz.	
	Diazinon AG 600WBC	12.75 fl. oz. per 100 gals.	
	Admire Pro 4.6F	2.8 fl. oz.	
	Assail 30SG	8 oz.	
	Centaur 70WDG	34.5-46 oz.	
	Movento 2SC	6-9 fl oz.	
	Sivanto 200SL	10.5 - 14 fl. oz.	
European red mite	Savey 50DF	3-6 oz.	
	Apollo 4SC	4-8 fl. oz.	
	Agri-Mek 0.15EC	10-20 fl. oz.	
	Acramite 50WS	0.75-1 lb.	
	Portal 0.4EC	2 pts.	
	Kanemite 15SC	21-31 fl. oz.	
	Envidor 2SC	16-18 fl. oz.	
	Nexter 75WP	6.6-10.67 oz.	
	Zeal 72WP	2-3 oz.	
	Onager 1EC	12-24 fl. oz.	
	Nealta 1.67L	13.7 fl. oz.	
mealybug	Admire Pro 4.6F	7 fl. oz.	
	Actara 25WDG	4.5-5.5 oz.	
	Assail 30SG	4-8 oz.	
	Portal 0.4EC	2 pts.	
	Movento 2SC	6-9 fl. oz.	
	Centaur 70WDG	34.5-46 oz.	

Cherry Spray Schedule

■ Cherry Dormant

Before buds break in the spring.

Pest/Problem	Material	Rate/Acre	Comments
bacterial canker	copper compounds		Bacterial canker is generally more serious on sweet than tart cherry. Many copper compounds are registered for use as a dormant application for control of bacterial canker on cherry. See labels for rates and timings. Do not apply copper later than white bud stage; flower injury can occur.
European red mite eggs	superior oil	2%	
	Apollo SC	2-8 fl. oz.	

■ Cherry Early Bloom

Also referred to as popcorn or white bud.

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight)	Abound	12-15.5 fl. oz.	Also controls shot hole, powdery mildew and anthracnose.
	Aframe	14 fl. oz.	A pre-mix of azoxystrobin (FRAC 11) and propiconazole (FRAC 3). Be careful with subsequent rotations.
	Bravo Weather Stik	3-4 pts.	Other formulations and generics available.
	Cabrio	9.5 oz.	Do not exceed 2 sequential applications before alternating to a non-Group 11 fungicide with a different mode of action.
	Captan 80WDG	2.5 lbs.	Other formulations are available, such as 4L and 50WP.
	CaptEate 68WDG	3.75 lbs.	
	Elevate 50WG	1-1.5 lbs.	
	Fontelis	14-20 fl. oz.	Do not exceed 61 fl. oz. per acre per year.
	Indar 2F	6 oz.	Do not exceed 8 applications or 48 fl. oz. per acre per season. Indar has a PHI of up to day of harvest.
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-10 oz.	
	Luna Sensation	5-5.6 fl. oz.	
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Orbit	4 fl. oz.	Do not exceed 8 applications or 48 fl. oz. per acre per season.
	Pristine 38WG	10.5-14.5 oz.	
	Procure 50WS	9-12 oz.	
Quadris Top	12-14 fl. oz.	Contains azoxystrobin, a fungicide known to cause phytotoxicity on these apple cultivars: Braeburn, Cortland, Gala, GoldRush, Hampshire, Jonamac, Macintosh, Silken, Spigold, Sun crisp, Zestar! These fungicides are only labeled for use on stone fruit, but drift, or improper sprayer cleaner could damage apple fruit.	
Quash 50	2.5-3.5 oz.		

Cherry Early Bloom *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight) <i>(continued)</i>	Quilt Xcel	14 fl. oz.	Contains azoxystrobin, a fungicide known to cause phytotoxicity on these apple cultivars: Braeburn, Cortland, Gala, GoldRush, Hampshire, Jonamac, Macintosh, Silken, Spigold, Sun crisp, Zestar! These fungicides are only labeled for use on stone fruit, but drift, or improper sprayer cleaner could damage apple fruit.
	Rally 40WSP	2.5-6 oz.	Registered for control of brown rot (blossom blight), leaf spot, and powdery mildew on cherries. Do not exceed 2.75 lbs. per acre per season, or within 7 days of harvest.
	Rovral 4F	1-2 lbs.	Do not exceed 2 sprays per season. Cannot be applied after petal fall on any stone fruit.
	wettable sulfur 95%	18 lbs.	
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Start application at 1-5% bloom followed by an applications at 50-100% bloom.
	Topsin M70 WSB	1- 1.5 lbs.	
	Ziram	5-6 lbs.	

■ Cherry Full Bloom

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight)	Same as for Cherry Early Bloom, pages 40-41.		
insects, mites	SAVE THE BEES! Do not apply insecticides during bloom.		

■ Cherry Petal Fall

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight)	Same as for Cherry Early Bloom, pages 40-41. However, Rovral cannot be applied after petal fall. If previously using Rally, rotate to another product with a different mode of action.		
	Except for sulfur, all materials listed for brown rot under Cherry Early Bloom (pages 40-41) may be used for both brown rot and leaf spot. Do not apply Bravo after shuck fall.		
leaf spot	Tart cherry is more susceptible to leaf spot than is sweet cherry. See Cherry Leaf Spot Management, pages 47-48.		
	Aframe	14 fl. oz.	A pre-mix of azoxystrobin (FRAC 11) and propiconazole (FRAC 3). Be careful with subsequent rotations.
	Bravo Weather Stik	3-4 pts.	Other formulations and generics available.
	Cabrio	9.5 oz.	
	Elite 45DF	4-8 oz.	
	Fontelis	14-20 fl. oz.	
	Gem 500SC	1.9-3.8 oz.	
	Indar 2F	6 oz.	
	Luna Experience	6-10 oz.	
	Luna Sensation	5-5.6 fl. oz.	
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.

(continued)

Cherry Petal Fall (continued)

Pest/Problem	Material	Rate/Acre	Comments
leaf spot (continued)	Pristine 38WG	10.5-14.5 oz.	
	wettable sulfur	See label	Can be used between petal and harvest. Must be reapplied frequently in wet seasons.
	Syllit FL PLUS Captan 80WDG	1.5-3 pts. 2.5 lbs.	Other formulations are available, such as 4L and 50WP.
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 fl. oz.	Start applications now and repeat as necessary.
	powdery mildew	Abound	12-15.5 fl. oz.
Cabrio		9.5 oz	Do not exceed 2 sequential applications before alternating to a non-Group 11 fungicide with a different mode of action.
Fontelis		14-20 fl oz	
Gem 500SC		1.9-3.8 oz.	
Inspire Super		16-20 fl oz	
Luna Experience		6-10 oz.	
Luna Sensation		5-5.6 fl oz	
Pristine 38WG		10.5-14.5 oz.	
Procure 50WS		10-16 oz.	
Quash 50WDG		3.5-4 oz	
Quintec 2.08F		7 fl. oz.	Quintec is a protectant fungicide and must be applied before the powdery mildew fungus penetrates or infects tissues.
Rally 40WSP		2.5-6 oz.	
wettable sulfur 90%		10-30 lbs.	Refer to label for further information about recommended rates.
Topguard		14 fl. oz.	
Topguard EQ		6-8 fl. oz.	
plum curculio	Imidan 70WP	2.13-2.5 lbs.	Do not use on sweet cherries.
	Pounce 25WP	6.4-12.8 oz.	
	Asana XL 0.66EC	4.8-14.5 fl. oz.	
	Baythroid XL 1EC	2.4-2.8 fl. oz.	
	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Warrior II	1.28-2.56 fl. oz.	
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
	Proaxis 0.5EC	2.56-5.12 fl. oz.	
	Assail 30SG	5.3-8 oz.	
Exirel 0.83SE	13.5 -20.5 fl. oz.		

■ Cherry Shuck Fall

When shucks have split and are falling from expanding fruit.

Pest/Problem	Material	Rate/Acre	Comments
leaf spot	Tart cherry is more susceptible to leaf spot than sweet cherry. See Cherry Leaf Spot Management, pages 47-48.		
	Aframe Plus	14 fl. oz.	
	Bravo Weather Stik	3-4 pts.	Make 1 application at shuck fall. Do not apply Bravo after shuck fall and before harvest. If additional disease control is needed before harvest, use another registered fungicide. Other formulations and generics available.
	Cabrio	9.5 oz.	Do not exceed 2 sequential applications before alternating to a non-Group 11 fungicide with a different mode of action.
	Elite 45DF	4-8 oz.	
	Flint Extra	2.5-3.8 fl. oz.	
	Fontelis	14-20 fl. oz.	
	Gem 500SC	1.9-3.8 oz.	Because of resistance risks, tank-mix with Captan 80WDG at 2 lbs. per acre.
	Indar 2F	6 oz.	
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-10 oz.	
	Luna Sensation	5-5.6 fl. oz.	
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Pristine 38WG	10.5-14.5 oz.	
	Quash	4 oz.	
	Quilt Xcel	14 fl. oz.	Contains azoxystrobin, a fungicide known to cause phytotoxicity on these apple cultivars: Braeburn, Cortland, Gala, GoldRush, Hampshire, Jonamac, Macintosh, Silken, Spigold, Suncrip, and Zestar! These fungicides are only labeled for use on stone fruit, but drift, or improper sprayer cleaner could damage apple fruit.
	Rally 40WSP	2.5-6 oz.	
	Syllit	1.5-3 pts.	
Topguard EQ	6-8 fl. oz.		
Topsin-M 70 WSB PLUS Captan 80WDG	1.5 lbs. 2.5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.	

■ Cherry First Cover Spray

10 days after shuck-fall. The first cover spray timing after shuck fall is a critical disease timing in tart cherry orchards.

Pest/Problem	Material	Rate/Acre	Comments
powdery mildew	Same as for Cherry Petal Fall, page 42.		
plum curculio	Same as for Cherry Petal Fall, page 42. Do not apply Bravo after shuck-fall.		
leaf spot	Same as for Cherry Shuck Fall except not Bravo, page 43. See Cherry Leaf Spot Management, pages 47-48.		
powdery mildew, leaf spot	Same as for Cherry Petal Fall or a copper fungicide, page 42.		
plum curculio, cherry fruit fly	Imidan 70WP	2.13 lbs.	Do not use on sweet cherries.
	Lorsban 75WG	2 lbs.	May be used on tart cherries only — is phytotoxic on sweet cherries.
	Asana XL 0.66EC	4.8-14.5 fl. oz.	
	Warrior II	1.28-2.56 fl. oz.	
	Baythroid XL 1EC	2.4-2.8 fl. oz.	
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
	Proaxis 0.5EC	2.56-5.12 fl. oz.	
	Assail 30SG	5.3-8 oz.	
	Danitol 2.4EC	10.7-21.3 fl. oz.	Use lower rate for plum curculio; use higher rate for cherry fruit fly.
	Exirel 0.83SE	10-20.5 fl oz	Use at lower rate for cherry fruit fly and at higher rate for plum curculio.
Apta 1.31EC	21-27 fl. oz.	Use at lower rate for plum curculio and at higher rate for cherry fruit fly.	
cherry fruit fly only	The products listed above for both pests OR		
	Admire Pro 4.6F	2-2.8 fl. oz.	
	Entrust 80WP	1.25-2.5 oz.	
	Entrust 2SC	4-8 fl. oz.	
	Altacor 35WDG	3-4.5 oz.	

■ Cherry Second Cover Spray

10 days after first cover.

Pest/Problem	Material	Rate/Acre	Comments
leaf spot	Same as for Cherry Shuck Fall except not Bravo, page 43. Do not apply Bravo after shuck-fall. See Cherry Leaf Spot Management, pages 47-48.		
powdery mildew	Same as for Cherry Petal Fall, page 42.		
plum curculio, cherry fruit fly	Same as for Cherry First Cover, page 44.		

■ Cherry Additional Cover Sprays

10 days after second cover, then every 10-14 days.

Pest/Problem	Material	Rate/Acre	Comments
brown rot	Same as for Cherry Early Bloom except not Rovral, pages 40-41. Do not apply Rovral after petal fall.		
leaf spot	Same as for Cherry Shuck Fall except not Bravo, page 43. Do not apply Bravo after shuck-fall. See Cherry Leaf Spot Management, pages 47-48.		
powdery mildew	Same as for Cherry Petal Fall, page 42.		
cherry fruit fly	Imidan 70WP	2.13 lbs.	
	Lorsban 75WG	2 lbs.	
	Asana XL 0.66EC	4.8-14.5 fl. oz.	
	Warrior II	1.28-2.56 fl. oz.	
	Baythroid XL 1EC	2.4-2.8 fl. oz.	
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
	Proaxis 0.5EC	2.56-5.12 fl. oz.	
	Assail 30SG	5.3-8 oz.	
	Danitol 2.4EC	16-21.3 fl. oz.	
	Exirel 0.83SE	10-17 fl. oz.	
	Diazinon AG 600WBC	6.5-12.7 fl. oz. per 100 gals.	
	Sevin XLR Plus (4L)	2-3 qts.	
	Admire Pro 4.6F	2-2.8 fl. oz.	
	Entrust 80WP	1.25-2.5 oz.	
Entrust 2SC	4-8 fl. oz.		
Altacor 35WDG	3-4.5 oz.		
borer control	See Borers of Peach, Cherry, and Plum Trees, page 68.		

■ Cherry Pre-harvest Sprays

Beginning 3-4 weeks before harvest.

Pest/Problem	Material	Rate/Acre	Comments
brown rot	Aframe Plus	14 fl. oz.	PHI=0 days.
	Cabrio	9.5 oz.	
	Captan 80WDG	2.5 lbs.	Other formulations are available, such as 4L and 50WP.
	CaptEstate 68WDG	3.75 lbs.	
	Elite 45DF	4-8 oz.	
	Elevate 50WDG	1-1.5 lbs.	
	Fontelis	14-20 fl. oz.	Do not exceed 61 fl. oz. per acre per year.
	Indar 2F	6 oz.	Do not exceed 8 applications or 48 fl. oz. per acre per season. Indar has a PHI of up to day of harvest.
	Luna Sensation	5-5.6 fl. oz.	
	Merivon 2.09SC	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Orbit	4 fl. oz.	
	Pristine 38WG	10.5-14.5 oz.	

(continued)

Cherry Post-harvest Sprays (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot (continued)	Procure 50WS	9-12 oz.	
	Quadris Top	12-14 oz.	Contains azoxystrobin, a fungicide known to cause phytotoxicity on these apple cultivars: Braeburn, Cortland, Gala, GoldRush, Hampshire, Jonamac, Macintosh, Silken, Spigold, Suncrisp, Zestar! These fungicides are only labeled for use on stone fruit, but drift, or improper sprayer cleaner could damage apple fruit. Check PHI restrictions very carefully.
	Quash 50WDG	2.5-3.5 oz.	
	Quilt Xcel	14 fl. oz.	Contains azoxystrobin, a fungicide known to cause phytotoxicity on these apple cultivars: Braeburn, Cortland, Gala, GoldRush, Hampshire, Jonamac, Macintosh, Silken, Spigold, Suncrisp, Zestar! These fungicides are only labeled for use on stone fruit, but drift, or improper sprayer cleaner could damage apple fruit. PHI=0 days.
	Rally 40WSP	2.5-6 oz.	Registered for control of brown rot (blossom blight), leaf spot, and powdery mildew on cherry. Do not exceed 2.75 lbs. per acre per season, or apply within 7 days of harvest.
	wettable sulfur 90%	10-30 lbs.	
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 fl. oz.	
spotted wing Drosophila	Baythroid XL 1EC	2.4-2.8 fl. oz.	
	Entrust 80WP	1.25-2.5 oz.	
	Entrust 2SC	4-8 fl. oz.	
	Delegate 25WG	4.5-7 oz.	
	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Malathion	See label	Formulations and rates vary by state. Check labels for specific information.
	Pyganic 5EC	4.5-17 fl. oz.	
	Pounce 25WP	12.8 oz.	
	Rimon 0.83EC	20-40 fl. oz.	
	Imidan 70WP	2.13 lbs.	
	Mustang Maxx 0.8EC	4 fl. oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	

■ Cherry Post-harvest Sprays

Pest/Problem	Material	Rate/Acre	Comments
leaf spot	Tart cherry is more susceptible to leaf spot than is sweet cherry. See Cherry Leaf Spot Management, pages 47-48.		
	Adament 50WG	4-8 oz.	
	Bravo Weather Stik	3-4 pts.	Can be applied on trees after harvest, and (for the purposes of fungicide resistance management) would be the fungicide of choice. Make one application to foliage within 7 days after fruit is removed. In orchards with a history of high leaf spot, make a second application 10-14 days later. Other formulations and generics available.
	Orbit	4 fl. oz.	
	Rally 40WSP	2.5-6 oz.	

Cherry Post-harvest Sprays (continued)

Pest/Problem	Material	Rate/Acre	Comments
leaf spot (continued)	Syllit F	1.5-3 pts.	
	Topguard	14 fl. oz.	
leaf spot, powdery mildew	Fontelis	14-20 fl. oz.	
	Indar 2F	6 oz.	
	Luna Sensation	5-5.6 fl. oz.	
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Pristine 38WG	10.5-14.5 oz.	
	Rally 40WSP	2.5-6 oz.	
	Topguard	14 fl. oz.	

■ Cherry Leaf Spot Management

Integrated Copper/Sterol Inhibitor/Strobilurin Program

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

Pest/Problem	Material	Rate/Acre spray on 10- to 14-day interval	Comments
late petal fall or shuck fall stage	Bravo Weather Stik	4 pts.	Other formulations and generics available.
first cover	copper (e.g., Kocide 2000)	5 lbs.	<p>Copper fungicides can cause leaf bronzing and russeting but have negligible effects on photosynthesis and do not noticeably affect yield or fruit quality. Adding lime to COCS (copper oxychloride) is recommended on the label to prevent plant injury.</p> <p>Trees under drought stress may be more susceptible to premature defoliation from copper injury. Therefore, irrigate copper-treated trees in dry weather.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Do not apply copper when temperatures are predicted to exceed 80°F.</p>

(continued)

Cherry Leaf Spot Management (continued)

Pest/Problem	Material	Rate/Acre	Comments
second cover	Gem	4 oz.	
	Pristine	14.5 oz.	
third cover	Copper (e.g., Kocide 2000)	5 lbs.	
fourth cover	Rally 40WSP	2.5-6 oz.	
fifth cover (if needed before harvest)	Pristine	10.5 oz.	
post-harvest	Bravo Weather Stik	4 pts.	Other formulations and generics available.

Efficacy of Selected Insecticides and Acaricides Against Cherry Insects and Mites¹

Product	IRAC code	predator mite toxicity	bee toxicity	European red mite	plum curculio	cherry fruit fly	borers	spotted wing Drosophila	REI (hours) ²	PHI (days) ²
Organophosphates										
Diazinon	1B	ST	HT	P	G			G	96	21
Imidan	1B	ST	HT		G	G	P	E	72	7
Malathion	1B							G		3
Lorsban	1B	MT	HT			G	E			21
Carbamate										
Sevin	1A	HT	HT		F		P	G	12	3
Insect Growth Regulator										
Rimon	15	ST	ST			E			12	8
Neonicotinoids										
Admire Pro	4A	MT	HT		F				12	7
Assail	4A	ST	MT		E			F	12	7
Pyrethroids										
Asana	3A	HT	HT		G	G	G	E	12	14
Baythroid	3A	HT	HT		G	G	G	E	12	7
Danitol	3A	HT	HT	F	G	G		E	24	3
Mustang Maxx	3A	HT	HT		E	G		E	12	14
Pounce	3A	HT	HT		G		G		12	3
Proaxis	3A	HT	HT		G	G		E	24	14
Pyganic	3A	ST	ST		P	P		P	12	0
Warrior	3A	HT	HT		G	G	G	E	24	14
Other										
Altacor	28	ST	ST		P	G			4	10
Apta	21A		HT		G			F	12	14
Delegate	5	MT	HT		P	P		E	4	7
Entrust	5	ST	MT		P	G		G	4	7
Exirel	28		ST		G	G		G	12	3
Miticide										
Apollo	10A	ST	ST	E					12	21

¹ P = poor. F = fair. G = good. E = excellent. ST = slightly toxic. MT = moderately toxic. HT = highly toxic. NT = not toxic.

² Specific preharvest intervals or restricted entry intervals vary for different formulations, application rates, or geographical location. See product labels for details.

Peach Spray Schedule

■ Peach Dormant

After leaves drop in the fall or before buds swell in spring.

Pest/Problem	Material	Rate/Acre	Comments
peach leaf curl	To effectively control peach leaf curl, fungicide must be applied before bud swell. Best control is achieved by applying in late autumn at leaf fall.		
	Bordeaux mixture	See label	Using copper at the dormant stage may also reduce the overwintering inoculum of the bacteria that cause bacterial canker and bacterial spot.
	Bravo Weather Stik	3-4 pts.	Other formulations and generics available.
	copper hydroxide (Kocide 3000, Champ)	3.5-5 lbs.	Using copper at the dormant stage may also reduce the overwintering inoculum of the bacteria that cause bacterial canker and bacterial spot.
	copper oxychloride (C-O-C-S WDG)	12-15.6 lbs.	
	Ferbam 76WDG	4.5 lbs.	
	Syllit FL	3 pts.	Use 3 pints per acre just before buds swell in the spring only. Not labeled for fall application.
Ziram 76DF	3.75-8 lbs.		
Phytophthora crown, collar, and root rot	Ridomil Gold SL	2 qts. or 1.5 oz. per 1,000 sq. ft.	Apply under tree canopy in spring before growth starts. See Phytophthora Root, Crown, and Collar Rots, page 67.
Mites	superior oil		
San Jose scale	Esteem 35WP	4-5 oz.	
	Assail 30SG	5.3-8 oz.	Apply with horticultural oil.

■ Peach Pink

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight)	Aframe	14 fl. oz.	
	Bravo Weather Stik	3.1-4.1 pts.	Other formulations and generics available.
	Captan 80WDG	2.5-5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Elevate 50WDG	1-1.5 lbs.	
	Elite 45WSP	6 oz.	
	Fontelis	14-20 fl. oz.	Do not exceed 61 fl. oz./acre per year.
	Gem 500SC	1.9-3.8 oz.	Contains the same active ingredient as Flint, but is labeled for stone fruit.
	Indar 2F	6 oz.	Apply in a minimum of 50 gals. of water per acre.
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-10 oz.	PHI=35 days.
	Luna Sensation	5-7.6 fl. oz.	PHI=1 day.
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Meteor	1-2 pts.	Apply at bud break when tissue is susceptible.
Orbit	4 fl. oz.	Apply in a minimum of 50 gals. of water per acre.	
Pristine 38WG	10.5-14.5 oz.		

(continued)

Peach Pink (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight) (continued)	Topguard EQ	6-8 oz.	This is a premix of azoxystrobin and flutriafol.
	Quadris Top	12-14 fl. oz.	Effective for brown rot management. Contains azoxystrobin, which is known to be phytotoxic to certain apple varieties. Do not use where drift might affect apples.
	Quash 50WDG	2.5-3.5 oz.	Do not exceed 3 applications per season. Do not exceed 12 oz./acre per season. Do not exceed 2 applications after petal fall.
	Quilt Xcel	14 fl. oz.	Effective for brown rot management. Contains azoxystrobin, which is known to be phytotoxic to certain apple varieties. Do not use where drift might affect apples.
	Rally 40WSP	2.5-6 oz.	Do not exceed 3.25 lbs. per season.
	Rovral 50 WP	1-2 pts.	Do not exceed 2 applications per season. May not be applied after petal fall on stone fruit.
	Scala 5SC	9-18 fl. oz.	
	wettable sulfur 90%	10-30 lbs.	
	Tilt 3.6EC	4 fl. oz.	
	Topguard	14 fl. oz.	Also controls scab.
	Topguard EQ	6-8 oz.	Also controls powdery mildew and scab.
	Topsin-M 70WSB PLUS	1.5 lbs.	Topsin-M and the sterol-inhibiting fungicides (Rally, Indar, and Orbit) should always be alternated or combined with another fungicide (such as captan) to minimize the development of resistance. Topsin-M also is available in a flowable formulation (4.5 FL). Make one application at popcorn (pink, red or early white bud) and a second application at full bloom. If weather conditions are 60-70 degrees and wet, make an additional application at petal fall.
	Captan 80WDG	2.5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Vanguard 75WG	5 oz.	Designated as reduced-risk by the EPA.
Ziram 76DF	4.5-8 lbs.	Under severe disease pressure, use the higher rate.	
tarnished plant bug, stink bugs	As pink begins to show, examine trees for tarnished plant bug. If present, apply insecticides. Make application before any blooms open.		
	Asana XL 0.66EC	4.8-14.5 fl. oz.	
	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Pounce 25WP	6.4-16 oz.	Not labeled for stink bug control.
	Warrior II	1.28-2.56 fl. oz.	
	Proaxis 0.5EC	2.56-5.12 fl. oz.	
	Baythroid XL	2-2.4 fl. oz.	
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
	Sevin XLR Plus (4L)	2-3 qts.	
	Beleaf 50SG	2-2.8 oz.	Not labeled for stink bug control.
Assail 30SG	5.3-8 oz.		

(continued)

Peach Pink (continued)

Pest/Problem	Material	Rate/Acre	Comments
oriental fruit moth (monitoring)	Refer to Peach Petal Fall, page 53. Put pheromone traps to monitor oriental fruit moth 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 Mating Disruption for Peach Pests, page 67.
	CheckMate OFM	108-150 dispensers	
	CheckMate OFM-F Sprayable pheromone	1.32-2.93 fl. oz.	

■ **Peach Full Bloom**

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight)	Abound	12-15.5 fl. oz.	This product contains azoxystrobin and may be phytotoxic if applied to apples. For brown rot blossom blight, begin applications at bloom and continue through petal fall.
	Aframe	14 fl. oz.	
	Bravo Weather Stik	3.1-4.1 pts.	Other formulations and generics available.
	Captan 80WDG	2.5-5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Elevate 50WDG	1-1.5 lbs.	
	Elite 45WSP	6 oz.	
	Fontelis	14-20 fl. oz.	
	Gem 500SC	1.9-3.8 oz.	Contains the same active ingredient as Flint, but is labeled for stone fruit.
	Indar 2F	2 oz.	Apply in a minimum of 50 gals. of water per acre.
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-8 oz.	
	Luna Sensation	5-7.6 fl. oz.	PHI=1 day.
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Orbit	4 fl. oz.	Apply in a minimum of 50 gals. of water per acre.
	Pristine 38WG	10.5-14.5 oz.	
	Quadris Top	12-14 fl. oz.	Effective for brown rot management. Contains azoxystrobin, which is known to be phytotoxic to certain apple varieties. Do not use where drift might affect apples. Under high disease pressure and/or with very susceptible varieties, applications may be needed at 50-75% bloom and petal fall. Do not exceed 2 sequential applications before switching to a non-Group 11 fungicide.
Quash 50WDG	2.5-3.5 oz.	Do not exceed 3 applications per season. Do not exceed 12 oz./acre per season. Do not exceed 2 applications after petal fall.	

Peach Full Bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight) (continued)	Quilt Xcel	14 fl. oz.	Effective for brown rot management. Contains azoxystrobin, which is known to be phytotoxic to certain apple varieties. Do not use where drift might affect apples. Under high disease pressure and/or with very susceptible varieties, applications may be needed at 50-75% bloom and petal fall. Do not exceed 2 sequential applications before switching to a non-Group 11 fungicide.
	Rally 40WSP	2.5-6 oz.	Do not exceed 3.25 lbs. per season.
	Rovral	1-2 pts.	Do not exceed 2 applications per season. May not be applied after petal fall on stone fruit. Contains iprodione. Also sold as Meteor.
	Scala 5SC	9-18 fl. oz.	For brown rot control of all stone fruit except cherry.
	wettable sulfur 95%	10-30 lbs.	
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Also controls powdery mildew and scab.
	Topsin-M 70WSB PLUS	1.5 lbs.	Topsin-M and the sterol-inhibiting fungicides (Rally, Indar, and Orbit) should always be alternated or combined with another fungicide (such as captan) to minimize the development of resistance. Topsin-M also is available in a flowable formulation (4.5 FL).
	Captan 80WDG	2.5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Vanguard 75WG	5 oz.	
Ziram 76DF	4.5-8 lbs.		
insects, mites	SAVE THE BEES! Do not apply insecticides during bloom.		

■ **Peach Petal Fall**

Pest/Problem	Material	Rate/Acre	Comments
brown rot	Same as for Peach Pink, pages 49-50. Do not apply Rovral after petal fall. If previously using Rally, rotate to another product with a different mode of action.		
bacterial spot	FireLine	12 oz.	If bacterial spot has been a problem, apply at 7-day intervals beginning at petal fall (<5% shuck split) through first cover.
	Mycoshield	12 oz.	
peach scab	Abound	12.0-15.5 fl. oz.	Begin applications at petal fall and continue at 7-14 day intervals in rotation with other products. For peaches, do not exceed 15.5 fl. oz. for scab control.
	Aframe	14 fl. oz.	Generic version of Quilt Xcel.
	Bravo Weather Stik	3.1-4.1 oz.	Other formulations and generics available.
	Captan 80WDG	2.5-5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Flint Extra	2.5-3.8 fl. oz.	Effective against scab. Suppresses brown rot.
	Gem 500SC	1.9-3.8 fl. oz.	
	Indar 2F	6 fl. oz.	

(continued)

Peach Petal Fall (continued)

Pest/Problem	Material	Rate/Acre	Comments
peach scab (continued)	Luna Experience	6-8 oz.	PHI=35 days.
	Luna Sensation	5-7.6 fl. oz.	PHI=1 day.
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Pristine 38WG	10.5-14.7 oz.	
	Quilt Xcel	14 fl. oz.	Effective for brown rot management. Contains azoxystrobin, which is known to be phytotoxic to certain apple varieties. Do not use where drift might affect apples. Under high disease pressure and/or with very susceptible varieties, applications may be needed at 50-75% bloom and petal fall. Do not exceed 2 sequential applications before switching to a non-Group 11 fungicide.
	Rovral	1-2 pts.	Contains iprodione. Also sold as Meteor. Do not apply after petal fall.
	Scala SC	9-18 oz.	For brown rot control of all stone fruit except cherry.
	Topguard	14 oz.	Do not use within 7 days of harvest.
lesser peachtree borer	Topguard EQ	6-8 oz.	This is a premix of azoxystrobin and flutriafol.
oriental fruit moth, plum curculio, stink bugs, tarnished plant bug	Asana, Baythroid, Pounce, Actara, Mustang Maxx, Warrior, Proaxis, Danitol, or Assail as at Peach Pink, pages 50-51 OR		
	Exirel	10-20.5 fl. oz.	Not labeled for tarnished plant bug or stink bugs. User lower rate for oriental fruit moth; use higher rate for plum curculio.
	Imidan 70WP	2.13-4.25 lbs.	
oriental fruit moth	Any of the products listed above for three species combined OR		
	Entrust 80WP	4-8 fl. oz.	
	Entrust 2SC	4-6 fl. oz.	
	Intrepid 2F	10-16 fl. oz.	
	Altacor 35WDG	3-4.5 oz.	
	Delegate 25WG	6-7 oz.	
	Rimon 0.83EC	20-40 fl. oz.	

■ Peach Shuck Split

Pest/Problem	Material	Rate/Acre	Comments
brown rot, scab	Abound	12-15.5 fl. oz.	Begin applications at petal fall and continue at 7-14 day intervals in rotation with other products.
	Bravo Weather Stik	3.1-4.1 pt	This should be the last Bravo application to minimize damage to fruit finish. Other formulations and generics available.
	Captan 80WDG	2.5-5 lbs.	See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32. Captan at 2.5 lbs. is a good tank mix partner if disease and fungicide resistance risk are high.
	Flint Extra	2.5-3.8 fl. oz.	Effective against powdery mildew and scab. Suppresses brown rot.

(continued)

Peach Shuck Split (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot, scab (continued)	Fontelis	14-20 fl. oz.	
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-10 oz.	PHI=35 days.
	Luna Sensation	5-7.6 fl. oz.	PHI=1 day.
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan. Can be used day of harvest.
	Pristine 38WG	10.5-14.5 oz.	
	Quash 50WDG	3.5-4 oz.	
	wettable sulfur 90%	10-30 lbs.	
	Topsin-M 70WSB PLUS	1.5 lbs.	Topsin-M and the sterol-inhibiting fungicides (Rally, Indar, and Orbit) should always be alternated or combined with another fungicide (such as captan) to minimize the development of resistance. Topsin-M also is available in a flowable formulation (4.5 FL).
	Captan 80WDG	2.5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Also controls powdery mildew.
Ziram 76DF	4.5-8 lbs.		
powdery mildew	Captan 80WDG	2.5-5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Flint Extra	2.5-3.8 fl. oz.	Effective against powdery mildew and scab. Suppresses brown rot.
	Fontelis	14-20 fl. oz.	
	Gem 25WG	4-8 oz.	
	Luna Experience	6-17 oz.	Also effective against brown rot and scab. Do not exceed 34 oz. per acre per year.
	Luna Sensation	5-7.6 fl. oz.	PHI=1 day.
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Pristine 38WG	10.5-14.5 oz.	
	Quash 50WDG	3.5-4 oz.	
	Quintec 2.08F	7 fl. oz.	
	Rally 40WSP	2.5-6 oz.	
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Also controls powdery mildew and scab.
bacterial spot	FireLine	12 oz.	
	Mycoshield 17WP	12 oz.	See Bacterial Spot of Peach, page 67. The use rate for Mycoshield on the label reads, "0.75-1.5 lbs per 50 to 200 gallons of water per acre." See the label for additional information. Not effective once disease establishes and begins to progress. Some research shows modest efficacy when Mycoshield is combined with copper; copper is phytotoxic, so use combinations cautiously.
plum curculio, stink bugs, tarnished plant bug	Same as for Peach Petal Fall, page 53.		

(continued)

Peach Shuck Split *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
plum curculio	Any of the products listed at Peach Petal Fall for the three species combined, page 53 OR		
	Avaunt 30WG	5-6 oz.	
	Belay2.13	6 fl. oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Apta 1.31EC	21-27 fl. oz.	
oriental fruit moth	Same for Peach Petal Fall, page 53.		
green peach aphid	Admire Pro 4.6F	1.4-2.8 fl. oz.	
	Sivanto	7-14 fl. oz.	
	Closer SC	1.5-2.75 fl. oz.	
	Beleaf 50SG	2-2.8 oz.	
	Movento 2SC	6-9 fl. oz.	
European red mite, twospotted spider mite	Acramite 50WS	0.75-1 lb.	Use low rate for twospotted mite, high rate for European red mite.
	Apollo 4SC	2-8 oz.	European red mite only
	Nexter 75WP	4.4-10.67 oz. (1-3 bags)	Controls European red mite at 4.4-5.2 oz./acre, and twospotted spider mite at 8.8-10.67 oz./acre.
	Savey 50DF	3-6 oz.	European red mite only.
	Envidor 2SC	16-18 fl. oz.	
	Agri-Mek 0.15EC	10-20 fl. oz.	Most effective if applied before leaves harden off.
	Zeal 72WP	2-3 fl. oz.	
	Onager 1EC	12-24 fl. oz.	
	Portal XLO	2 pts.	

■ Peach First Cover

7-10 days after shuck split.

Pest/Problem	Material	Rate/Acre	Comments
brown rot, scab	Abound	12.0-15.5 fl. oz.	Begin applications at petal fall and continue at 7-14 day intervals in rotation with other products.
	Captan 80WDG	2.5-5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32. Do not exceed 30 lbs. of captan per season.
	Flint Extra	2.5-3.8 fl. oz.	Effective against powdery mildew and scab. Suppresses brown rot.
	Fontelis	14-20 fl. oz.	
	Gem 500SC	1.9-3.8 oz.	
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-10 oz.	Do not exceed 34 oz. per acre per year.
	Luna Sensation	5-7.6 fl. oz.	PHI=1 day.
	Merivon	4-6.7 fl. oz.	Do not apply with an EC or oil-based products. Do not apply with Bravo or captan.
	Pristine 38WG	10.5-14.5 oz.	
	Quadris Top	12-14 fl. oz.	Effective for brown rot management. Contains the fungicide azoxystrobin, which is known to be phytotoxic to certain varieties of apple. Do not be use where drift might affect apples.
	Quash 50WDG	3.5-4 oz.	

(continued)

Peach First Cover (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot, scab (continued)	Quilt Xcel	14 fl. oz.	Effective for brown rot management. Contains the fungicide azoxystrobin, which is known to be phytotoxic to certain varieties of apple. Do not be use where drift might affect apples.
	wettable sulfur 90%	10-30 lbs.	
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Also controls powdery mildew and scab.
	Topsin-M 70WSB PLUS Captan 80WDG	1.5 lbs. 2.5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Ziram 76DF	4.5-8 lbs.	
powdery mildew	Flint Extra	2.5-3.8 fl. oz.	Effective against powdery mildew and scab. Suppresses brown rot.
	Fontelis	14-20 fl. oz.	
	Gem 5005C	1.9-3.8 oz.	Provides excellent peach scab control but is weak on brown rot.
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-10 oz.	Do not exceed 34 oz. per acre per year.
	Luna Sensation	5-7.6 fl. oz.	PHI=1 day.
	Merivon	4-6.7 fl. oz.	Do not apply an EC or oil-based products. Do not apply with Bravo or captan.
	Pristine 38WG	10.5-14.5 oz.	
	Quadris Top	12-14 fl. oz.	Effective for brown rot management. Contains the fungicide azoxystrobin, which is known to be phytotoxic to certain varieties of apple. Do not use where drift might affect apples.
	Quash 50WDG	3.5-4 fl. oz.	
	Quilt Xcel	14 fl. oz.	Effective for brown rot management. Contains the fungicide azoxystrobin, which is known to be phytotoxic to certain varieties of apple. Do not use where drift might affect apples.
	Quintec 2.08F	7 fl. oz.	
	Rally 40WSP	2.5-6 oz.	Can be applied at 10- to 14-day intervals for powdery mildew control until terminal growth stops.
	Scala SC	9-18 oz	For brown rot control of all stone fruit except cherry.
	Topguard	14 oz.	PHI=7 days.
	Topguard EQ	6-8 oz.	PHI=7 days.
wettable sulfur 90%	10-30 lbs.		
bacterial spot	FireLine	12 oz.	
	Kocide 2000/3000	0.75 lbs.	Only recommended if bacterial spot is a recurring issue. Post-bloom application pplied at first and second cover sprays. NOTE: Do not spray 3 weeks prior to harvest. Use only recommended rates. Spotting of leaves and defoliation may occur from use in cover sprays.
	Mycoshield 17WP	1-1.5 lbs.	Use lower rates — higher concentrations may be phytotoxic. Essential to spray entire tree once a week.
plum curculio, oriental fruit moth, stink bugs, tarnished plant bug	Same as for Peach Petal Fall, page 53.		

Peach First Cover *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
oriental fruit moth	Same as for Peach Petal Fall, page 53.		
European red mite	Same as for Peach Shuck Split, page 55.		
lesser peachtree borer	Control of the first generation of lesser peachtree borer with trunk sprays is during the time of peak moth flight, generally from early May to early June, depending on latitude and spring temperatures. See Borers of Peach, Cherry, and Plum Trees, page 68.		

■ Peach Second Cover

10 days after first cover.

Pest/Problem	Material	Rate/Acre	Comments
brown rot, scab	Same as for Peach First Cover, page 55. Luna Experience has a 35-day PHI.		
bacterial spot	Kocide 2000/3000	0.75 lb.	Only recommended if bacterial spot is a recurring issue. Post-bloom application applied at first and second cover sprays. NOTE: Do not spray 3 weeks prior to harvest. Use only recommended rates. Spotting of leaves and defoliation may occur from use in cover sprays.
	Mycoshield 17WP	1-1.5 lbs.	Use lower rates — higher concentrations may be phytotoxic. Essential to spray entire tree once a week.
powdery mildew	Same as for Peach First Cover, page 56.		
plum curculio, oriental fruit moth, catfacing insects	Same as for Peach Petal Fall, page 53.		
mites	Same as for Peach Shuck Split, page 55.		

■ Peach Third, Fourth, and Additional Covers

Apply at 10- to 14-day intervals.

Pest/Problem	Material	Rate/Acre	Comments
brown rot, scab	Same as for Peach First Cover, page 55. Scab requires control until fruit is within 40 days of harvest.		
powdery mildew	Same as for Peach First Cover, page 56.		
oriental fruit moth	Same as for Peach Petal Fall, page 53.		
mites	Same as for Peach Shuck Split, page 55.		
San Jose scale	Esteem 35WP	4-5 oz.	Time application for first activity of crawlers.
	Diazinon AG600 WBC	12.75 fl. oz. per 100 gals.	
	Centaur 70WDG	34.5 oz.	
	Movento 2SC	6-9 oz.	
	Assail 30SG	5.3-8 oz.	
	Belay 2.13SC	6 fl. oz.	
	Admire Pro 4.6F	1.4-2.8 fl. oz.	
peachtree borer	If not using Isomate PTB Dual for mating disruption, peachtree borer is best controlled by a trunk drench at the time of peak moth flight, usually in early August. See Borers of Peach, Cherry, and Plum Trees, page 68.		

■ Peach Pre-harvest

Apply according to label directions beginning 3 weeks before harvest.

Pest/Problem	Material	Rate/Acre	Comments
brown rot	Captan 80WDG	5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32. Do not exceed 30 lbs. of captan per season.
	Flint Extra	2.5-3.8 fl. oz.	Suppresses brown rot. PHI= 1 day.
	Fontelis	14-20 fl. oz.	
	Indar 2F	6 oz.	

(continued)

Peach Pre-harvest (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot (continued)	Inspire Super	16-20 fl. oz.	
	Luna Sensation	5-7.6 oz.	PHI=1 day.
	Merivon	4-6.7 fl. oz.	Do not apply with an EC or oil-based products. Do not apply with Bravo or captan.
	Orbit	4 fl. oz.	
	Pristine 38WG	10.5-14.5 oz.	
	Quadris Top	12-14 fl. oz.	Effective for brown rot management. Contains the fungicide azoxystrobin, which is known to be phytotoxic to certain varieties of apple. Do not use where drift might affect apples.
	Quash 50 WDG	3.5-4 oz.	
	Quilt Xcel	14 fl. oz.	Effective for brown rot management. Contains the fungicide azoxystrobin, which is known to be phytotoxic to certain varieties of apple. Do not use where drift might affect apples.
	Topguard	14 oz.	PHI=7 days.
	Topguard EQ	6-8 oz.	PHI=7 days.
	Topsin-M 70WSB PLUS Captan 80WDG	1.5 lbs. 2.5 lbs.	Pre-harvest use, restrictions, and limitations vary by product; refer to label for details. Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
Ziram 76DF	4.5-8 lbs.		
oriental fruit moth, Japanese beetle, green June beetle	Sevin XLR Plus (4L)	2-3 qt.	Can be used up to three days before harvest. Oriental fruit moth pheromone traps indicate the need for control.
	BeetleGONE!	1-17.5 lbs.	
	Assail 30SG	5.3-8 oz.	
	Exirel 0.83SE	10-20.5 fl. oz.	Use higher rate for Japanese beetle.
spotted wing Drosophila	Baythroid XL 1EC	1.28- 4 fl. oz.	
	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Sevin XLR Plus	2-3 qts.	
	Entrust 2SC	4-8 fl. oz.	
	Entrust 80WP	1.25-2.5 oz.	
	Malathion	See label	Formulations and rates vary by state. Check labels for specific information.
	Pyganic 5EC	4.5-17 fl. oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	

Efficacy of Selected Insecticides and Acaricides Against Peach Insects and Mites¹

Product	IRAC code	predator mite toxicity	bee toxicity	European red mite	green peach aphid	plum curculio	oriental fruit moth	peachtree borers	Japanese beetle	plant bugs / stink bugs	San Jose scale	spotted wing Drosophila	REI (hours)	PHI (days)
Organophosphates														
Diazinon	1B	ST	HT	P	G	G	G		G	P	F	G	96	21
Imidan	1B	ST	HT		F	G	E	P	G	P	P	E	72	14
Lorsban	1B	MT	HT					E						
Carbamates														
Sevin	1A	HT	HT			F	F	P	E	F	P	G	12	3
Lannate	1A	HT	HT		G	F	F		F	E		E	²	4
Neonicotinoids														
Actara	4A	MT	HT		E	G			E	G			12	14
Admire Pro	4A	MT	HT		E	F			F		F		12	0/21 ²
Assail	4A	ST	MT		E	E	E		F	F	F	F	12	14 ²
Belay	4A		HT		E	G			E	E	G		12	21
Closer	4C	ST	HT		E						F ³		12	7
Sivanto	4D		ST		E								4	14
Insect Growth Regulators														
Centaur	16	ST	ST								E		12	14
Esteem	7C	ST	ST				F			P	E		12	14
Intrepid	18	ST	ST				G		F				4	7
Rimon	15	ST	ST				E						12	8
Pyrethroids														
Asana	3A	HT	HT		F	G	E ⁴	G	E	E		E	12	14 ²
Baythroid	3A	HT	HT			G	E ⁴	G	E	E		E	12	7
Danitol	3A	HT	HT		F	G	E ⁴		E	E		E	24	3
Mustang Maxx	3A	HT	HT			E	E ⁴		E	E		E	12	14
Pounce	3A	HT	HT		G	G	E ⁴	G	E	G			12	14 ²
Proaxis	3A	HT	HT		G	G	G ⁴		E	E		E	24	14
Pyganic	3A	ST	ST		F	P	P		F			P	12	0
Warrior	3A	HT	HT		G	G	G ⁴	G	E	E		E	24	14

(continued)

Efficacy of Selected Insecticides and Acaricides Against Peach Insects and Mites¹ (continued)

Product	IRAC code	predator mite toxicity	bee toxicity	European red mite	green peach aphid	plum curculio	oriental fruit moth	peachtree borers	Japanese beetle	plant bugs / stink bugs	San Jose scale	spotted wing Drosophila	REI (hours)	PHI (days)
Other														
Altacor	28	ST	ST			P	E						4	10
Apta	21A		HT			G						F	12	14
Avaunt	22	MT	HT			G	F	F	G				12	14
Delegate	5	MT	HT			P	E					E	4	14
Entrust	5	ST	MT			P	F					G	4	14
Exirel	28		ST			G	E		G			G	12	3
Movento	23		MT		G						G		24	7
Miticides														
Acramite	un	ST	MT	F									12	3
Agri-Mek	6	MT	HT	G									12	21
Apollo	10A	ST	ST	E									12	21
Envidor	23	MT	ST	E									12	7
Nexter	21A	HT	MT	G									12	7
Onager	10A	ST	ST	E									12	7
Portal XLO	21A	MT	ST	E									12	7
Savey	10A	ST	ST	E									12	28
Zeal	10B	MT	ST	E									12	7

¹ P = poor. F = fair. G = good. E = excellent. ST = slightly toxic. MT = moderately toxic. HT = highly toxic. NT = not toxic.

² Specific preharvest intervals or restricted entry intervals vary by formulations, application rates, and geographical locations. See product labels for details.

³ Suppression only.

⁴ Pyrethroid-resistant populations of oriental fruit moth are not controlled by this insecticide.

Plum Spray Schedule

■ Plum Dormant

Before buds break in the spring.

Pest/Problem	Material	Rate/Acre	Comments
bacterial blast	copper compounds	See label	Early-season copper applications for bacterial blast are effective for controlling bacterial spot populations, but also likely to induce phytotoxicity if applied to green tissue. The efficacy of this treatment is questionable.
black knot	copper compounds	See label	Check labels carefully because they change. If labeled, apply at bud swell up to early bloom for early-season disease suppression. Prune out all black knots during the dormant period, making cuts 6-8 inches below any knots. Remove these prunings from the orchard and burn or bury them.
	Bordeaux mixture	See label	Using copper at dormant stage may also reduce the overwintering inoculum of the bacteria that cause bacterial canker and bacterial spot.
	copper hydroxide (Kocide 3000, Champ)	3.5-5 lbs.	
	Cuprofix Ultra 40 Disperss	3-3.75 lbs.	
	Bravo Weather Stik	3-4 pts.	Other formulations and generics available.
European red mite, scale insects	superior oil	2 gals. per 100 gals.	Apply when temperatures are above 40°F — never during freezing weather.

■ Plum Pre-bloom

Pest/Problem	Material	Rate/Acre	Comments
black knot	See Plum Dormant		
	Topsin-M 70WSB	1-1.5 lbs.	Apply at pre-bloom and petal fall.
brown rot (blossom blight), black knot	Bravo Weather Stik	3.1-4.1 pts.	Other formulations and generics available.
	Topsin-M 70WSB PLUS	1.5 lbs.	Always combine Topsin-M with another fungicide such as captan to minimize the development of resistance. It is also available as a flowable formulation (4.5 FL).
	Captan 80WDG	3.75 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
brown rot (blossom blight)	Abound	12.0-15.5 fl. oz.	Begin applications at petal fall and continue at 7-14 day intervals in rotation with other products.
	Bravo Weather Stik	3.1-4.1 pts.	Other formulations and generics available.
	Captan 80WDG	5.0 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32. Do not exceed 33.75 lbs. per season.
	Elevate 50WDG	1-1.5 lbs.	
	Flint Extra	2.5-3.8 fl. oz.	Begin applications at bud stage.
	Fontelis	14-20 fl. oz.	Do not exceed 61 fl. oz./acre per year.
	Indar 2F	6 oz.	Begin application at red bud stage.
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-10 oz.	
Luna Sensation	5-7.6 fl. oz.	Also controls fruit rot and powdery mildew.	

(continued)

Plum Pre-bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight) (continued)	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Meteor	1-2 pts.	Contains iprodione, the same active ingredient as Rovral. Do not exceed 2 applications o per season. Cannot be applied after petal fall on stone fruit.
	Orbit	4 fl. oz.	
	Pristine 38WG	10.5-14.5 fl. oz.	
	Quadris Top	12-14 fl. oz.	Effective for brown rot management. It contains the fungicide azoxystrobin, which is known to be phytotoxic to certain apple varieties. Do not use this product where drift might affect apples.
	Quash 50WDG	2.5-3.5 oz.	Do not exceed 3 applications per season. Do not exceed 12 oz./acre per season. Do not exceed 2 applications after petal fall. Do not apply to Stanley-type plums.
	Rally 40WSP	2.5-6 oz.	Registered for control of brown rot (blossom blight) and powdery mildew. Do not exceed 2.75 lbs./acre per season. Do not apply within 7 days of harvest.
	Rovral 50WP	1-2 lbs.	Do not exceed 2 applications o per season. Cannot be applied after petal fall on stone fruit.
	Scala SC	9-18 fl. oz.	
	wettable sulfur 90%	10-30 lbs.	
	Tilt 3.6EC	3.6-6 oz.	
	Topsin-M 70WSB PLUS Captan 80WDG	1.5 lbs. 2.5- lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Start applications at 1-5% bloom, and then at 50-100%.
	Vanguard 75WG	5 oz.	Begin application at green tip and again at full bloom.

■ Plum Full Bloom

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight), black knot	Same as at Plum Pre-bloom, pages 61-62.		
brown rot (blossom blight)	Same as at Plum Pre-bloom, pages 61-62.		
insects, mites	SAVE THE BEES! Do not apply insecticides during bloom.		

■ Plum Petal Fall

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight), black knot	Same as at Plum Pre-bloom, pages 61-62.		
brown rot (blossom blight)	Same as at Plum Pre-bloom, pages 61-62. If previously using Rally, rotate to another product with a different mode of action.		
plum curculio, oriental fruit moth	Failure to control plum curculio may result in an increase in brown rot.		
	Imidan 70WP	2.13-4.25 lbs.	
	Asana XL	4.8-14.5 fl. oz.	
	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Warrior II	1.28-2.56 fl. oz.	
	Baythroid XL	2.4-2.8 fl. oz.	
	Proaxis 0.5EC	2.56-5.12 fl. oz.	
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
	Avaunt 30WDG	5-6 oz.	Use 6 oz. rate for oriental fruit moth.
	Assail 30SG	5.3-8 oz.	
Exirel 0.83SE	10-20.5 fl. oz.	Use 13.5-20.5 fl. oz. for plum curculio	
oriental fruit moth	Any of the products listed above for two species combined OR		
	Intrepid 2F	10-16 fl. oz.	
	Entrust 80WP	1.25-2.5 oz.	
	Entrust 2SC	4-8 fl. oz.	
	Altacor 35WDG	3-4.5 fl. oz.	
	Delegate 25WG	6-7 oz.	
	Rimon 0.83EC	20-40 fl. oz.	

■ Plum Shuck Split

Pest/Problem	Material	Rate/Acre	Comments
brown rot, black knot	Same as at Plum Pre-bloom except Roval, pages 61-62. Rovral cannot be applied after petal fall.		
brown rot	Abound	12.0-15.5 fl. oz.	Begin applications at petal fall and continue at 7- to 14-day intervals in rotation with other products.
	Bravo Weather Stik	3.1-4.1 pts.	Other formulations and generics available. Cannot be applied past shuck split.
	Captan 80WDG	3.75 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Luna Experience	6-10 oz.	PHI= 35 days.
	Luna Sensation	5-7.6 fl. oz.	Also controls fruit rot and powdery mildew.
	Merivon	4-6.7 oz.	
	Orbit	4 oz.	
	Pristine 38WG	10.5-14.5 fl. oz.	
	Quadris Top	12-14 oz.	Effective for brown rot management. It contains the fungicide azoxystrobin, which is known to be phytotoxic to certain apple varieties. Do not use this product where drift might affect apples.

(continued)

Plum Shuck Split *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
brown rot <i>(continued)</i>	wettable sulfur 90%	10-30 lbs.	
	Topsin-M 70WSB PLUS	1.5 lbs.	
	Captan 80WDG	2.5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
plum curculio, oriental fruit moth	Same as at Plum Petal Fall, page 63.		
mites	Acramite 50WS	0.75-1 lb,	
	Nexter 75WP	4.4-10.67 oz.	
	Savey 50DF	3-6 oz.	Do not exceed 1 application per year.
	Envidor 25C	16-18 fl. oz.	
	Agri-Mek 0.15EC	10-20 fl. oz.	
	Onager 1EC	12-24 oz.	
	Zeal 72WP	2-3 oz.	
	Portal XLO	2 pts.	

■ Plum First Cover Spray

7-10 days after shuck split.

Pest/Problem	Material	Rate/Acre	Comments
brown rot, black rot	Same as at Plum Shuck Split except Roval, page 64. Rovral cannot be applied after petal fall. Bravo cannot be applied after shuck split.		
plum curculio, oriental fruit moth	Same as at Plum Petal Fall, page 63.		
peachtree borers	See Borers of Peach, Cherry, and Plum Trees, page 68.		

■ Plum Second and Additional Cover Sprays

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

Pest/Problem	Material	Rate/Acre	Comments
brown rot	Same as at Plum Shuck Split, page 65. Luna Experience has a 35-day PHI. Orbit applied to Stanley prune plums has a 21-day PHI.		
plum curculio, oriental fruit moth	Same as at Plum Petal Fall, page 63.		
Japanese beetle	Sevin XLR Plus (4 L)	2-3 qts.	
	Admire Pro 4.6F	1.4-2.8 fl. oz.	
	Warrior II	1.28-2.56 fl. oz.	
	Assail 30SG	5.3-8 oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	

■ Plum Pre-harvest Sprays

Beginning 3-4 weeks before harvest.

Pest/Problem	Material	Rate/Acre	Comments
brown rot	Captan 80WDG	3.75 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
	Flint Extra	2.5-3.8 fl. oz.	Suppressive against brown rot. PHI=1 day.
	Fontelis	14-20 fl. oz.	
	Indar 2F	6 oz.	
	Inspire Super	16-20 fl. oz.	PHI=2 days.
	Luna Sensation	5-7.6 fl. oz.	Also controls fruit rot and powdery mildew. PHI= 1 day.
	Merivon	4-6.7 fl. oz.	Do not apply with EC or oil-based products. Do not apply with Bravo or captan. Do not use nonionic adjuvants that acidify or enhance penetration within 2 weeks of harvest. PHI= 1 day.
	Pristine 38 WG	10.5-14.5 fl. oz.	PHI= 1 day.
	Quadris Top	12-14 fl. oz.	Effective for brown rot management. It contains the fungicide azoxystrobin, which is known to be phytotoxic to certain apple varieties. Do not use this product where drift might affect apples. PHI=0 days.
	Topguard	14 fl. oz.	
spotted wing Drosophila	Topsin-M 70WSB PLUS	1.5 lbs.	Pre-harvest use, restrictions, and limitations are variable according to product; refer to label for details.
	Captan 80WDG	2.5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.
spotted wing Drosophila	Baythroid XL 1EC	2.4-2.8 fl. oz.	
	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Sevin XLR Plus (4 L)	2-3 qts.	
	Entrust 2SC	4-8 fl. oz.	
	Entrust 80WP	1.25-2.5 oz.	
	Pyganic 5EC	4.5-17 fl. oz.	

Efficacy of Selected Insecticides and Acaricides Against Plum Insects and Mites¹

Product	IRAC code	predator mite toxicity	bee toxicity	European red mite	plum curculio	oriental fruit moth	peachtree borers	Japanese beetle	spotted wing Drosophila	REI (hours)	PHI (days)
Organophosphates											
Imidan	1B	ST	HT		G	E	P	G	E	72	7
Lorsban	1B	MT	HT				E			24	14
Carbamates											
Sevin	1A	HT	HT		F	F	P	E	G	12	3
Neonicotinoids											
Admire Pro	4A	MT	HT		F			F		12	7
Assail	4A	ST	MT		E	E		F	F	12	7
Insect Growth Regulators											
Intrepid	18	ST	ST			G		F		4	7
Rimon	15	ST	ST			E				12	8
Pyrethroids											
Asana	3A	HT	HT		G	E ³	G	E	E	12	14
Baythroid	3A	HT	HT		G	E ³	G	E	E	12	7
Danitol	3A	HT	HT	F	G	E ³		E	E	24	3
Mustang Maxx	3A	HT	HT		E	E ³		E	E	12	14
Proaxis	3A	HT	HT		G	G ³		E	E	24	14
Pyganic	3A	ST	ST		P	P		F	P	12	0
Warrior	3A	HT	HT		G	G ³	G	E	E	24	14
Other											
Altacor	28	ST	ST		P	E				4	10
Avaunt	22	MT	HT		G	F	F	G		12	14
Delegate	5	MT	HT		P	E			E	4	7
Entrust	5	ST	MT		P	F			G	4	7
Exirel	28		ST		G	E		G	G	12	3
Miticides											
Acramite	un	ST	MT	F						12	3
Agri-Mek	6	MT	HT	G						12	21
Envidor	23	MT	ST	E						12	7
Nexter	21A	HT	MT	G						12	7
Onager	10A	ST	ST	E						12	7
Portal XLO	21A	MT	ST	E						12	7
Savey	10A	ST	ST	E						12	28
Zeal	10B	MT	ST	E						12	7

¹ P = poor. F = fair. G = good. E = excellent. ST = slightly toxic. MT = moderately toxic. HT = highly toxic. NT = not toxic.

² Specific preharvest intervals or restricted entry intervals vary for different formulations, application rates, or geographical locations. See product labels for details.

³ Pyrethroid-resistant populations of oriental fruit moth are not controlled by this insecticide.

Special Problems and Pests of Peach and Other Stone Fruit

Bacterial Canker of Sweet Cherry

Bacterial canker is a sporadic but serious problem on sweet cherries. It is generally less severe on tart cherries, plums, and prunes.

The disease is favored by cold, wet conditions during and shortly after bloom. Copper compounds are moderately effective in reducing pathogen populations and controlling the disease. Apply copper compounds according to the product label in the spring while trees are dormant.

If favorable conditions for the disease persist, then apply reduced-rate applications (25-35 percent of dormant rate) after budbreak but before bloom. You can add hydrated lime (6-9 lbs./acre) 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 strong winds blow the sand.

Planting cultivars that are resistant to bacterial spot provides the best control. In the past, various control programs have been tried that use foliar sprays of zinc sulfate plus lime, or fall applications of copper with or without lime. None of these programs offered reliable control and, in some cases, caused foliar and twig damage.

An antibiotic, oxytetracycline (Mycoshield or FireLine) provides good control when properly applied. For best results, you must use oxytetracycline at 12 oz. per 100 gals. of dilute spray. Use dilute or 2x; higher concentrates are not effective and may be phytotoxic.

Spraying the entire tree once per week is essential. If you spray only one side of the tree (alternate row middle), make certain to spray the other side of the tree within three to four days. Begin sprays at shuck split and continue at 7-day intervals until three weeks before harvest. Copper sprays, applied for peach leaf curl at leaf drop, also may help control bacterial spot.

For more information, see "Learning from Peach Bacterial Spot Epidemics: Potential Strategies for Reducing Fruit Losses" (David Ritchie, North Carolina State University), plantpathology.ces.ncsu.edu/wp-content/uploads/2013/06/Learning-from-Peach-Bacterial-Spot-Epidemics.pdf?fw=no.

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. Make applications just before growth starts in the spring and at two- to three-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 that contain phosphorous acid have been registered for use in the United States as nutritional supplements and "plant conditioners." Several of these products also are registered for use as fungicides for control of root and collar rot, caused by *Phytophthora* spp., on apple, pear, and stone fruit. Brand names for these products include Agri-Fos, ProPhyt, Phostrol, and Topaz. Several other products also may be available or introduced in the near future.

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

Mating Disruption for Peach Pests

Multiple mating disruption products are labeled for control of oriental fruit moth, lesser peachtree borer, and (greater) peachtree borer. They dispense

specific sex attractants that prevent male moths from locating and mating with females.

This approach works best in blocks at least 1-2 acres in size, where populations are low to moderate, and surrounding areas do not harbor large populations of the target pest. If you use mating disruption in smaller blocks, or in blocks adjacent to unmanaged populations of the target pest, we recommend border sprays and/or higher rates of dispensers.

Mating disruption controls only the target pests listed on each product label. Mating disruption has proven to be effective against oriental fruit moth (several dispenser types), and Isomate PTB Dual is effective against both lesser peachtree borer and (greater) peachtree borer.

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 help control borers; however, specific trunk and scaffold branch sprays are often required. Pheromone traps are available to monitor emergence of the adult stage (moth) of lesser peachtree borer and peachtree borer. Knowing the time of initial moth emergence and peak emergence can help you properly time insecticide applications, because insecticides target the hatching eggs laid by the newly emerged moths.

See *Insecticides Used to Manage Borers of Peach, Cherry, and Plum Trees*, page 69.

Periodical Cicadas

See *Periodical Cicadas*, page 30.

RainGard, Cherry Cracking Suppressant

RainGard is applied as a protective coating to decrease rainwater uptake by fruit to reduce cracking susceptibility.

Make the first application 4 weeks before anticipated harvest, and additional applications at 7- to 10-day intervals. Three weekly applications are much more effective at reducing rain cracking than a single application. Use 102 ounces of RainGard per 100 gal. per acre. Ground sprayer speed should not exceed 2 miles per hour. RainGard must cover all fruit for maximum crack prevention.

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

Borer	Material	Rate/Acre	Comments
lesser peachtree borer	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.		
	Asana XL 0.66EC	4.8-14.5 fl. oz.	
	Pounce 25WP	6.4-25.6 oz.	
	Warrior II	1.28-2.56 fl. oz.	
	Baythroid XL 1EC	1.4-2 fl. oz.	
	Lorsban Advanced 4EC	1.5-4 pts.	Apply to bark of scaffold branches and trunk, but do not allow to contact fruit. Where lesser peachtree borer has been a light to moderate problem, apply Lorsban to scaffold branches 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 the application earlier — about 14 days after emergence of first-generation moths begins (spray mid-May to early June). Do not exceed 1 application on peaches, plums, and nectarines. Do not exceed 3 applications on cherries. 14-day PHI for peaches, plums, and nectarines. 21-day PHI for cherries.
	Isomate-PTB Dual	150-250 dispensers	Deploy dispensers before moth flight begins (approximately mid-April). For more information, see Mating Disruption for Peach Pests, page 67.
peachtree borer	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.		
	Lorsban Advanced 4EC	1.5-4 pts.	Make a single spray directed at the base of the trunk at the time of peak moth emergence (usually in late July or early August). Do not exceed 1 application on peaches, plums, and nectarines. Do not exceed 3 applications on cherries. 14-day PHI for peaches, plums, and nectarines. 21-day PHI for cherries.
	Asana XL 0.66EC	4.8-14.5 fl. oz.	
	Warrior II	1.28-2.56 fl. oz.	
	Isomate-P	100-250 dispensers	Deploy dispensers before moth flight begins (approximately early June). For more information, see Mating Disruption for Peach Pests, page 67.
	Isomate-PTB Dual	150-250 dispensers	Deploy dispensers before moth flight begins (approximately early June), or by mid-April if control of lesser peachtree borer is also desired. For more information, see Mating Disruption for Peach Pests, page 67.
peachtree borer (preplant dip)	Lorsban 75WG	1.33-2 lbs.	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.
	Lorsban Advanced 4E	3 qts.	
shot-hole borer	Insecticide sprays are not effective. Maintain tree health and vigor, prune dead and dying limbs, and remove dead trees to prevent beetle problems.		

Efficacy of Selected Fungicides Against Stone Fruit Diseases¹

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
CaptEstate	E	E	—	—	—	G	G
Elevate	E	E	—	—	—	—	—
Fixed copper	—	—	G	—	F	G	P
Fontelis	E	E	—	F-G	G	F-G	—
Gem	—	—	—	E	G	E	—
Indar ²	E	E	—	—	G	E ³	—
Topguard	E	E	—	—	G	G	—
Luna Sensation	E	E	—	—	G	F-G	—
Merivon	E	E	—	F-G	G	F-G	—
Orbit ²	E	E	—	G	G	G ³	—
Pristine	G	G	—	G	E	E	—
Procure ²	G	G	—	—	E	G ³	—
Rally ²	E	—	—	—	E	E ³	—
Rovral	E	E	—	P	—	F	—
Rubigan (Vintage) ²	—	—	—	—	G	E ³	—
Quash	G	G	—	G	—	—	—
Quintec	O	O	O	O	G	O	O
Scala	G	G	—	—	—	—	—
Sulfur	F	P	—	G	G	P	O
Syllit ²	—	P	G	—	O	G	—
Topsin-M ²	E	E	—	G	F	G	F
Inspire Super	E	E	—	G	E	—	—
Vanguard	G	G	—	—	—	—	—
Ziram	P-F	P-F	G	G	—	F	—

¹— = unknown or doesn't apply. O = none. P = poor. F = fair. G = good. E = excellent.

²Many areas of the Midwest may contain strains of the brown rot, powdery mildew, and cherry leaf spot fungi tolerant of these chemicals. Therefore, these fungicides may not be effective in some areas.

³Excellent where the leaf spot pathogen is not resistant but only fair where sterol-inhibiting fungicides have been used extensively.

Vole Control

Mice, known as voles, can cause serious damage to tree fruit plantings. Frequently, damage occurs but growers do not notice it until trees become weak, die, or are removed.

You can anticipate vole damage each year, particularly from late summer to early spring, as mice eat bark from the base of small saplings. Such damage can girdle and kill a tree. Apple trees are most susceptible, but hungry voles will attack other fruit trees. Apple trees on dwarfing rootstocks 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.

Voles can be a problem in blueberry plantings, but almost never feed on grapes, blackberries, raspberries, or strawberries.

General Orchard Management Practices

You can employ several general orchard management practices to reduce the risk of injury and improve effectiveness of control. No single material or technique is effective for complete control of voles. Therefore, we suggest that you vary both the materials and the methods of control during the season.

You can construct tree guards “hardware cloth” or similar materials with a 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).

Placing pea-sized gravel or cinders around the trees in a circle 4 to 6 inches wide and at the same depth, also tend to discourage meadow voles from attacking crowns of trees but do not discourage other mouse species.

To proliferate, voles need abundant cover. Thus, maintaining a clean area 1 to 2 feet around the base of each tree discourages surface feeding. This also will regulate vole populations in the long term. Chemical weed control in early spring significantly reduces the amount of labor involved in keeping the area around the tree clean.

You should mow short the orchard cover or sod in late August and again after harvest to reduce runway cover and aid baiting. Cleaning out drainage ditches and fencerows, and picking up or crushing all dropped fruit discourages large vole populations.

Orchard Vole Control Program

Essential Knowledge

The first thing you must do to control voles is to determine the problem species (use snap traps for this). There are three common species: meadow vole (*Microtus pennsylvanicus*), prairie vole (*Microtus ochrogaster*), and pine vole (*Pitymys pinetorum*). While the control materials for these species may be the same, the control methods differ.

You can make quick field identifications of vole species (for both juveniles and adults) based on the length of their tails:

Pine vole: Tail is about as long as its hind foot.

Meadow and prairie vole: Tail is about twice as long as its hind foot.

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

Control

You can control voles in orchards by using either zinc phosphide or chlorophacinone baits. You must use both baits according to label directions.

Zinc phosphide, a restricted use pesticide, is an acutely toxic bait that kills 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) is an anticoagulant bait that is available as a weather-resistant, pellet-style bait. This bait is highly accepted by rodents, but it does not kill them for several days. For effective control, you need to make a second application of chlorophacinone within 20 to 40 days.

Use caution: baits can be attractive to other wildlife (including birds) and domestic pets. You must apply bait 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. Zinc phosphide is more effective against meadow voles than pine voles. Consistently using just one of these chemicals will result in population shifts from one vole 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.

Baiting Techniques

There are three main baiting techniques:

1. **Machine baiting.** You expose bait in an artificial trail (Trail Builder).
2. **Trail baiting.** You expose bait only in natural, active runways.
3. **Broadcast baiting.** You broadcast bait by hand, cyclone-type seeder, or tractor drawn equipment at recommended rates. *This technique is not recommended for pine vole control.* 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.

Comparison of Baiting Techniques

Baiting Technique	Meadow or Prairie Vole Control (%)	Pine Vole Control (%)
Machine	90-95	80-85
Trail	80-85	70-75
Broadcast	78	not recommended

Timing

Apply rodenticides on a sunny day in late fall when voles are active. Voles begin to build up in early August, but you should delay baiting as late as possible in the fall. The most effective application period is just before snow cover after frost reduces the grass cover 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

Applying 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 provide 100 percent control. Therefore, some voles survive the pre-harvest control and enter into fruit boxes on the ground that will be carried into cold storage.
2. The pre-harvest poison application will reduce the population of voles in the orchard, which will greatly reduce competition among survivors, making food and cover 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 poison 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

To protect fruit in storage from rodents, pay attention to what you do before and during harvest.

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 one week before picking (pay special attention near loading areas).
 - c. Use 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

You can prepare bait stations in several ways and eliminate or reduce the opportunity for non-target animals to contact the bait. Placing squares of heavy roofing shingles (or other weather-resistant materials) 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 two or three weeks before adding the bait.

Vole Control for Small Fruit

Prozap zinc phosphide pellets are a restricted use pesticide labeled for vole control in highbush blueberries, blackberries, and red and black raspberries. You may only apply this product in the dormant season after final harvest and not later than the beginning of leaf emergence in the spring. The minimum preharvest interval is 70 days. Do not apply when the ground is snow covered.

You may broadcast bait with a cyclone seeder or by hand. When applying by hand, throw a tablespoon amount (12 grams) into heavy cover along bushes, rocky outcrops, and fence lines. Make two applications at a rate of 6 to 10 lbs. per acre per application at a minimum interval of 21 days. The maximum application per growing season is 20 lbs. per acre.

Suggestions for Growth Regulators

Ethephon on Apples

Ethephon, which is available as a 21.3% formulation of 2-chloroethylphosphonic acid (Ethrel, Cepha, or Motivate), may:

1. Promote early color development and maturity
2. Loosen fruit for easier harvesting by hand or machine
3. Increase fruit bud formation and early bearing on young trees

Promoting Early Color Development and Maturity

To increase red coloration and early maturity, apply ethephon 14 to 21 days prior to anticipated harvest at a concentration of 150 to 300 ppm (0.5 to 1 pt. per 100 gals. water). For concentrate sprays, use 2.5 pts. per acre in 50 to 100 gals. of water. Use lower dosage ranges for late-maturing varieties.

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 in the next 14 days. Apply ethephon between 60°F and 90°F. Most red apple varieties do not develop red color during hot weather 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. You can add naphthaleneacetic acid (NAA) 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.

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 you can harvest and market in a timely manner. You should promptly market fruit treated with ethephon because it may have short shelf life.

Increasing Early Bearing on Young Trees

To increase fruit bud development on young, nonbearing trees, apply a foliar spray of ethephon one to two weeks after full bloom. Apply at 1,000 ppm (3.33 pts. per 100 gals. of water). For spur-type trees, reduce the rate to 500 ppm (1.66 pts. per 100 gals. of water).

Caution: Do not use this treatment on trees that have started to bear fruit because the application may completely de-fruit trees.

Stop-Drop Sprays

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

Concentration and Timing of Stop-Drop Application

Variety	Application Time Before Picking (days)	NAA Concentration (ppm)
Red Delicious	7-10	10-15
Jonathan	7-10	10
Golden Delicious	7	10
Rome Beauty	7	10
Winesap	7	15

Apply NAA (Fruitone N, Amid-Thin W, K-salt Fruit Fix 800, K-salt Fruit Fix 200, and PoMaxa) 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. This application should normally prevent fruit drop for 7 to 10 days.

Make a second NAA application within 7 to 10 days of the first application if fruits were not harvested. Do not exceed two NAA applications. Do not apply within two days of harvest. NAA works best as a dilute spray.

Using NAA too early, or in greater than recommended concentrations, may accelerate fruit maturity and decrease storage life. Apply stop-drop sprays at concentrations no higher than 3x. You may apply stop-drop sprays 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

For Harvest Management

ReTain is labeled on apple, pear, peach, nectarine, plum, prune, and apricot. The active ingredient in ReTain is aminotheoxy-vinylglycine (AVG), which is a natural inhibitor of ethylene synthesis. Ripening fruit normally produces ethylene gas, which 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 you apply ReTain before the first visible signs of ripening. Research has shown that ReTain should be applied four weeks before the optimum harvest date on apples and one or two weeks before the anticipated beginning of the normal harvest period for untreated fruit for other fruit types. The PHI for ReTain is 7 days.

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

Dilute ReTain in at least 100 gals. 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. Including a silicone-based spreader sticker (e.g., Stylwet L-77) is absolutely critical for good results.

For Increasing Fruit Set

ReTain is labeled to increase fruit set on apples, European pears, and cherries. Make a single application from pink to bloom on apple, from white bud to first bloom on pear, and from balloon stage to first bloom on cherries. Never apply ReTain earlier or later than these stages.

Comments. ReTain is expensive; therefore, it use it only on high-value, productive blocks with good fruit quality. Store treated fruit separately.

Apogee

Apogee is mainly used on trees that are overly vigorous because of crop loss, inappropriate rootstock, or tree spacing. Apogee can decrease the length of shoots by 30 to 60 percent. In addition, reducing shoot growth by treating with Apogee treatment can reduce susceptibility to fire blight. For details, see *Managing the Shoot Blight Phase of Fire Blight with Apogee*, pages 28-29.

Sprout and Sucker Control on Apple and Pear

You can inhibit sprouting by applying Tre-Hold Sprout Inhibitor A112 to pruning cuts on scaffold limbs and trunk bases, and to rootstock suckers on bearing and non-bearing trees.

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

Tre-Hold RTU Sprout Inhibitor, a ready-to-use formulation (1.15% Ethyl, 1-NAA), also is available to control sprouts and sucker growth on apples and pears. Follow manufacturer's label for use.

The herbicide Rely may be used to control suckers on apple. Follow manufacturer recommendations and precautions.

Pro-Gibb on Cherries

The active ingredient in Pro-Gibb is a natural plant hormone, gibberellin A3. You can use it to maintain and extend high fruiting capacity of bearing tart cherry trees and to reduce the occurrence of "blind" nodes by stimulating lateral vegetative buds and a more productive balance of lateral shoots and spurs.

Apply 4 to 8 fl. oz. of Pro-Gibb 4% in 100 gals. finished spray, from 14 to 28 days after bloom, in 50 to 150 gals. 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 gals. of water, two to four 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 10SG on Apples

Russetting

Applying ProVide, a mixture of gibberellins A4 and A7, reduces (but does not eliminate) russetting on Golden Delicious.

Apply ProVide two to four times, beginning at petal fall and continuing at 7- to 10-day intervals. The rate is 60 to 100 grams applied in 100 gals. of solution per acre (15- 25 ppm). Do not use surfactants with ProVide because some surfactants have the potential to cause russetting.

Under conditions of high humidity and rain, you will obtain best russet control with four, 100-gram-per-acre applications. Do not use excessive spray volumes since excess moisture can induce russet. Direct 85 percent of the spray volume to the upper two-thirds of the tree.

Stayman Cracking

You should start applying ProVide 10SG three to six weeks before cracking begins (normally by mid-June to mid-July). Apply three to six consecutive sprays at 14- to 21-day intervals at an application rate of 100 to 200 grams of ProVide per 100 gals. per acre, per application (REI is 4 hours).

Because weather changes influence cracking, and because cracking can occur over extended periods, multiple applications have given the best response. Apply ProVide early in the morning or late in the evening under slow drying conditions to maximize absorption.

Promalin on Apples

Promalin contains 1.8% 6BA N-(phenylethyl)-1H-purine-6-amine and 1.8 percent gibberellins A4 and A7. A single application to Delicious from early king bloom to the early stages of petal fall of the side blossoms elongate the fruit and encourages the development of more prominent calyx lobes.

The application rate is 1 to 2 pts. in 75 to 200 gals. of spray mixture per acre. If the bloom period is prolonged, two applications provide better results. Make the first application of 0.5 to 1 pt. of Promalin per acre at the beginning of the bloom period as above. Make the second application of 0.5 to 1 pt. of Promalin per acre three to 21 days later when the remainder of the canopy comes into bloom.

Do not exceed 2 pts. per acre for the combined sprays. Do not apply Promalin when air temperatures are lower than 40°F or higher than 90°F.

Promalin for Branching

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

You can make foliar Promalin applications on bearing and nursery apples and non-bearing pears at 1-3 inches of new terminal growth. The applications rate is 125-500 ppm (0.25-1 pt. of Promalin per 5 gals. of spray solution). On apple, non-bearing pears, and non-bearing sweet cherries, you may treat trees when they have reached a terminal height at which lateral branching is desired. For this treatment, apply Promalin at 250-1,000 ppm (0.5-2 pts.) per 5 gals. of spray solution.

You must make Promalin-latex paint applications before bud break or you may injure new shoot tips, causing shoot growth failure. Apply uniformly to cover the bark surface with a brush or sponge only on one-year-old wood. The application rate is 5,000 to 7,500 ppm (0.2-0.33 pts. or 3.2-5.3 fl. oz.) of Promalin per pint of latex paint.

Chemical Thinning of Apples

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

NAA (naphthalene acetic acid), NAD (naphthalene acetamide), Sevin (1-naphthyl-N-methylcarbamate), and MaxCel (6-benzyladenine) are suggested.

Apply NAA to fall and winter varieties when king fruit are 11 to 13 mm in diameter. Sevin is more effective than NAA for fruit larger than 13 mm. 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.

You can combine NAA and Sevin, and apply it on fall and winter varieties when king fruit are 11 to 13 mm in diameter, and on summer varieties (Wealthy and Earliblaze) at petal fall.

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 gals.)	MaxCel ^{2,8}	Combinations ^{2,3,7,8} (PPM + qt./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	M	
Jonamac		5-10	3-5	1/2-1	M	
McIntosh	35-50	7½-12	3-5	¼-½	E	
Jonathan	35-50	7½-12	3-5	¼-½	E	
Spartan		10-15	5-7½	1/2-1	?	
Cortland	35-50	7½-12	3-5	¼	E	
Grimes Golden	35-50	5-10	5-7½		?	NAD 25-50 + Sevin 1/2-1
Red Delicious/ non-spur		5-10	3-5	1/2-1	E	
Red Delicious/ spur		5-10	5-7½	1/2-1	M	
Honeycrisp		3-5		¼-½	?	N.R.
Empire		10-15	5-7½	1/2-1	E	
Golden Delicious		10-20	5-10	1/2-1	M	NAA 5-10 + Sevin 1/2-1
Blushing Golden				¼-½	?	
Firmgold				¼-½	?	
Idared				1/2-1	E	
Winesap	35-50	7½-10	3-5	1/2-1	E	
Stayman & Turley	35-50	7½-10	3-5	1/2-1	M	
Braeburn		7½	7½			NAA 7½ + Sevin 1
Rome	50-60	15-20	7½-10	N.R. ⁹	E	
Fuji ⁸		N.R. ⁹			H	MaxCel 150 ppm + Sevin 1

¹ See *Apple Thinning Guide* by P. Schwallier (Great Lakes Publishing) and the *Tree Fruit Production Guide* (Penn State University Extension publication AGRS-045, extension.psu.edu/plants/tree-fruit/tfpg).

² Lower concentrations suggested when conditions are favorable for thinning.

³ Apply NAD (Amid-Thin) from late bloom to petal fall.

⁴ Apply NAA, Sevin, or combinations to fall and winter varieties when king fruits are 11-13 mm in diameter. On summer varieties (such as Wealthy and Earliblaze) apply the combination at petal fall.

⁵ WA = wetting agent: Regulaid at 0.5 pt. per 100 gals.

⁶ Adding NAA at 2.5-4 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 you use other Sevin formulations.

⁸ Variety ease of thinning with MaxCel: E = easy, M = moderate, H = hard. See MaxCel Recommendation Tables (page 79) for suggested rates of Maxcel and Sevin for thinning.

⁹ N.R. = not recommended.

Applying NAA to 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, so you should not use it on these varieties.

NAA is not successful in thinning Fuji, as this often results in pygmy apples. Honeycrisp is easy to overthin, so you should use combinations.

You can avoid the variability of results and excessive foliage injury often experienced with NAA by using it at one-third and one-half of the rates recommended on the label in combination with 0.75 pt. of Tween 20 per 100 gals. Adding 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. Eliminating foliage wilting and tree "shock" will result in better fruit size at harvest than the same amount of fruit thinning obtained by the full dosage of NAA alone.

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

MaxCel, Exilis Plus, RiteWay for Thinning

For MaxCel, Exilis Plus, and RiteWay, apply 75 to 200 ppm in spray volumes of a minimum of 100 gals. per acre. Use a sufficient volume to ensure complete coverage. In most cases, 100 gals. per acre are adequate.

Apply when the average king fruitlets are 5 to 15 mm in diameter. Only two applications are allowed per season. Do not exceed 308 fl. oz. (182 grams 6-BA) of MaxCel or RiteWay, or 296 fl. oz. of Exilis Plus per acre per season for all uses. Do not apply within 86 days of harvest. Do not add surfactant to tank.

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

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

Fuji Thinning

Fuji has been notoriously difficult to thin in the past. On young trees MaxCel at 100 ppm (2 qts.) + 1 qt. Sevin XLR per 100 gals. has worked well.

On mature trees with a heavy set there are two options:

1. 150 ppm (3 qt) MaxCel + 1 qt Sevin XLR
2. If **captan has not been used** prior to this during the current season: 100 ppm (2 qts.) MaxCel + 1 qt. Sevin XLR + 1 qt. horticultural spray oil per 100 gals.

Important Reminders about Chemical Thinning

NAA generally gives best results under fast drying conditions and when the temperature is between 70°F 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 chemical thinner sprays 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. Miscalibrating the sprayer manifold will be magnified in concentrate application. Concentrating more than 4x has resulted in variable results, so you should avoid it.

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
8. Cloudy, cool weather preceding or following the bloom period

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

Defruiting Young Apple Trees

It is often desirable to remove all the fruit from young trees when they have not reached a profitable bearing size. NAA at 15 ppm + Sevin XLR at 1 qt./100 gals. applied at petal fall will effectively defruit Jonathan, Red Delicious, and McIntosh. For other cultivars, use NAA at the recommended rate + Sevin XLR at 1 qts./100 gals. These sprays may not completely defruit the trees, but higher NAA rates 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 gals. of water required to make a 10 ppm solution (table developed by R. Marini, VPI).

MaxCel for Apples and Pears

Use	For Fruit Thinning, Sizing, and Enhanced Return Bloom
Application	Apply 75 to 200 ppm spray concentration. Refer to dilution table on label for assistance.
Spray Volume	Use sufficient volume to ensure complete tree coverage.
Spray Timing	Apply when average king fruit diameter is 5-15 mm. 10 mm is optimal. Do not apply more than twice in a season.

MaxCel for Thinning Apples Only¹

Thinning Difficulty	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

¹ See Recommended Chemical Thinners for Apples table (page 77) for variety thinning difficulty rating.

MaxCel Dilution Table¹

Fluid ounces of MaxCel per 100 gallons of spray required to obtain given ppm concentrations.

10 ppm	25 ppm	50 ppm	75 ppm	100 ppm	125 ppm	150 ppm	175 ppm	200 ppm
6	16	32	48	64	80	96	112	128

¹ MaxCel contains 75 grams active ingredient per 128 fl. oz. (1 gal.).

NAD and NAA Formulations for Chemical Thinning of Apples

Trade Name	Chemical	Formulation	Acid Equivalent (% of active ingredient)	Amount of Formulation per 100 gals. to make 10 ppm
Amid-Thin W	1-Napthaleneacetamide	WP	8.4	1.6 oz.
Fruitone N	1-Napthaleneacetic acid, sodium salt (3.5%)	WP	3.1	4.0 oz.
PoMaxa	1-Napthaleneacetic acid, sodium salt (3.5%)	liquid	3.1	4.0 fl. oz.
K-salt Fruit Fix 800	1-Napthaleneacetic acid, potassium salt (24.2%)	liquid	20.2	0.63 fl. oz.
K-salt Fruit Fix 200	1-Napthaleneacetic acid, potassium salt (6.25%)	liquid	5.18	2.47 fl. oz.

NOTES

Grape Spray Schedule

Note on Disease Control Recommendations

The following information is intended to provide general guidelines for use in developing a fungicide spray program for grapes in the Midwest. This spray schedule presents various fungicide options that growers can consider.

The major grape diseases that generally require at least some fungicide application for control on an annual basis include black rot, powdery mildew, downy mildew, and Phomopsis cane and leaf spot. Several recommendations in this guide include tank mixes of different fungicides that are intended to provide a program that will control all of these diseases simultaneously.

In some cases, we also provide recommendations for a single disease alone. If you wish to make a fungicide application to control only one specific disease, refer to, Effectiveness of Fungicides for Control of Grape Diseases, page 96.

■ Grape Delayed Dormant through Bud Swell

Apply just as buds are beginning to swell but before they show green.

Pest/Problem	Material	Rate/Acre	Comments
Anthracnose	lime sulfur solution	10 gals.	This delayed dormant application is aimed at reducing overwintering inoculum on canes. See Anthracnose, page 92.
	Sulfurix	1-2 gals.	
European red mite, mealybug, scale insects	superior oil (70-sec.)	1-4 gals.	Use lower rates for mites and scales, and higher rates for mealybugs
grape mealybug	Lorsban Advanced (4EC)	1 qt.	Apply prior to late bud-break.
	Lorsban 75WG	1.33 lbs.	Do not exceed 1 application per year.
grape scale	Lorsban Advanced (EC)	1 qt.	Do not exceed 1 application per year.
flea beetle (adults)	Scout at least weekly as bud swell occurs.		
	Baythroid XL 1EC	2.4-3.2 fl. oz.	Do not exceed 12.8 fl. oz. per acre per year.
	Danitol 2.4EC	5.3-10.7 fl. oz.	Use lower rate for flea beetles; higher rate for cutworms.
	Imidan 70WP	1.3-2.1 lbs.	Do not exceed 6.5 lbs per acre per year.
	Scorpion 35SL	2-5 fl. oz.; 9-10.5 fl. oz.	Use the low rate for foliar application; use the high rate for soil application.
	Sevin XLR Plus (4F)	1-2 qts.	Use lower rate for flea beetles; higher rate for cutworms. Limit 10 qts. per acre per year. Other formulations may be available. See Special Re-entry Interval (REI) Considerations for Topsin M, Pristine and Sevin, page 95.

(continued)

Grape Delayed Dormant through Bud Swell *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
climbing cutworms	Scout at least weekly as bud swell occurs.		
	Baythroid, Danitol, or Sevin as listed for flea beetle adults above OR		
	Altacor 35WDG	3-4.5 oz.	Do not exceed 4 applications per year.
	Brigade 2EC	3.2-6.4 fl. oz.	Do not exceed 6.4 fl. oz. per acre per year.
	Delegate 25WG	3-5 oz.	
	Entrust 2SC	4-8 fl. oz.	Do not exceed 23 fl. oz. or 5 applications per acre per year.
	Lorsban 4E or Lorsban Advanced (EC)	1 qt.	Apply as a spray drench ground application. Do not use now if you will use Lorsban later for root borer. Do not exceed 1 application per year.
Mustang Maxx 0.8EC	2-4 fl. oz.	Do not exceed 24 fl. oz. per acre per year.	

■ Grape Bud Break to Pre-bloom

Begin applications at 1-3 inch new shoot growth, and repeat at 7-10 day intervals or according to label instructions and environmental conditions for disease development. This application is aimed primarily at Phomopsis cane and leaf spot. However, protectant fungicides (Mancozeb, Captan, Ziram) that control Phomopsis also control black rot and downy mildew, but not powdery mildew. Adding one of the sterol inhibitor fungicides (Bayleton, Mettle, Procure, Rally, Tebuzol) in the third or fourth spray during this time period will improve control of black rot and powdery mildew. See note at Grape Pre-bloom Through Bloom.

On varieties highly susceptible to powdery mildew, include a fungicide for powdery mildew control in these early sprays. Primary infections of powdery mildew can occur during this period.

Fungicide Resistance Alert: See Powdery Mildew Resistance Management, page 94, for information about fungicide resistance development in powdery and downy mildews.

Pest/Problem	Material	Rate/Acre	Comments
black rot, Phomopsis cane and leaf spot, powdery mildew, downy mildew	Early sprays for Phomopsis cane and leaf spot are especially critical. Mancozeb and Captan are both very effective for control of Phomopsis. Mancozeb is sold under the trade names Dithane, Manzate, Penncozeb, and others. If black rot is a problem in the vineyard, Mancozeb would be the fungicide of choice. Captan is less effective than Mancozeb for black rot control. See Effectiveness of Fungicides for Control of Grape Diseases, page 96.		
	Captan 50WP	3 lbs.	Captan 80WDG, Captan 4L, and Captec 4L are also available. The PHI on grapes is 0 days. The REI on grapes is 48 hours. Always check the label on the Captan product you are using for the PHI and REI.
	Mancozeb 75DF	3 lbs.	
	Ziram 76DF	3-4 lbs.	
	ANY OF THE ABOVE PLUS ONE OF THE FOLLOWING:		
	Aprovia	8.6-10.5 fl. oz.	
	Endura 70WG	4.5-8.0 oz.	Specifically for powdery mildew.
	Inspire Super	16-20 fl. oz.	Inspire Super, Quadris Top, and Revus Top all contain the active ingredient difenoconazole. All fungicides with difenoconazole labeled for grapes have the following precaution: "On <i>V. labrusca</i> , <i>V. labrusca</i> hybrids, and other non-vinifera hybrids where sensitivity is not known, the use of Inspire Super, Quadris Top, or Revus Top by itself or in tank mixes with materials that may increase uptake (adjuvants, foliar fertilizers) may result in leaf burning or other phytotoxic effects." The Revus Top label states that it cannot be used on Concord, Concord Seedless, and Thomcord grapes.

Grape Bud Break to Pre-bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
black rot, Phomopsis cane and leaf spot, powdery mildew, downy mildew (continued)	Mettle 125ME	3-5 fl. oz.	
	potassium salts	See comments.	Specifically for powdery mildew. See Powdery Mildew Resistance Management, page 94.
	Procure 50WS	4-8 oz.	
	Quintec	4-6.6 fl. oz.	Specifically for powdery mildew.
	Rally 40WSP	3-5 oz.	
	sulfur	See label.	Use sulfur with caution.
	Tebuzol 45DF	4 oz.	Several generic fungicides contain the active ingredient tebuconazole — see Generic Fungicides, page 134.
	OR ONE OF THE PRODUCTS BELOW BY ITSELF:		
	Abound	10.0-15.5 fl. oz.	See Downy Mildew Resistance to Strobilurin Fungicides, page 94.
	Flint 50WG	1.5-4.0 oz.	Do not apply to Concord or other American type grapes as injury may occur. Not recommended for downy mildew control.
	Luna Experience	8.0-8.6 f. oz.	Not effective against downy mildew. Labeled for wine grapes, only. Do not use on Thompson Seedless or Concord grapes.
	Pristine	8-12.5 oz.	Do not apply to Concord or other American type grapes as injury may occur.
	Quadris Top	12-14 fl. oz.	
	Revus Top	7 fl. oz.	
Sovran 50WG	3.2-6.4 oz.		
powdery mildew	On varieties that are highly susceptible to powdery mildew, include a fungicide for powdery mildew control in these early sprays. Primary infections of powdery mildew can occur during this period. Fungicide Resistance Alert: See Powdery Mildew Resistance Management, page 94, for information about fungicide resistance development in powdery and downy mildews.		
	Abound	10.0-15.5 fl. oz.	See Powdery Mildew Resistance Management, page 94.
	Endura 70WG	4.5-8.0 oz.	
	Flint 50WG	1.5-4.0 oz.	See Powdery Mildew Resistance Management, page 94.
	JMS Stylet Oil	1-2% conc.	Not registered in all states.
	Kenja 400SC	20-22 fl. oz.	
	Luna Experience	6.0-8.6 fl. oz.	Labeled for wine grapes, only. Do not use on Thompson Seedless or Concord grape cultivars.
	Mettle 125ME	3-5 fl oz	
	potassium salts	See comments.	See Powdery Mildew Resistance Management, page 94.
	Procure 50WS	4-8 oz	
	Quintec 2.08F	3-4 fl. oz.	
	Rally 40WSP	3-5 oz	
	Sovran 50WG	3.2-6.4 oz.	See Powdery Mildew Resistance Management, page 94.
	sulfur	See label.	Use sulfur with caution.
	Tebuzol 45DF	4 oz	See note for Tebuzol in black rot, etc., above.
Torino	3.4oz		
Vivando 2.5F	10.3-15.4 fl. oz.		
flea beetle, climbing cutworm	Same as for Grape Delayed Dormant through Bud Swell, pages 81-82.		

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Grape Bud Break to Pre-bloom *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
grape phylloxera	Admire Pro (4.6F)	7-14 fl. oz.	Admire Pro is soil-applied for systemic control. Use if there is history of leaf galling. Apply from bud swell until the first expanded leaf to be sure the chemical is available as soon as roots begin taking up water, because it takes several weeks for the chemical to get to the leaves. Do not exceed 14 fl. oz. per acre per year.

■ Grape 4- to 10-inch Shoots

Certain insect pest may be present when new shoots are about 10 inches long.

Pest/Problem	Material	Rate/Acre	Comments
flea beetle (larvae)	Same as for Grape Delayed Dormant through Bud Swell, page 81. Flea beetle larvae may be present any time between 4- and 10-inch shoot growth and bloom.		
rose chafer	Rose chafer may be present any time between 4- and 10-inch shoot growth and bloom.		
	Assail 30SG	2.5-5.3 oz.	Do not exceed 2 applications per year.
	Danitol 2.4EC	10.7-21.3 fl. oz.	Do not exceed 42.7 fl. oz. per acre per year.
	Imidan 70 WP	1.3-2.1 lbs.	Do not exceed 6.5 lbs. per acre per year.
redbanded leafroller	Sevin XLR Plus (4F)	1-2 qts.	Other formulations may be available. See Special Re-entry Interval (REI) Considerations for Topsin M, Pristine and Sevin, page 95.
	Redbanded leafroller may be present any time between 4- and 10-inch shoot growth and bloom.		
	Danitol 2.4EC	10.7-21.3 fl. oz.	Do not exceed 42.7 fl. oz. per acre per year.
	Delegate 25WG	3-5 oz.	Do not exceed 19.5 fl. oz. or 5 applications per acre per year.
	Entrust 2SC	4-8 fl. oz.	Do not exceed 23 fl. oz. or 5 applications per acre per year.
	Imidan 70WP	1.3-2.1 lbs.	Do not exceed 6.5 lbs per acre per year.
	Intrepid 2F	8-16 fl. oz.	PHI depends on rate — 12 fl. oz. or less: PHI=21 days. More than 12 fl. oz.: PHI=30 days.
European red mite	Sevin XLR Plus (4F)	2 qts.	Other formulations may be available. See Special Re-entry Interval (REI) Considerations for Topsin M, Pristine and Sevin, page 95.
	Acramite 50WS	0.75-1 lb.	Do not exceed 1 application per year with any of these products.
	Apollo 1SC	4-8 fl. oz.	
	Envidor 2SC	16-34 fl. oz.	
	Nealta 1.67SC	13.7 fl. oz.	
	Nexter 75WP	4.4-5.2 oz. (1-1.5 bags)	
	Onager 1EC	12-24 fl. oz.	
	Portal 0.4EC	2 pts.	
Zeal 72WP	2-3 oz.		
grape phylloxera	Movento 2SC	6-8 fl. oz.	See label regarding adjuvants. Movento is applied to leaves but it moves to the roots. It is most effective if applied at this early stage of grape growth. Do not exceed 12.5 fl. oz. per acre per year.

■ Grape Pre-bloom through Bloom

Apply from just before bloom through the bloom period.

Critical Period for Disease Control: The period from immediate pre-bloom through four or five weeks after bloom is the most critical period to control fruit infections by the black rot, powdery mildew, and downy mildew pathogens. Fungicide protection during this period is critical. Research in New York has shown that the fruit of most varieties is resistant to all three of these diseases by four weeks after bloom. Beyond four to five weeks after bloom, black rot should no longer be a problem. Although fruit becomes resistant to powdery and downy mildews, the rachises (cluster stems) and leaves remain susceptible. Therefore, fungicide protection against powdery and downy mildews may be required throughout the growing season.

Pest/Problem	Material	Rate/Acre	Comments
black rot, Phomopsis cane and leaf spot, powdery mildew, downy mildew	Same as for Grape Bud Break to Pre-bloom, pages 82-83. Very important sprays for controlling black rot, powdery mildew and downy mildew fruit infections. Pay attention to pre-harvest intervals, especially for products that contain mancozeb.		
flea beetle larvae, rose chafer, redbanded leafroller*, grape berry moth*	Same as for Grape 4- to 10-inch Shoots, page 84. *Pheromone traps for grape berry moth and redbanded leafroller will indicate if they are present and help determine the need for control.		
grape scale	Not a common pest in most of the Midwest. In southern areas, flag scale-infested vines during dormant pruning. In early May begin weekly inspections of flagged vines for scale crawlers. Lift live adult scale covers and look for yellow moving crawlers (use a hand lens with 10x magnification). Protect canes by applying sprays every 10 days as long as you see moving crawlers (2-3 week crawler emergence period).		
	Lorsban Advanced	1 qt.	
grape phylloxera (leaf form)	Control the root gall form of grape phylloxera by using rootstocks derived from American grapes. Native American grapes (Eastern U.S.) are highly resistant to this pest. Since bees do not pollinate grapes, there is no danger to bees at this time unless they are working on other blooming plants in the area being sprayed. Mow before spraying to eliminate blooms on weeds.		
	Assail 30SG	2.5-5.3 oz.	Apply at pre-bloom and repeat 10-14 days later. Do not exceed 2 applications per year.
	Danitol 2.4EC	10.7-21.33 fl. oz.	Apply at pre-bloom and repeat 10-14 days later.
	Movento 2SC	6-8 fl. oz.	See label regarding adjuvants. Allow 30 days between applications. Do not exceed 12.5 fl. oz. per acre per year.
	Platinum 2SC	8-17 fl. oz.	Soil-applied. Do not exceed 17 fl. oz. per acre per year. PHI=60-days.
	Scorpion 35SL	2-5 fl.oz.; 9-10.5 fl. oz.	Use low rate for foliar application (PHI=1 day). Use high rate for soil application (PHI=28 days). Do not exceed 20.25 fl. oz. per acre per year.

■ Grape Bloom

Apply when caps begin to fall.

Pest/Problem	Material	Rate/Acre	Comments
black rot, Phomopsis cane and leaf spot, powdery mildew, downy mildew	Same as for Grape Bud Break to Pre-bloom, pages 82-83. If wet weather persists during bloom or if the interval between the pre-bloom and shatter spray is greater than 7-10 days, a fungicide application during bloom may be necessary.		

(continued)

Grape Bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
downy mildew	Downy mildew is one of the most common diseases in the Midwest. Initial infections can occur as early as bloom. Leaf infections may occur throughout the summer, so it may be necessary to protect susceptible varieties from bloom to post-harvest. Fungicide Resistance Alert: See Powdery Mildew Resistance Management, page 94, for information about fungicide resistance development in powdery and downy mildews.		
	Abound	10.0-15.5 fl. oz.	See Downy Mildew Resistance to Strobilurin Fungicides, page 94
	Captan 50WP	3-4 lbs.	See note for Captan on page 82.
	fixed copper	See comments	See Fixed Copper Fungicides, pages 94.
	Forum	6 oz	
	Mancozeb 75DF	3-4 lbs.	PHI=66-days.
	phosphorous acid	See label.	
	Pristine 38WG	8-12.5 oz.	See Downy Mildew Resistance to Strobilurin Fungicides, page 94. Do not apply on Concord or other American type grapes as injury may occur.
	Ranman	2.1-2.75 fl oz	Do not use any surfactant.
	Reason 500C	2.7 fl oz	
	Revus	8 fl. oz.	Adding a spreading/penetrating type of adjuvant (such as a nonionic-based surfactant or crop oil concentrate or blend) is recommended.
	Ridomil Gold Copper	2 lbs.	PHI=42-days.
	Ridomil Gold MZ WG	2.5 lbs.	PHI=66-days.
	Sovran 50WG	3.2-6.4 oz.	See Downy Mildew Resistance to Strobilurin Fungicides, page 94.
Zampro	11-14 fl oz	Do not exceed 2 applications per season.	
Ziram 76DF	3-4 lbs.		
powdery mildew	Same as for Grape Bud Break to Pre-bloom, page 83.		
Botrytis bunch rot	This spray is critical in vineyards or on tight-clustered varieties (especially French hybrids or Vinifera) where Botrytis bunch rot has been a problem. See Botrytis Bunch Rot, page 93.		
	Elevate 50WDG	1 lb.	
	Kenja 400SC	20-22 fl. oz.	
	Luna Experience	8.0-8.6 fl .oz.	Labeled for wine grapes, only. Do not use on Thompson Seedless or Concord grape cultivars.
	Rovral 4F	1-2 pts.	
	Scala SC	18 fl. oz.	Registered for use at 18 fl. oz. alone, or at 9 fl. oz. when used in a tank mix. Application timing is approximately the same as for Rovral.
	Switch 62.5WG	11-14 oz.	Also registered for control of sour rot (caused by a complex of organisms). Pre-harvest applications may be beneficial for control of sour rot. See label for additional information.
	Topsin M WSB	1-1.5 lbs.	Apply at 1-1.5 lbs./acre at first bloom. Topsin M is also available in 70WDG and 4.5 FL formulations.
	Vanguard WG	10 oz.	Registered for use at 10 oz./acre when used alone, or at 5-10 oz./acre when used in a tank mix.

■ Grape Shatter

Apply when unfertilized berries fall from clusters, about 7-10 days after bloom or 7-10 days after last spray.

Pest/Problem	Material	Rate/Acre	Comments
black rot, Phomopsis cane and leaf spot, powdery mildew, downy mildew	Same as for Grape Bud Break to Pre-bloom, pages 82-83. Note PHI on products that contain mancozeb. OR		
	Kenja 400SC	20-22 fl. oz.	Labeled for powdery mildew.
	OSO 5% SC	3.75-13.0 fl. oz.	Labeled for powdery mildew
downy mildew	Same as for Grape Bloom, page 86. Especially on susceptible varieties. Note PHI on products that contain mancozeb.		
grape berry moth	Pheromone traps help determine the presence and timing of grape berry moth. Berry moth emergence begins in late May and June; there may be three generations per year.		
	Altacor 35WDG	2-4.5 oz.	Do not exceed 4 applications per year.
	Assail 30SG	2.5-5.3 oz.	Do not exceed 2 applications per year.
	Avaunt 30WG	5-6 oz.	Do not exceed 2 applications per year.
	Baythroid XL (1EC)	2.4-3.2 fl. oz.	Do not exceed 12.8 fl. oz. per acre per year.
	Belay 2.13SC	6 fl. oz.	Do not exceed 1 application per year.
	Brigade 2EC	3.2-6.4 fl. oz.	Do not exceed 6.4 fl. oz. per acre per year.
	Brigade WSB (10WP)	8-16 oz.	Do not exceed 16 fl. oz. per acre per year.
	<i>Bt (Bacillus thuringiensis)</i>		See Generic Insecticides, pages 139-140, for a list of products that contain <i>Bacillus thuringiensis</i> . See individual product labels for rates and application details.
	Danitol 2.4EC	10.7-21.3 fl. oz.	Do not exceed 42.7 fl. oz. per acre per year.
	Delegate 25WG	3-5 oz.	Do not exceed 19.5 oz. per acre per year or 5 applications per year.
	Entrust 2SC	4-8 fl. oz.	Do not exceed 23 fl. oz. per acre per year or 5 applications per year.
	Entrust 80WP	1.25-2.5 oz.	Do not exceed 3 sprays in any 30-day period. Do not exceed 7.5 oz. per season. See Insecticide and Miticide PHIs and REIs, pages 135-138.
	Imidan 70WP	1.3-2.1 lbs.	Do not exceed 6.5 lbs. per acre per year.
	Intrepid 2F	8-16 fl. oz.	Apply at initiation of egg hatch and 10-18 days later. PHI depends on rate — 12 fl. oz. or less: PHI=21 days. More than 12 fl. oz.: PHI=30 days.
	Mustang Maxx (0.8EC)	4 fl. oz.	Do not exceed 24 fl. oz. per acre per year.
Scorpion 35SL	2-5 fl. oz.	Do not exceed 20.25 fl. oz. per acre per year.	
Sevin XLR Plus (4F)	2 qts.	Other formulations may be available. See Special Re-entry Interval (REI) Considerations for Topsin M, Pristine and Sevin, page 95. Do not exceed 10 qts. per acre per year.	
Venom 70SG	1-3 oz.	Do not exceed 6 oz. per acre per year.	
grape rootworm	Occasional problems from grape rootworm (adult beetles) are also controlled by Sevin, Imidan, Danitol, Baythroid, or Brigade applied for berry moth control. This is most likely as a perimeter problem, low in the canopy.		
rose chafer	Assail 30SG	2.5-5.3 oz.	Do not exceed 2 applications per year.
	Danitol 2.4EC	10.7-21.33 fl. oz.	Do not exceed 42.7 fl. oz. per acre per year.
	Sevin XLR Plus (4F)	1-2 qts.	Other formulations may be available. See Special Re-entry Interval (REI) Considerations for Topsin M, Pristine and Sevin, page 95.
	Surround WP	25-50 lbs.	May leave residues on grapes.

(continued)

Grape Shatter (continued)

Pest/Problem	Material	Rate/Acre	Comments
Japanese beetle	Same as for rose chafer above OR		
	Actara 25WDG	1.5-3.5 oz.	Do not exceed 7 oz. per acre per year.
	Avaunt 30WG	3.5-6 oz.	Do not exceed 2 applications per year.
	Aza-Direct	1-2 pts.	
	BeetleGONE!	1-17.5 lbs.	
	Belay 2.13SC	2-4 fl. oz.	Do not exceed 1 application per year.
	Brigade WSB (10WP)	8-16 oz.	Do not exceed 16 oz. per acre per year.
	Brigade 2EC	3.2-6.4 fl. oz.	Do not exceed 6.4 fl. oz. per acre per year.
	Imidan 70WP	1.3-2.1 lbs.	
	Mustang Maxx 0.8EC	4 fl. oz.	
	Platinum 2SC	8-17 fl. oz.	Soil-applied for systemic control. PHI-60 days.
	Pyganic 5%EC	4.5-17 fl. oz.	
Scorpion 35SL	2-5 fl. oz.		
redbanded leafroller	Although adult moths are commonly caught in traps, the larvae of this pest are not common in grapes in the Midwest.		
	Danitol 2.4EC	10.7-21.33 fl. oz.	Do not exceed 42.7 fl. oz. per acre per year.
	Delegate 25WG	3-5 oz.	Do not exceed 19.5 oz. per acre per year or 5 applications per year.
	Entrust 2SC	4-8 fl. oz.	Do not exceed 23 fl. oz. per acre per year or 5 applications per year.
	Imidan 70WP	1.3-2.1 lbs.	Do not exceed 6.5 lbs. per acre per year.
	Intrepid 2F	8-16 fl. oz.	Intrepid should target small larvae. Do not exceed 10 qts. per acre per year.
Sevin XLR Plus (4F)	2 qts.	Other formulations may be available. See Special Re-entry Interval (REI) Considerations for Topsin M, Pristine and Sevin, page 95.	
leafhoppers (including sharpshooters)	Examining the undersides of grape leaves will indicate if leafhoppers are present.		
	Actara 25WG	1.5-3.5 oz.	Do not exceed 7 oz. per acre per year.
	Admire Pro (4.6F)	1.0-1.4 fl. oz.; 7-14 fl. oz.	Use low rate for foliar application (PHI=0 days). Use high rate for soil application (PHI=30 days).
	Agri-Mek 0.15EC	8-16 fl. oz.	REI is 12 hours or 4 days depending on activity.
	Assail 30SG	2.5-5.3 oz.	Do not exceed 2 applications per year.
	Baythroid XL (1EC)	1.6-3.2 fl. oz.	Do not exceed 12.8 fl. oz. per acre per year.
	Belay 2.13SC	2-4 fl. oz.; 6-12 fl. oz.	Use low rate for foliar applications; use high rate for soil applications.
	Brigade 2EC	3.2-6.4 fl. oz.	Do not exceed 6.4 fl. oz. per acre per year.
	Brigade WSB (10WP)	8-16 oz.	Do not exceed 16 oz. per acre per year.
	Closer 2SC	2.75-5.75 fl. oz.	Do not apply until after petal-fall. Do not exceed 17 fl. oz. per acre per year.
	Danitol 2.4EC	10.7-21.33 fl. oz.	Do not exceed 42.7 fl. oz. per acre per year.
	Imidan 70WP	1.3-2.1 lbs.	Do not exceed 6.5 lbs. per acre per year.
	Mustang Maxx 0.8EC	4 fl. oz.	Do not exceed 24 fl. oz. per acre per year.
	Nexter 75WP	4.4-10.67 oz. (1-3 bags)	Do not exceed 2 applications per year.
	Portal 0.4EC	1-2 pts.	Do not exceed 2 applications per year.
	Platinum 2SC	8-17 fl. oz.	Soil-applied for systemic control. PHI=60 days.
	Pyganic 5%EC	4.5-17 fl. oz.	Do not exceed 10 applications per year.
Scorpion 35SL	2-5 fl. oz.; 9-10.5 fl. oz.	Use low rate for foliar applications; use high rate for soil applications. Do not exceed 21.25 fl. oz. per acre per year.	

Grape Shatter (continued)

Pest/Problem	Material	Rate/Acre	Comments
leafhoppers (including sharpshooters) (continued)	Sevin XLR Plus (4F)	1-2 qts.	Other formulations may be available. See Special Re-entry Interval (REI) Considerations for Topsin M, Pristine and Sevin, page 95. Do not exceed 10 qts. per acre per year.
	Sivanto Prime (1.67SC)	7-10.5 fl. oz.; 21-28 fl.oz.	Use low rate for foliar application (PHI=0 days). Use high rate for soil application (PHI=30 days).
	Surround WP	25-50 lbs.	May leave residues on grapes at harvest. Repeat applications might be necessary.
	Venom 70SG	1-3 oz.; 5-7.5 oz.	Use low rate for foliar applications (PHI=1 day). Use high rate for soil applications (PHI=28 days).
grape mealybug	This pest is not common in the Midwest.		
	Actara 25WG	1.5-3.5 oz.	Do not exceed 7 oz. per acre per year.
	Admire Pro (4.6F)	1.0-1.4 fl. oz.; 7-14 fl. oz.	Use low rate for foliar application (PHI=0 days). Use high rate for soil application (PHI=30 days).
	Assail 30SG	2.5-5.3 oz.	Do not exceed 2 applications per year.
	Baythroid XL (1EC)	2.4-3.2 fl. oz.	Crawlers only. Do not exceed 12.8 fl. oz. per acre per year.
	Belay 2.13SC	6 fl. oz.; 6-12 fl. oz.	Use low rate for foliar applications; use high rate for soil applications. Do not exceed 1 application per year.
	Closer 2SC	2.75-5.75 fl. oz.	Do not apply until after petal-fall. Do not exceed 17 fl. oz. per acre per year.
	Imidan 70WP	1.3-2.1 lbs.	Do not exceed 6.5 lbs. per acre per year.
	Movento 2SC	6-8 fl. oz.	See label regarding post-bloom. Do not exceed 12.5 fl. oz. per acre per year.
	Platinum 2SC	8-17 fl. oz.	Soil-applied for systemic control. PHI=60 days.
	Portal 0.4EC	2 pts.	Do not exceed 2 pts. per acre per year.
	Pyganic 5%EC	4.5-17 fl. oz.	Do not exceed 10 applications per year.
	Scorpion 35SL	2-5 fl. oz.; 9-10.5 fl. oz.	Use low rate for foliar applications; use high rate for soil applications. Do not exceed 21.25 fl. oz. per acre per year.
Venom 70SG	1-3 oz.; 5-7.5 oz.	Use low rate for foliar applications (PHI=1 day). Use high rate for soil applications (PHI=28 days).	
mites	Acramite 50WS	0.75-1.0 lb.	Do not exceed 1 application per year.
	Agri-Mek 0.15EC	8-16 fl. oz.	Add a nonionic surfactant. Do not exceed 2 applications per year.
	Apollo 1SC	4-8 fl. oz.	Do not exceed 1 application per year.
	Envidor 2SC	16-34 fl. oz.	Do not exceed 1 application per year.
	Kanemite 15SC	21-31 fl. oz.	Do not exceed 2 applications per year.
	Nealta 1.67SC	13.7 fl. oz.	Do not exceed 2 applications per year.
	Nexter 75WP	4.4-10.67 oz. (1-3 bags)	Controls European red mite at 4.4-5.2 oz./acre, and twospotted spider mite at 8.8-10.67 oz./acre. Do not exceed 2 applications per year.
	Onager 1EC	12-24 fl. oz.	Do not exceed 1 application per year.
	Portal 0.4EC	2 pts.	Do not exceed 2 pts. per acre per year.
Zeal 72WP	2-3 oz.	Do not exceed 1 application per year.	

■ Grape Shatter to Veraison (Berry coloring)

First cover applications should follow shatter by 7-10 days. Thereafter, sprays for disease control should be applied every 10-14 days until veraison. If heavy rainfall occurs, you may need to shorten the interval between sprays. Refer to labels for application timing and harvest restrictions.

Important Note on Disease Control: After bloom, the threat of Phomopsis infection is greatly reduced. Fruit remain susceptible to black rot, powdery mildew, and downy mildew until about 4-5 weeks after bloom. It is critical to maintain a fungicide program that controls all three of these diseases until about 4-5 weeks after bloom. At 4-5 weeks after bloom, the fruit should be resistant to black rot, powdery mildew, and downy mildew; however, the leaves and rachises (cluster stems) remain susceptible to both powdery and downy mildew for the rest of the season. Therefore fungicide protection against both powdery and downy mildew may be required throughout the growing season.

Pest/Problem	Material	Rate/Acre	Comments
black rot, powdery mildew, downy mildew	Same as for Grape Bloom, pages 85-86. Note PHI on products that contain mancozeb.		
grape berry moth, grape rootworm (adults), leafhoppers, rose chafer, Japanese beetle, redbanded leafroller, grape mealybug, mites	Same as for Grape Shatter, pages 87-88. Rose chafer infestations usually subside by veraison.		

■ Grape Veraison to Harvest

Pest/Problem	Material	Rate/Acre	Comments
Botrytis bunch rot	See comments under Grape Bloom for Topsin M, Rovral, Vanguard, and Elevate. See Botrytis Bunch Rot, page 93. Same as for Grape Bloom, page 86		
	OR OSO 5% SC	3.75-13.0 fl. oz.	
powdery mildew, downy mildew	Same as for Grape Bloom, page 86.		
black rot	As berries reach full size and sugar content starts to increase, they become resistant to infection by the black rot fungus. Research in New York has demonstrated that berries of most varieties become resistant to black rot infection 4-5 weeks after bloom. Sprays for black rot should not be needed at this time.		
grape berry moth, grape rootworm, Japanese beetle, leafhopper, redbanded leafroller, mites	Same as for Grape Shatter, page 87. Continue to monitor for insect and mite pests, and apply insecticide as needed. Refer to product labels for specific insects, rates, and harvest restrictions.		
green June beetle	Sevin XLR Plus (4F)	2 qts.	Other formulations may be available. See Special Re-entry Interval (REI) Considerations for Topsin M, Pristine and Sevin, page 95. In the southern Midwest, apply in July when first beetles enter the vineyard. Repeat sprays as needed (weekly). Several insecticides listed for Japanese beetle control for Grape Shatter on page 88 (including Danitol and Brigade) also provide at least some green June beetle control.
stink bugs	Brigade 2EC	6.4 fl. oz.	As recommended on 2(ee) label. PHI=30 days. Do not exceed 6.4 fl. oz. per acre per year.
	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Scorpion 35SL	5 fl. oz.	Do not exceed 21.25 fl. oz. per acre per year. PHI=1 day.

(continued)

Grape Veraison to Harvest (continued)

Pest/Problem	Material	Rate/Acre	Comments
Drosophila (also known as fruit flies and vinegar flies), including spotted wing Drosophila	Baythroid XL (1EC)	2.4-3.2 fl. oz.	As recommended on 2(ee) label. PHI=3 days.
	Danitol 2.4EC	10.7-21.3 fl. oz.	PHI=21-days.
	Delegate 25WG	3-5 oz.	As recommended on 2(ee) label. PHI=7 days.
	Entrust 2SC	4-8 fl. oz.	As recommended on 2(ee) label. PHI=7 days.
	Entrust 80 WP	1.25-2.5 oz.	As recommended on 2(ee) label. PHI=7 days.
	Imidan 70WP	1.3-2.1 lbs.	PHI is 7 or 14 days depending on activity.
	Malathion	See label	See Spotted Wing Drosophila, page 91. Malathion formulations and rates vary by state. Check labels for specific information. PHI= 3 days.
	Mustang Maxx 0.8EC	4.0 fl. oz.	As recommended on 2(ee) label. PHI=1 day.
multicolored Asian lady beetle	See Multicolored Asian Lady Beetle, page 92. Scout vineyards several days before harvest to determine the abundance of multicolor Asian lady beetle. Additional insecticides (including Baythroid and Mustang Maxx) have short pre-harvest intervals, and although not labeled specifically for this pest, they have been effective in trials and vineyard use.		
	Belay 2.13SC	2-4 fl. oz.	PHI=0 days.
	Mustang Maxx 0.8EC	2-4 fl. oz.	PHI=1 day.
	Scorpion 35SL	2-5 fl. oz.	PHI=1 day.
	Venom 70SG	1-3 oz.	PHI=1 day
grape root borer	See Grape Root Borer, page 92.		
RESIDUE REMINDER: Wettable powder formulations may leave visible residues on fruit at harvest.			

Grape Post Harvest

Pest/Problem	Material	Rate/Acre	Comments
downy mildew, powdery mildew	Same as for earlier sprays. Check labels for details. In some years, these diseases may cause defoliation well before the onset of cool weather in the fall. Post-harvest early defoliation predisposes the vines to winter injury and reduces productivity for the following season. Thus, it is important to maintain at least some protection against foliar infections by these fungi. Post-harvest rates for fungicides should be the same as pre-harvest rates. Check labels for season limits on quantity of products.		

Special Comments on Grape Schedule

Spotted Wing Drosophila

Spotted wing Drosophila (SWD) is a very serious new invasive pest that attacks small fruit crops, some stone fruits (cherry, nectarine, peach), high tunnel tomatoes, and wild hosts (including pokeweed, autumn olive, crabapple, nightshade, Amur honeysuckle, and wild grape).

What makes SWD different from other fruit flies is that the female has a stout, toothed ovipositor (egg layer) that enables her to lay eggs under the skin of ripening fruits that are otherwise healthy and sound. Generally, soft-skinned fruit become vulnerable to attack as they begin to soften and turn color during ripening, which is usually in the final seven to 10 days before harvest. The larvae tunnel and feed under

the skin of the fruit and can reach 4 millimeters long. There is often a sunken area at the site where the eggs are laid, and damaged fruit may appear to collapse from the internal damage and rots.

SWD is able to complete its life cycle in just more than a week when temperatures are optimal, and there may be 10 or more generations per year. Growers need to monitor plantings for SWD in the final weeks before harvest. Traps for monitoring and detecting SWD are available. More information about SWD is available from Michigan State University Integrated Pest Management: www.ipm.msu.edu/swd.htm.

Look for additional state labels that may allow for changes to rates and allowable number of applications of various insecticides. When applying insecticides during the harvest period, be sure to

carefully watch the pre-harvest intervals for the products you choose to apply.

Multicolored Asian Lady Beetle

The multicolored Asian lady beetle (MALB), a late-season vineyard inhabitant, can significantly reduce wine quality. These beetles are attracted to ripening grapes as a source of sugars in late summer and fall. They may congregate, often by the hundreds or thousands, in and among grape clusters from August through October.

Although they may cause direct yield loss, they more often reduce wine quality when sufficient numbers become trapped in the harvested grapes and are crushed along with the grapes at the winery. MALB secretes a defense chemical when they are stressed. This defense chemical causes wine to smell “dirty” (a musty, damp odor), masking the flavors and smells of the grapes.

As few as two MALB per lug of grapes can alter wine flavor and bouquet enough to be detected. Excessive numbers of MALB in grape clusters are most common in late-ripening varieties such as Cabernet Franc, Cabernet Sauvignon, Chambourcin, Riesling, Vidal, and Vignoles, but earlier grapes that are prone to cracking can also be infested.

Scout vineyards several days before harvest to determine the abundance of MALB. Belay 2.13SC, Venom 70SG, and Scorpion 35S are labeled specifically for control of this insect in grapes. Additional insecticides (including Baythroid and Mustang Maxx) have short pre-harvest intervals and, although they are not labeled specifically against MALB, they have been effective in trials and vineyard use.

Grape Root Borer

It is generally difficult to evaluate grape root borer damage. Injury is most often associated with a slow decline of vineyards, when it can be associated at all.

If grape root borer is not a problem, there is no reason to risk destroying the natural control processes (predators, parasites, diseases). A pheromone lure is available that is very effective for attracting grape root borer males. Set out traps in early June. If you detect moths, then we advise treatment.

If you believe that this insect is affecting your vineyard's performance, you may wish to begin the program described below. Sampling is critical for several reasons, including:

1. The control program is relatively expensive.
2. Using insecticide can create, as well as solve, problems.

Immediately After Harvest

Sample 10 vines/acre (but not less than 50 vines). Older vines are more likely to be infested.

Examine a circular site (3 feet in diameter) around the base of each plant, concentrating on the inner 1 foot. Look for shed pupal skins of the grape root borer moth. If you find pupal skins beneath 5 percent of the vines examined, apply an insecticide next year.

35 Days Before Harvest the Next Season

If the previous year's sample indicates a need to spray, apply Lorsban Advanced, Lorsban 4E, or Lorsban 75WG. The directions on the Lorsban label are to use a rate of 4.5 pints of Advanced or 4E or 3 pounds of 75WG per 100 gallons of water. Apply 2 quarts of this diluted spray mix to the soil surface on a 15-square-foot area (4.4-foot circle) around the base of each vine. Do not allow the spray to contact fruit or foliage. The pre-harvest restriction is 35 days. Only one Lorsban application is allowed per year. Do not use for grape root borer control if you already used Lorsban pre-bloom for cutworm control.

Wasps in Fruit Plantings

Almost anywhere fruit is produced, wasps can become a nuisance, or in some cases, a severe pest. Primarily, they are pests more because they sting than because they damage much fruit. Unfortunately, there is very little help available for controlling wasps.

Wasps are generally attracted to the juice and soft fruit. By far, the key to prevention, or at least to reducing problems with wasps, is sanitation. Regularly and thoroughly pick all ripe fruit and fruit debris to help solve this problem. In addition, remove any item that has food value (e.g., soft drinks, lunches, etc.) that pickers may bring in.

Anthracnose

Anthracnose is often more common in the warmer, southern regions of the Midwest. However, reports of the disease from more northern areas are becoming more common, especially on super-cold-hardy varieties such as Frontenac and Marquette.

Fungicide recommendations for anthracnose control consist of a dormant application of Sulfurix in early spring followed by foliar fungicide applications during the growing season.

Delayed-dormant Application of Sulforix

Apply Sulforix at the rate of 1 to 2 gallons per acre to control anthracnose. This is probably the most important spray for controlling the disease.

Make the delayed-dormant spray in early spring just as buds swell, but before they show green. This high rate is intended to “burn out” overwintering inoculum on infected canes.

Foliar Fungicides

Early-season applications are important to keep anthracnose from spreading to new tissues. As leaves and canes mature (fully expanded), they become resistant to infection; however, new leaves and succulent cane tips are susceptible throughout the season, and berries remain susceptible until veraison.

Foliar fungicides will probably not provide satisfactory anthracnose control unless you use them in conjunction with a delayed-dormant Sulforix application. See Effectiveness of Fungicides for Control of Grape Diseases on page 96 for more information about the efficacy of foliar fungicides for anthracnose control.

Grape Bitter Rot

Unlike black rot, which does not infect berries late in the season, bitter rot attacks only mature berries. Both diseases result in black, shriveled (mummified) fruit, and some growers have mistaken bitter rot for black rot. A rule of thumb is that if a rot that looks like black rot develops on mature berries (8 percent or greater sugar), it is likely to be bitter rot.

The systemic FRAC 3 fungicides (Rally, Bayleton, Tebuzol, Mettle, and Procure) are not effective against bitter rot (see Effectiveness of Fungicides for Control of Grape Diseases, page 96). If bitter rot is a problem, pre-harvest applications of Captan may be beneficial. Observe all pre-harvest restrictions.

Botrytis Bunch Rot

Botrytis bunch rot is most commonly a problem on tight-clustered French hybrid and *Vitis vinifera* cultivars. Infections can occur near bloom, but the disease does not appear until veraison or during harvest. Proper timing and thorough spray coverage are essential for good control.

Note: Growers in Europe and Canada have reported fungicide resistance due to overuse of Rovral over a period of three to five years. Vangard and Elevate are also at risk for fungicide resistance development. Therefore, we recommend that you limit Rovral, Elevate, and Vangard applications to a maximum of

three per year to reduce the probability of developing strains of Botrytis that are resistant to these materials. In addition, consider alternating applications of Rovral, Elevate, and Vangard during the growing season.

Note: Removing leaves around clusters on mid- or low-wire cordon-trained vines before bunch closing has been shown to reduce losses caused by Botrytis.

Grape Sour Rot

Sour rot occurs late in the season near harvest on berries that are damaged from bird pecks, rain cracking, and insect damage. The most obvious sour rot symptom is a pre-harvest decay accompanied by a vinegar smell (that is, acetic acid, or what wine-makers call volatile acidity). The berries usually turn a tan color, soften, and eventually break down and disintegrate. The decayed berries seldom have any noticeable fungal growth or fruiting bodies on the surface like you would see with Phomopsis, Botrytis or black rot.

Sour rot is caused by a combination of yeasts and bacteria in a step-wise process. Yeasts convert the fruit sugar to ethanol, and then the bacteria convert the ethanol to acetic acid. The yeasts involved include the good *Saccharomyces* types as well as various wild types. The bacteria are mostly species of *Acetobacter* and *Gluconobacter*.

Both yeasts and bacteria require some type of physical injury or wound to infect the berries, so bird pecks, rain cracking, compression in tight clusters, and so on, are all involved in the process. While filamentous fungi (such as Botrytis) may be associated with the rotting berries, they don't appear to be the cause. Thus, traditional fungicides will not control sour rot.

Evidence shows that sour rot does not become a problem until berries reach about 15 Brix. Temperature dramatically affects the rate of development — rot develops most rapidly at high temperatures. Additionally, fruit flies of the genus *Drosophila* have been shown to be a key component of the disease cycle. They somehow facilitate the conversion of ethanol to acetic acid by bacteria.

Growers can minimize the risk of sour rot by minimizing berry injury from birds, insects, and other sources. Another strategy is to provide an open canopy microclimate that is not conducive to disease development. Thinning and positioning shoots, removing leaves, managing nutrients, and using a training system can all play a role.

The most effective sour rot control is to minimize the populations of yeasts, bacteria, and fruit flies. Research in New York has shown best results came from applying both an insecticide (to control fruit flies) and an antimicrobial (to reduce the pathogen population) starting at 15 Brix. Oxidate (hydrogen dioxide and peroxyetic acid) and Fracture (a naturally occurring seed protein from lupines, *Banda de Lupinus albus doce* BLAD) are effective antimicrobials. Both of these products are labeled for grapes and have short PHIs: 0 days and 1 day, respectively. Mustang Maxx, Delegate, and malathion are effective insecticides against fruit flies and also have relatively short PHIs (1, 7, and 3 days respectively).

Downy Mildew Resistance to Strobilurin Fungicides

Do not apply more than two sequential sprays of Abound, Sovran, Flint, or Pristine before alternating with a fungicide that has a different mode of action. For wine and table grapes, do not make more than four applications of a strobilurin fungicide per acre per year. For all other types of grapes, do not make more than three applications of a strobilurin fungicide per acre per year. Always read the label.

Consider not using strobilurin fungicides alone for downy mildew control, and think about incorporating some of the newer fungicides, such as Ranman, Revus, and Zampro. Also, tank-mix strobilurins with another fungicide with activity against downy mildew.

See Effectiveness of Fungicides for Control of Grape Diseases (page 96) for alternative fungicides for downy mildew control, and Note on Fungicide Resistance Management (page 133).

Powdery Mildew Resistance Management

In some locations, the powdery mildew fungus has developed resistance to:

- Sterol-inhibiting fungicides (FRAC 3) — Bayleton, Inspire Super, Mettle, Procure, Rally, and Tebuzol.
- Strobilurin fungicides (FRAC 11) — Abound, Flint, Reason, and Sovran.
- Pre-mixes of strobilurins (FRAC 11+ 3, 7, 27) — Adament, Pristine, Quadris Top, and Tanos

All of these materials are highly effective for powdery mildew control. In vineyards where these materials have been used for several years, reduced sensitivity or resistance may be present. For this reason, we rec-

ommend you do not use them alone to control powdery mildew. In order to adequately control powdery mildew, mix these products with sulfur, JMS Stylet Oil, Quintec, Endura, Torino, Tavano, or potassium salts. Sulfur is an inexpensive and effective fungicide for powdery mildew control. Consider using sulfur on varieties that are sulfur tolerant.

See Effectiveness of Fungicides for Control of Grape Diseases (page 96) for alternative fungicides for powdery mildew control, and Note on Fungicide Resistance Management (page 133).

Copper Fungicides for Grape Disease Control

When different formulations of copper are dissolved in water, copper ions are released into solution. These copper ions are toxic to fungi and bacteria because of their ability to destroy proteins. However, using copper fungicides carries the risk of injuring foliage and fruit of most crops.

Factors promoting copper injury include:

1. The amount of actual copper applied
2. Cold, wet weather (slow drying conditions) that apparently increases the availability of copper ions and, thus, increases the risk of plant injury.

Because of the potential to injure plants and to accumulate in soil, copper fungicides in conventional production systems has largely been replaced with conventional fungicides that are generally safer to plant tissues and often more effective.

Several terms are used when discussing copper as a fungicide. The original material used was called copper sulfate (also known as blue vitriol or bluestone). When this material was combined with lime in the French vineyards, the combination became known as Bordeaux mixture.

Bordeaux Mixture

Bordeaux mixture is a mixture of copper sulfate and hydrated lime in water. It has long residual action and has been used for years to control many diseases, including downy mildew and powdery mildew of grape. It can be mixed on-site. It is also available as a dry wettable powder.

Fixed Copper Fungicides

Fixed copper formulations release copper ions more slowly and generally injure plant tissues less (safer to use) than Bordeaux mixture. But fixed copper use is still limited because of their potential to injure plants and lack of compatibility with other pesticides.

Some of the more common commercial formulations of fixed copper include:

Basic copper sulfate: Griffin Basicop, Basic Copper "53," Micro Flo Cuproxat, Tennessee Brand Tri-Basic Copper Sulfate, Tenn-Cop 5E, and Cuprofix Ultra 40DF.

Copper (Cupric) hydroxide: Agtrol Champion WP, Agtrol Champ flowable, Agtrol Champ 2F, Kocide 101, Kocide 3000DF, Kocide 2000D, Microflo BlueShield WP, and Microflo BlueShield DF.

Recommendations for Copper Fungicide Use on Grapes

Copper fungicides are highly effective against downy mildew and are moderately effective against powdery mildew. Copper fungicides are weak for controlling black rot, Botrytis bunch rot and Phomopsis cane and leaf spot.

To reduce the risk of phytotoxicity when using copper:

1. Do not make a complete seasonlong spray program with only copper fungicides.
2. Use fungicides other than copper whenever possible.
3. Delay copper use as late into the growing season as possible.
4. Avoid the use of copper sulfate alone. Always use a "fixed" copper formulation.
5. Use the full recommended rate of lime. Never eliminate lime use completely, unless the pesticide label indicates such.
6. Remember that cool, wet weather enhances the risk of copper injury. Be especially certain to use adequate lime levels during such periods or switch to other fungicides.
7. Some products are incompatible with copper. Do not mix copper products with anything that will acidify the spray mixture (such as phosphorus acid fungicides).
8. Avoid copper and lime sprays on fruit destined for fresh market.

Special Re-entry Interval (REI) Considerations for Topsin M, Pristine and Sevin

Some grape pesticides have special REIs.

The Topsin M label states: "Do not allow worker entry into the treated areas during the restricted-entry interval (REI) of 2 days."

The Pristine label states: "The REI is 12 hours for all crop uses except when performing cane tying, cane turning or cane girdling on grapes. The REI is 5 days for treated grapes when conducting cane tying, cane turning or cane girdling."

The Sevin label states: "For grapes East of the Rocky Mountains, the restricted-entry interval is 2 days for all activities except cane girdling and cane tying. The REI is 6 days for grape girdling and cane tying."

Cane girdling, cane turning, and cane tying are not common tasks in the Midwest, but might be interpreted to include more common Midwest tasks such as shoot positioning, cluster thinning, shoot tucking, etc. Carefully read labels before using these products.

Note on Insecticide Resistance Management

Insects have been known to develop resistance to insecticides after repeated exposure. For insecticide resistance management, avoid successive applications of insecticides within the same group or type of chemistry. The Insecticide Resistance Action Committee codes (IRAC codes) listed in the Insecticide and Miticide PHIs and REIs tables (pages 135-138) identify the various insecticide mode of action groups. Rotating to insecticides with a different IRAC code should help avoid development of insecticide resistance.

Effectiveness of Fungicides for Control of Grape Diseases¹

These ratings are intended to provide readers with an idea of relative effectiveness. They are based on published data and/or field observations from various locations. Ratings could change based on varietal susceptibility and the environment's effect on disease development. Inclusion does not imply endorsement, and omission does not indicate disapproval.

Fungicide	Phomopsis cane and leaf spot	black rot	downy mildew	Powdery mildew	Botrytis rot	bitter rot	anthracnose
Abound ^{2,3}	F	E	E ^R	E ^R	G	1	E
Aprovia	0	F	0	G	0	0	0
Captan	E	F	E	0	F	G	G
Elevate	0	0	0	0	E	0	1
Endura	0	0	0	E	G	0	E
Ferbam	F	E	F	0	0	G	1
fixed copper and lime	F	F	E	G	F	F	1
Flint ^{2,3}	F	E	F ^R	E ^R	G	1	E
Forum	0	0	E	0	0	0	0
Fracture	0	0	0	E	E	0	0
Inspire Super	0	E	0	E	E	1	E
JMS Stylet Oil	0	0	0	E	0	0	0
Kenja	0	0	0	F	F	0	0
Luna Experience	G	G	G	E	E	G	0
Mancozeb/Dithane	E	E	E	0	0	G	E
Mettle	0	E	0	E ^R	0	0	E
Potassium salts	0	0	0	G	0	0	0
Phosphorous acid/ Prophyt, Phostrol, Agri-Fos, Topaz, Legion, Rampart	0	0	E	0	0	0	0
Pristine ³	F	E	E ^R	E	G	1	E
Procure ²	0	G	0	E ^R	0	1	1
Quadris Top	F	E	E	E	G	1	E
Quintec	0	0	0	E	0	0	0
Rally ²	0	E	0	E ^R	0	1	E
Ranman	0	0	E	0	0	0	0
Reason	G	G	E	E	1	1	1
Revus	0	0	E	0	0	0	0
Revus Top	0	E	E	E	1	1	E
Ridomil Gold MZ	F	G	E	0	0	G	G
Ridomil Gold Copper	F	F	E	G	F	F	0
Rovral	0	0	0	0	G	0	1
Scala	0	0	0	0	G	0	1
Sovran ^{2,3}	F	E	G ^R	E ^R	G	1	E
Sulfur	F	0	0	E	0	0	1
Switch	0	0	0	0	G	1	0
Tanos	0	0	E	0	0	0	0
Tebuzol ²	0	E	0	E ^R	0	1	E
Topsin M ⁴	G	F	0	E	G	G	E
Torino	0	0	0	E	0	0	0
Vanguard	0	0	0	0	E	0	1
Vintage	0	E	0	E ^R	0	1	E
Vivando	0	0	0	E	0	0	0
Zampro	0	0	E	0	0	0	0
Ziram	G	E	G	0	0	1	G

¹ E = Excellent. G = Good. F = Fair. F = Fair. 0 = not effective. 1 = effectiveness unknown or not established. R = Fungicide resistance possible. See Fungicide PHIs and REIs (Pages 130-133) for FRAC codes and discussion of fungicide resistance.

² These fungicides are not recommended for powdery mildew control if fungicide-resistant strains of the powdery mildew fungus are present in your vineyard.

³ These fungicides are not recommended for downy mildew control if fungicide resistant strains of the downy mildew fungus are present in your vineyard.

⁴ Where Topsin M-resistant strains of the powdery mildew and Botrytis fungi have been detected, Topsin M will be ineffective and should not be used.

Pre-harvest Restrictions for Fungicides Registered for Use on Grapes¹

Trade Name	Common Name	Grape Pre-harvest Intervals (PHI) and Limitations (maximum amount per acre per season) ²	FRAC Code ³	REI ⁴ (hours)
Abound	azoxystrobin	14* (92.3 fl. oz.)	11	12
Aprovia	benzovindiflupyr	21 (31.5 fl. oz.)	7	12
Aliette	fosetyl-AL	15*	33	12
basic copper sulfate	copper sulfate	0	M	24
Captan	captan	0 (24 lbs.)	M	72
Dithane M-45, others	mancozeb	66*	M	24
Elevate	fenhexamid	0* (3 lbs.)	17	12
Endura	boscalid	14* (24 oz.)	7	12
Ferbam	carbamate	7	M	24
Flint	trifloxystrobin	14* (24 oz.)	11	12
Forum	dimethomorph	28* (24 oz.)	40	12
Fracture	Banda de Lupinus albus doce (BLAD)	1	M	4
Inspire Super	difenoconazole + cyprinil	14* (8 oz.)	3+9	12
JMS Stylet Oil	oil	0	-	12
Kenja	isofetamid	16 (66 fl. oz.)	7	12
Luna Experience	fluopyram + tebuconazole	14 (34 fl. oz)	7+3	12 hr / 5 days ⁵
Mettle	tetraconazole	14 (10 oz.)	3	12
Pristine	Pyraclostrobin + boscalid	14* (69 oz.)	11+7	12 hr / 5 days ⁵
Procure	triflumizole	7 (32 oz.)	3	24
Prophyt, Phostrol, Agri-Fos, Topaz, Legion, Rampart	Phosphorous acid	0	33	4
Quadris Top	difenoconazole + azoxystrobin	14* (56 oz.)	3+11	12
Quintec	quinoxifen	14* (33 oz.)	13	12
Rally	myclobutanil	14 (1.5 lbs.)	3	24
Ranman	cyazofamid	30* (16.5 oz.)	21	12
Reason	fenamidone	30 (8.1 fl. oz.)	11	12
Revus	mandipropamid	14 (32 oz.)	40	12
Revus Top	difenoconazole + mandipropamid	14* (28 oz.)	3+40	12
Ridomil Gold MZ	mefenoxam + mancozeb	66 (10 lbs.)	4+M	48
Ridomil Gold Copper	mefenoxam + copper	42 (8 lbs.)	4+M	48
Rovral	iprodione	7* (8 pts.)	2	48
Scala	pyrimethanil	7 (36 oz.)	9	12
Sovran	kresoxim-methyl	14* (25.6 oz.)	11	12
Sulforix, Lime sulfur solution	calcium polysulfide	0*	M	48
Sulfur	sulfur	0	M	24
Switch	cyprodinil + fludioxonil	7 (56 oz.)	9+12	12
Tanos	famoxadone + cymoxanil	30	11+27	12
Tebuzol	tebuconazole	14 (2 lbs.)	3	12
Topsin M	thiophanate	7 (6 lbs.)	1	2 days
Torino	cyflufenamid	3* (6.8 oz.)	U6	4
Vanguard	cyprodinil	7* (30 oz.)	9	12
Vivando	metrafenone	14 (42.6 fl. oz.)	U8	12
Zampro	ametctradin + dimethomorph	14 (56 fl. oz.)	45 + 40	12
Ziram	ziram	21 (28 lbs.)	M	48

¹ * = limited number of applications allowed, or other restrictions apply. Refer to label directions.

² Amounts shown in parenthesis are the maximum amounts of the fungicide permitted per season.

³ FRAC code represents the fungicide mode of action.

⁴ All fungicides have a restricted-entry interval (REI), the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REIs. REI restrictions may prohibit the use of certain pesticides during harvest.

⁵ The REI is 5 days for treated wine grapes when conducting cane tying, turning, or girdling on wine grape. The REI is 12 hours for all other activities in wine grapes.

Effectiveness of Insecticides and Miticides for Grape¹

Trade Name	Common Name	IRAC	climbing cutworms	eight spotted forester	grape berry moth	grape cane girdler, grape cane gallmaker	grape flea beetle	grape phylloxera (foliar)	grape root borer	Japanese beetle	leafhoppers	multicolored Asian lady beetle	redbanded leafroller	rose chafer	spider mites	spotted wing Drosophila	PHI (days)	REI (hours)
Actara	thiamethoxam	4A									G						5	12
Admire Pro	imidacloprid	4A						G		F	E	G		F		F	0/30*	12
Altacor	chlorantraniliprole	28	G		E								E				14	4
Assail	acetamiprid	4A						G		G	E			E		F	3	12
Avaunt	indoxacarb	22			G					G							7	12
Baythroid	cyfluthrin	3A			E	G	G	G		E	G	G		E		E	3	12
BeetleGONE!	B.t. galleriae	11								G							0	4
Belay	clothianidin	4A			F					F	E	E					0/30*	12
Brigade	bifenthrin	3A	G		G		G	G		G	G			G		E	30	12
Closer	sulfoxaflor	4C									E						7	12
Danitol	fenpropathrin	3A	G		E			E		E	G				G	E	21	24
Delegate	spinetoram	5			E								E			E	7	4
Dibrom	naled	1B															10	48
Entrust	spinosad	5			G								G			G	7	4
Imidan	phosmet	1B			G		F			G	G		G	G		G	7/14	14 days
Intrepid	methoxyfenozide	18			E								G				21/30	4
Lorsban	chlorpyrifos	1B	E						G								35*	24
Malathion	malathion	1B			F					G	G			G		G	3*	12/24
Movento	spirotetramat	23						E			G						7	24
Mustang Maxx	zeta-cypermethrin	3A			E	G	G	G		E	E	G		E		E	1	12
Platinum	thiamethoxam	4A						G									60	12
Sevin	carbaryl	1A	E	E	G		E			E	G	E	G	E		F	7	2 days/6 days
Sivanto	flupyradifonone	4D									G						0/30*	4/48*
Venom, Scorpion	dinotefuran	4A			F					F	G	G					1/28	12
Miticides																		
Acramite	bifenazate	20													G		14	12/5 days
Agri-Mek	abamectin	6									F				G		28	12 hrs/4 days
Apollo	clofentezine	10A													E		21	12 hrs; 14 days; 39 days
Dicofol	dicofol	UN													F		7	39 days
Envidor	spirodiclofen	23													E		14	12
Kanemite	acequinocyl	20B													F		7	12
Nealta	cyflumetafen	25													G		14	12
Nexter	pyridaben	21A									G				G		7/10	12
Onager	hexythiazox	10A													E		7	12
Portal	fenpyroximate	21									F				E		14	12
Vendex	fenbutatin-oxide (hexakis)	12B													F		28*	48
Zeal	etoxazole	10B													E		14	12

¹ P = poor. F = fair. G = good. E = excellent. Blank indicates not labeled or not recommended.

* = limited number of applications allowed, or other restrictions apply.

Relative Disease Susceptibility and Chemical Sensitivity Among Grape Cultivars

The relative ratings in this chart apply to an average growing season under conditions usually favorable for disease development. Any given cultivar may be more or less severely affected depending on conditions.

Cultivar	Susceptible or Sensitive to											
	black rot	downy mildew	powdery mildew	Botrytis	Phomopsis	Eutyp ¹	crown gall	anthracnose	sulfur ²	copper ³	2,4-D ⁴	dicamba ⁴
Arandell	+	+	+	+	++	?	?	+	?	?	++	?
Aromella	+	+++	+	+	++	?	?	+	?	?	+++	+++
Aurore	+++	++	++	+++	+	+++	++	+	No	++	?	?
Baco Noir	+++	+	++	++	+	++	+++	+	No	?	?	?
Brianna	?	+	?	+	?	?	?	?	Yes	+++	++	+
Cabernet Franc	+++	+++	+++	+	?	?	+++	++	No	?	+	+++
Cabernet Sauvignon	+++	+++	+++	+	+++	+++	+++	?	No	+	+	?
Catawba	+++	+++	++	+	+++	+	+	++	No	++	++	++
Cayuga White	+	++	+	+	++	+	++	+++	No	+	+	+++
Chambourcin	+++	+	+++	++	+	?	++	+	Yes	?	+++	++
Chancellor	+	+++	+++	+	+++	+	+++	++	Yes	+++	++	?
Chardonel	++	++	++	++	+++	++	++	+	No	?	++	+++
Chardonnay	++	+++	+++	+++	+++	++	+++	+++	No	+	++	+++
Concord	+++	+	++	+	+++	+++	+	+	Yes	+	+++	++
Corot noir	+	+++	+	+	++	+	+	+	No	?	++	+++
Cynthiana/Norton	+	++	+	+	+	?	+	+	Yes	?	+++	+++
DeChaunac	+	++	++	+	+++	+++	++	++	Yes	+	+	++
Delaware	++	+++ ⁵	++	+	+++	+	+	++	No	+	+++	?
Edelweiss	?	?	?	?	?	?	?	?	?	?	++	?
Foch	++	+	++	+	+	+++	+	++	Yes	++	+++	+++
Fredonia	++	+++	++	+	+++	?	+	+++	No	?	++	++
Frontenac	+++	+	++	++	+	?	?	+++	No	++	+	+++
Frontenac Gris	++	+	++	++	+	?	?	++	No	++	+	+
Geneva Red	+	++	++	++	+	+	+	+	No	?	+	+++
Gewürztraminer	+++	+++	+++	+++	?	?	+++	+++	No	+	?	?
Jupiter	++	+++	+++	+	+	?	?	+	?	?	+	++
LaCrescent	++	+++	++	+	+++	+	+	+	No	?	+++	+++
LaCrosse	+++	++	++	+++	++	?	?	+	No	++	+++	+++
Lemberger	+++	+++	+++	+	?	+++	+++	?	No	?	++	?
Leon Millot	+	++	+++	+	+	+	?	+	Yes	++	+	?
Marquette	++	+	+	+++	+++	?	+	+++	No	++	+++	+
Marquis	+	+++	+	+	+++	?	?	+++	?	?	+	?
Mars	+	+	+	+	+	?	+	++	?	?	+	+
Merlot	++	+++	+++	++	+	+++	+++	++	No	++	?	?
Moore's Diamond	+++	+	+++	++	?	++	?	?	No	?	?	?
Niagara	+++	+++	++	+	+++	+	++	++	No	+	+++	++
Noiret	+++	++	++	+	+	?	++	+	No	?	++	+++
Pinot gris	+++	+++	+++	++	?	+++	+++	?	No	?	?	?
Pinot noir	+++	+++	+++	+++	?	?	+++	?	No	+	?	?
Reliance	+++	+++	++	+	++	?	?	+++	No	+	+	?

(continued)

Relative Disease Susceptibility and Chemical Sensitivity Among Grape Cultivars *(continued)*

Cultivar	Susceptible or Sensitive to											
	black rot	downy mildew	powdery mildew	Botrytis	Phomopsis	Eutyp ^a	crown gall	anthracnose	sulfur ²	copper ³	2,4-D4	dicamba ⁴
Riesling	+++	+++	+++	+++	++	++	+++	?	No	+	+	++
St. Croix	?	++	++	++	+++	?	?	+	No	++	++	?
Seyval	++	++	+++	+++	++	+	++	+	No	+	++	+++
Steuben	++	+	+	+	+	?	+	+++	No	?	+	++
Sunbelt	+	++	++	+	+	?	?	+	?	?	+++	++
Traminette	+	++	+	+	+++	?	++	+	No	?	++	++
Valvin Muscat	++	+	++	+	+	?	+	?	No	?	+++	+
Vanessa	+++	++	++	+	+	?	+	?	?	?	+	?
Vidal blanc	+	++	+++	+	+	+	++	+++	No	?	++	+++
Vignoles	+	++	+++	+++	++	++	++	+++	No	?	+	+++

¹ + = slightly susceptible or sensitive. ++ = moderately susceptible or sensitive. +++ = highly susceptible or sensitive. No = not sensitive. Yes = sensitive. ? = relative susceptibility or sensitivity not established.

² Slight to moderate sulfur injury may occur even on tolerant cultivars when temperatures are 85°F or higher during, or immediately following, the application.

³ Copper applied under cool, slow-drying conditions is likely to cause injury.

⁴ Herbicide sensitivity ratings based on observation and simulated drift studies in Indiana.

⁵ Berries not susceptible.

Blueberry Spray Schedule

■ Blueberry Delayed Dormant

Apply after buds begin to break.

Pest/Problem	Material	Rate/Acre	Comments
Phomopsis cane and twig blight	lime sulfur solution	See comments	The lime sulfur label reads: Use 5-6 gals. per 100-150 gals. of spray per acre. Apply at delayed dormant stage after leaf buds begin to break. Do not use within 14 days of an oil spray or when temperature is above 75°F as burning of foliage may occur.
Phytophthora root rot	Aliette WDG		
	Legion 80WDG		
	phosphorous acid	See Phytophthora Root Rot, page 105 Be sure the phosphorus acid spray solution has a pH >5.5 to limit phytotoxicity. Carefully monitor fertility, because phosphorous acid applications can cause nutrient deficiencies. Do not exceed 1 soil application per season of Ridomil Gold SL at 3.6 pts./A.	
	Ridomil Gold SL		

■ Blueberry Green Tip

Apply when leaf buds are showing 1/16-1/4 inch green tip.

Pest/Problem	Material	Rate/Acre	Comments
mummy berry (shoot blight phase), Phomopsis stem canker and stem blight	Unless diseases (mummy berry, anthracnose, or Phomopsis stem canker) are or have been a problem, an intensive fungicide spray program may not be required.		
	Abound	6-15.5 fl. oz.	
	Aframe	6-15.5 fl. oz.	
	Aframe Plus/Quilt Xcel	14-21 fl. oz.	
	Captan 80WDG	1.25-3 lbs.	Also available as Captec 4L (0.75-1 qts./100 gals.). Do not tank mix Captan with Diazinon.
	CaptEate 68WDG	4.7 lbs.	For management of mummy berry and anthracnose.
	Indar 2F	6 fl. oz.	A wetting agent is recommended to improve coverage.
	Luna Sensation	4-7.6 fl. oz.	A new 7/11 fungicide for blueberry disease control.
	Omega 500F	1.25 pts.	For management of Phomopsis twig blight and fruit rot, anthracnose, and Botrytis fruit rot. Do not use adjuvants with this product.
	Orbit/Tilt/Topaz	6 fl. oz.	For mummy berry management.
	Pristine	18.5-23 oz.	Do not tank-mix with other pesticides except fungicides that contain only captan as the active ingredient. Do not tank-mix with adjuvants, liquid fertilizers, nutrients, or other additives. Use only water as a spray carrier. See label.
	Proline 480 SC	5.7 fl. oz.	
	Quash	2.5 oz.	
Switch 62.5WDG	11-14 oz.		
Ziram 76DF	3 lbs.		

■ Blueberry Pink Bud Stage and 25% Bloom

Apply when flower petals show pink and again at 25% bloom.

Pest/Problem	Material	Rate/Acre	Comments
mummy berry (blossom infection), Phomopsis stem canker and stem blight, anthracnose	Abound/Aframe	6.2-15.5 fl. oz.	
	Aframe Plus/Quilt Xcel	14-21 fl. oz.	
	Captan 80WDG	1.25-3 lbs.	Provides protective control of stem canker and stem blight, anthracnose, and Phomopsis canker.
	CaptEate 68WDG	4.7 lbs.	For mummy berry and anthracnose management.
	Indar 2F	6-8 fl. oz.	
	Inspire Super	16-20 fl. oz.	
	Luna Sensation	4-7.6 fl. oz.	Controls phomopsis and anthracnose.
	Omega 500F	1.25 pts.	For management of Phomopsis twig blight and fruit rot, anthracnose, and Botrytis fruit rot. Do not use adjuvants with this product.
	Orbit/Tilt/Topaz	6 fl. oz.	
	Pristine	18.5-23 oz.	Do not tank-mix with other pesticides except fungicides that contain only captan as the active ingredient. Do not tank-mix with adjuvants, liquid fertilizers, nutrients, or other additives. Use only water as a spray carrier. See label.
	Quash	2.5 oz.	
	Tilt	6 fl. oz.	For mummy berry management.
Ziram 76DF	3 lbs.		
Botrytis blight	CaptEate 68WDG	3.5-4.7 lbs.	
	Elevate 50 WDG	1.5 lbs.	
	Luna Privilege	6.84 fl. oz.	
	Luna Sensation	4-7.6 fl. oz.	
	Luna Tranquility	16-27 fl. oz.	
	OSO 5% SC	3.75-13.0 fl. oz.	
	Pristine	18.5-23 oz.	
	Switch 62.5WG	11-14 oz.	

■ Blueberry Full Bloom to Early Petal Fall

Apply when all blossoms are open to when some petals begin to fall.

Pest/Problem	Material	Rate/Acre	Comments
mummy berry (blossom infection), Phomopsis stem canker and stem blight, anthracnose	Same as for Blueberry Pink Bud Stage and 25% Bloom, page 102.		
Botrytis blight	Same as for Blueberry Pink Bud Stage and 25% Bloom, page 103.		
cherry fruitworm	Intrepid 2F	10-16 fl. oz.	Cherry fruitworm control by conventional insecticides starts at petal fall, but control by Intrepid must begin earlier. First application is best at 400 degree days (base 50) after biofix (sustained catch of moths in pheromone trap). Second application at 100% petal fall.
	Esteem 0.86EC	16 fl. oz.	Apply when egg laying begins and again at petal fall.

■ Blueberry Petal Fall

Apply when petals are falling.

Pest/Problem	Material	Rate/Acre	Comments
cherry fruitworm	Control cherry fruitworm at petal fall and 10 days later. Insect pests of blueberry are rare in much of the region. Scout before applying insecticides. Unneeded insecticide applications can create problems where none existed.		
	Altacor 35WDG	3-4.5 oz.	
	Asana XL (0.66EC)	4.8-9.6 fl. oz.	
	Assail 30SG	4.5-5.3 oz.	
	Danitol 2.4EC	10.67-16 oz.	
	Delegate 25WG	3-6 oz.	
	Diazinon AG600	12.75 fl. oz.	
	Entrust 2SC	4-6 fl. oz.	
	Entrust 80WP	1.25-2 oz.	Do not exceed 9 oz. per season.
	Exirel 0.83SE	10-13.5 fl. oz.	
	Imidan 70WP	1.33 lbs.	
	Intrepid 2F	10-16 fl. oz.	
	Knack 0.83EC	16 fl. oz.	
	Lannate LV	1.5-3 pts.	
	Lannate SP	8-16 oz.	
Malathion	See label	Formulations and rates vary by state. Check labels for specific information.	
Sevin XLR Plus (4F)	1.5-2 qts.	Other formulations may be available.	

■ Blueberry First and Second Cover

Apply first cover about 7-10 days after petal fall, and second cover about 10 days later.

Pest/Problem	Material	Rate/Acre	Comments
anthracnose, Phomopsis stem canker and stem blight	Abound/Aframe	6.2-15.5 fl. oz.	
	Aframe Plus/Quilt Xcel	14-21 fl. oz.	
	Captan 80WDG	1.25-3 lbs.	Apply only if anthracnose or canker is a problem.
	CaptEvate 68WDG	3.5-4.7 lbs.	
	Indar 2F	6 fl. oz.	
	Inspire Super	16-20 fl. oz.	Not labeled for phomopsis.
	Luna Sensation	4-7.6 fl. oz.	
	Omega 500F	1.25 pts.	For management of Phomopsis twig blight and fruit rot, anthracnose, and Botrytis fruit rot. Do not use adjuvants with this product.
	Pristine	18.5-23 oz.	Do not tank-mix with other pesticides except fungicides that contain only captan as the active ingredient. Do not tank-mix with adjuvants, liquid fertilizers, nutrients, or other additives. Use only water as a spray carrier. See label.
	Switch 62.5WDG	11-14 oz.	
cherry fruitworm, cranberry fruitworm	Same as for Blueberry Petal Fall for cherry fruitworm, page 103. Control cherry fruitworm at petal fall and 10 days later. Control cranberry fruitworm 10 days and 20 days after petal fall.		
	Rimon 0.83EC	20-30 fl. oz.	Cranberry fruitworm only.
plum curculio	Plum curculio adults and larvae have not been observed to damage blueberries in the most southern portions of the region.		
	Brigade 2EC	2.1-6.4 fl. oz.	
	Brigade WSB (10WP)	5.3-16 oz.	
	Danitol 2.4EC	10.67-16 oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Imidan 70WP	1.33 lbs.	
Surround WP	25-50 lbs.	May leave noticeable residues on berries.	

■ Blueberry Third and Additional Covers

Apply about 10 days after previous cover, and repeat as needed. Be sure to check PHIs. See Fungicide PHIs and REIs (pages 130-133) and Insecticide and Miticide PHIs and REIs tables (pages 135-138).

Pest/Problem	Material	Rate/Acre	Comments
anthracnose, Phomopsis stem canker and stem blight	Same as Blueberry First and Second Cover, page 103. Be careful of PHI. Quilt Xcel and AFrame Plus have a 30 day PHI.		
blueberry maggot	Monitor for first emergence of blueberry maggot flies with traps. Emergence usually begins around July 1 in northern areas. Insecticide applications to protect berries may be needed until harvest. See product labels for pre-harvest intervals and restrictions. Blueberry maggot is not a common pest in the southern portion of the region.		
	Admire Pro (4.6F)	2.1-2.8 fl. oz.	
	Asana XL (0.66 EC)	9.6 fl. oz.	
	Assail 30SG	4.5-5.3 oz.	
	Brigade 2EC	2.1-6.4 fl. oz.	
	Brigade WSB (10WP)	5.3-16 oz.	
	Danitol 2.4EC	10.67-16 fl. oz.	
	Diazinon AG600	12.75 fl. oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Imidan 70WP	1.33 lbs.	
	Lannate LV	12-24 fl. oz.	
	Lannate SP	4-8 oz.	
	Malathion	See label	Formulations and rates vary by state. Check labels for specific information.
	Rimon 0.83EC	20-30 fl. oz.	
	Sevin XLR Plus (4F)	1.5-2 qts.	Other formulations may be available.
Sivanto 200SL	12-14 fl. oz.		
brown marmorated stink bug	Danitol 2.4EC	10.67-16 fl. oz.	
	Lannate LV	2-3 pts.	
	Lannate SP	2/3-1 lb.	
Japanese beetle	See Insecticide and Miticide PHIs and REIs tables (pages 135-138) for the PHIs of these insecticides.		
	Admire Pro (4.6F)	2.1-2.8 fl. oz.	
	Asana XL (0.66 EC)	4.8-9.6 fl. oz.	
	Assail 30SG	4.5-5.3 oz.	
	Aza-Direct	1-2 pts.	Acts as a repellent.
	Danitol 2.4EC	10.67-16 fl. oz.	
	Imidan 70WP	1.33 lbs.	Moderately effective and may be used until 3 days before harvest.
	Malathion	See label	Formulations and rates vary by state. Check labels for specific information.
	Neemix 4.5	7-16 fl. oz.	Acts as a repellent.
	Pyganic 1.4%EC	16-64 fl. oz.	Pyganic and Neemix provide some short-term control and may be applied until the day of harvest.
	Pyganic 5%EC	4.5-18 fl. oz.	
	Sevin XLR Plus (4F)	1-2 qts.	For Japanese beetle control on fruit, Sevin is labeled and effective, but may not be used within 7 days of harvest. Other formulations may be available.
	Surround WP	25-50 lbs.	May leave noticeable residues on berries.

Blueberry Third and Additional Covers *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
Drosophila (fruit flies, vinegar flies), including spotted wing Drosophila	Brigade 2EC (10WP)	6.4 fl. oz.	
	Danitol 2.4EC	10.67-16 fl. oz.	
	Delegate 25WG	3-6 oz.	
	Entrust 2SC	4-6 fl. oz.	
	Entrust 80WP	1.25-2 oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Imidan 70W	1.33 lbs.	
	Lannate LV	1.5-3 pts.	
	Lannate SP	0.5-1 lb.	
	Malathion	See label	Formulations and rates vary by state. Check labels for specific information.
	Mustang Maxx 0.8EC	4.0 fl. oz.	
	Rimon 0.83EC	20-30 fl. oz.	

■ Blueberry Post-harvest

Pest/Problem	Material	Rate/Acre	Comments
Phomopsis stem canker and stem blight	Captan 80WDG	1.25-3 lbs.	If canker is a problem, apply post-harvest sprays at 4-6 week intervals until leaf drop in the fall.

Special Comments on Blueberry Schedule

Spotted Wing Drosophila

Spotted wing Drosophila (SWD) is invasive fruit fly that infests small fruit crops, cherry, nectarine, peach, high tunnel tomatoes, and wild hosts (including pokeweed, autumn olive, crabapple, nightshade, Amur honeysuckle, and wild grape).

SWD is different from other fruit flies in that the female has a stout, toothed ovipositor (egg layer) that enables her to lay eggs under the skin of ripening fruits. Generally, soft-skinned fruits become vulnerable to attack as they begin to soften and turn color during ripening. The larvae tunnel and feed under the fruit skin and can reach 4 millimeters long. There is often a sunken area where the eggs are laid, and damaged fruit may appear to collapse from the internal damage and rots.

SWD completes its life cycle in a little more than a week during optimal temperatures, and there may be ten or more generations per year. Monitor plantings for SWD in the final weeks before harvest, beginning when fruit just starts to turn color. Traps for monitoring and detecting SWD are available. More information about SWD is available from Michigan State University Integrated Pest Management at: www.ipm.msu.edu/swd.htm.

Look for additional insecticide state labels allowing for changes to rates and allowable number of

applications. When spraying close to and during the harvest period, be sure to carefully watch the insecticides' pre-harvest intervals (PHIs).

Brown Marmorated Stink Bug

The brown marmorated stink bug (BMSB) has an extremely wide host range and is a pest of all small fruit. BMSB is attracted to fruits throughout much of the growing season. BMSB has piercing sucking mouthparts, which cause injury that may appear as sunken areas on the fruit. BMSB that are hidden in grape clusters at harvest may taint juice flavor at crush.

Actara, Brigade, Danitol, and Lannate have shown good efficacy in trials; however, multiple applications may be needed for reinfestations.

Phytophthora Root Rot

Ridomil Gold SL is labeled for control of Phytophthora root rot of blueberries. Apply to established plantings before the plants start growth in the spring. Apply to new plantings at time of planting.

Several phosphorous acid and aluminum tris fungicides are registered for Phytophthora root rot control on blueberry, including Aliette, Agri-Fos, ProPhyt, Phostrol, and Topaz. These materials essentially all have the same active ingredient. All are foliar sprays. They are highly systemic and move rapidly into leaves and are translocated down in the plant to the crown and roots. Read labels for additional information on use and restrictions.

Effectiveness of Pesticides for Blueberry Diseases¹

Trade Name	Common Name	FRAC Code ²	mummy berry (shoot)	Mummy berry (fruit)	Phomopsis twig blight and canker	Fusicoccum canker	Alternaria fruit rot	anthracnose fruit rot	Botrytis blight and fruit rot	Phytophthora root rot	PHI (Maximum amount/ acre/ season) ³	REI (hours) ⁴
Abound	azoxystrobin	11	F	F	F	—	F	E	F	—	0 (46 fl. oz.)	4
Aframe	azoxystrobin	11	F	F	F	—	F	E	F	—	0 (46 oz.)	4
Aframe Plus	azoxystrobin + propiconazole	3 + 11	F	F	G	—	—	F	—	—	30 (105 oz.)	12
Aliette WDG, Legion 80 WDG	aluminum tris (O-ethyl phosphonate)	33	—	—	G	—	G	G	—	G	12 (20 lbs.)	12
Captan 50WP	captan	M	F	F	F	F	F	G	F	—	0 (70 lbs.)	48
CaptEvote 68WDG	captan + fenhexamid	M 17	F	F	F	—	F	F	E	—	0 (21 lbs.)	48
Elevate 50WG	fenhexamid	M + 17	F	F	F	—	—	—	E	—	0 (6 lbs.)	12
Fontelis	penthiopyrad	7	F	F	—	—	—	E	—	—	0 (72 fl. oz.)	12
Indar	fenbuconazole	3	G	G	G	—	F	—	—	—	30	12
Inspire Super	difenoconazole + cyprodinil	3 + 9	—	—	—	—	—	—	—	—	7 (80 fl. oz.)	12
Luna Tranquility	fluopyram + pyrimethanil	7 + 9	G	E	—	—	—	—	E	—	1 (54.7 fl. oz.)	12
Omega 500F	fluazinam	29	F	G	—	—	F	G	—	—	30 (7.5 pts.)	12
OSO 5% SC	polyoxin D	319	GF	F	GF	—	—	G	G	—	0	4
Pristine	pyraclostrobin + boscalid	11 7	F	G	G	—	G	E	G	—	0 (92 oz.)	12
Proline 480C	prothioconazole	3	E	G	G	—	F	—	—	—	7 (11.4 oz.)	12
ProPhyt, Phostrol, Agri-Fos, Legion, Rampart	phosphorous acid	33	F	F	F	—	F	F	—	G	0	4
Quash	metconazole	3	G	G	E	—	—	G	G	—	7 (7.5 oz.)	12
Quilt Xcel	azoxystrobin + propiconazole	11 + 3	F	F	G	—	—	G	—	—	30 (82 fl. oz.)	12
Ridomil Gold SL	mefenoxam	4	—	—	—	—	—	—	—	E	0 (3.6 pts.)	48
Sulfurix	calcium polysulfide	M	G	F	—	—	—	F	—	—	0	48
Switch 62.5WG	cyprodinil + fludioxonil	9 12	F	F	F	—	E	G	G	—	0 (56 oz.)	12
Topaz	propiconazole	3	G	F	G	—	—	—	—	—	30 (30 fl. oz.)	12
Tilt	propiconazole	3	G	F	G	—	—	—	—	—	30 (30 fl. oz.)	12
Ziram 76DF	ziram	M	F	F	G	G	F	G	F	—	*	48

¹ E= excellent control; G=good control; F= fair control or suppression only; —=No data or no control.

² FRAC code represents the mode of action of the fungicide.

³ PHI refers to the post-harvest interval, which is the number of days before harvest that the product may not be applied. Amounts shown in parenthesis are the maximum amounts of the fungicide permitted per acre per season. If no amount is shown refer to the product label for specific restrictions.

⁴ All fungicides have a restricted-entry interval (REI), which is the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REI. REI restrictions may prohibit the use of certain pesticides during harvest.

* Do not apply later than 3 weeks after bloom. Refer to label directions.

Efficacy of Selected Pesticides for Control of Blueberry Insects¹

Trade Name	Common Name	IRAC Code (Mode of Action)	predator mite toxicity	plum curculio	cherry fruitworm	cranberry fruitworm	Japanese beetle	brown marmorated Stink bug	blueberry maggot	spotted wing Drosophila	PHI (days)	REI (hours)
Carbamates												
Lannate	methomyl	1A	HT	F	G			G	F	E	3	48
Sevin	carbaryl	1A	HT	G	G		E		G	G	7	12
Organophosphates												
Diazinon	diazinon	1B	ST	F					G	G	7	120
Imidan	phosmet	1B	ST	G	G		G	F	E	E	3	24
Malathion	malathion	1B	MT		F			F		G	1*	12/24*
Pyrethroids												
Asana	esfenvalerate	3A	HT	G	G		E	F		E	14	12
Brigade	bifenthrin	3A	HT	G	G		E	G	G	E	1	12
Danitol	fenpropathrin	3A	HT	G	G		E	G		E	3	24
Mustang Maxx	zeta-cypermethrin	3A	HT	G			E	G	G	E	1	12
Pyganic	pyrethrins	3A	HT	F						F	0	12
Neonicotinoids												
Actara	thiamethoxam	4A	MT	G				F			3	12
Admire Pro	imidacloprid	4A	MT				F				3/7*	12
Assail	acetamiprid	4A	ST	G	G		G		G	F	1	12
Insect Growth regulators												
Confirm	tebufenozide	18	ST		G	G					14	4
Esteem/Knack	pyriproxyfen	7C	ST		G	E					7	12
Intrepid	methoxyfenozide	18	ST		G	E	F				7	4
Rimon	novaluron	15	ST			G					8	12
Others												
Altacor	chlorantraniliprole	28	ST		G	G					1	4
Avaunt	indoxacarb	22	MT	G	F				F		7	12
Delegate	spinetoram	5	MT		G				F	E	3	4
Dipel	<i>B. thuringiensis</i>	11	ST		F						0	4
Entrust	spinosad	5	ST	F	G					G	1/3*	4
Exirel	cyantraniliprole	28		G	G				F	G	3	12
Sivanto	flupyradifurone	4D									3	24

¹P = poor. F = fair. G = good. E = excellent. ST = slightly toxic. MT = moderately toxic. HT = highly toxic. NT = not toxic. *= restrictions vary. See label for details.

(continued)

NOTES

Raspberry and Blackberry Spray Schedule

■ Raspberry and Blackberry Delayed Dormant

Apply when tips of buds show green.

Pest/Problem	Material	Rate/Acre	Comments
anthracnose, spur blight (reds only), cane blight	CaptEvate 68WDG	3.5 lbs.	Labeled for raspberries, only.
	copper hydroxide 50WP	4 lbs.	Copper products are available in various formulations. Read labels carefully.
	lime sulfur solution	6-12 gals.	This is a critical spray for good anthracnose control. Complete coverage is essential. This spray may burn the leaves if applied after new shoots are 3/4-inch long.
	Sulforix	3 gals./100 gals. water	Use with minimum 50 gals. carrier per acre.
Phytophthora root rot	phosphorous acid		Ridomil Gold SL has replaced Ridomil Gold EC. See Phytophthora Root Rot (page 105) for application information.
	Ridomil Gold SL		
raspberry crown borer	Apply insecticides after egg hatch in late October or early November or wait until late March. Apply as a soil drench directed at the crown of the plants in a minimum of 50 gals. of water per acre prior to a significant rainfall or irrigation.		
	Altacor 35WG	3-4.5 oz.	
	Brigade 2EC	6.4 fl. oz.	
	Brigade WSB (10WP)	16 oz.	
	Hero 1.24EC	10.3 fl. oz.	
rednecked cane borer	See Rednecked Cane Borer (page 114) about pruning to remove last year's galls.		

■ Raspberry and Blackberry Pre-bloom

Apply when flowers show white.

Pest/Problem	Material	Rate/Acre	Comments
anthracnose, spur blight (reds only), cane blight, raspberry leaf spot, Septoria leaf spot	Unless anthracnose, cane blight, or spur blight have been problems, fungicide applications prior to bloom are probably not required. This is especially true if you have made the delayed-dormant application of lime-sulfur. See Raspberry Leaf Spot and Septoria Leaf Spot of Blackberry and Raspberry, page 115.		
	Abound	6.0-15.5 fl. oz.	
	Cabrio EG	14 oz.	
	Captan 80WDG	2.5 lbs.	
	Captec 4L	0.75-1 qt.	
	CaptEvate	3-5 lbs.	Labeled for anthracnose and spur blight in raspberries.
	Pristine 38WG	18.5-23 oz.	
	Quilt Xcel	14-21 fl. oz.	Not labeled for spur blight. PHI=30 days.
	Tanos	8-10 oz.	Not labeled for cane blight. Suppresses anthracnose.
rust diseases (orange rust and late leaf rust), powdery mildew, raspberry leaf spot, Septoria leaf spot	See Raspberry Leaf Spot and Septoria Leaf Spot of Blackberry and Raspberry, page 115.		
	Abound	6.0-15.5 fl. oz.	Use 10-15.5 fl. oz. rate for blackberry rust.
	Cabrio EG	14 oz.	
	Pristine	18.5-23 oz.	Suppresses rust diseases.
	Quilt Xcel	14-21 fl. oz.	PHI=30-days.
	Rally 40WSP	1.25-3.0 oz.	For late leaf rust and powdery mildew, begin applications when disease first appears and repeat on a 10- to 14-day schedule. See Control of Orange Rust, page 115.
	Tilt	6 fl. oz.	

(continued)

Raspberry and Blackberry Pre-bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
raspberry fruitworm	Early fruit is more seriously attacked than later fruit. Check for feeding damage to spring leaves, buds, and early summer fruit.		
	Delegate 25WG	3-6 oz.	
	Entrust 2SC	4-6 fl. oz.	
	Entrust 80WP	1.25-2 oz.	
	Pyganic 5%EC	4.5-18 fl. oz.	
strawberry clipper (bud weevil)	Begin checking for the first clipped buds when buds' first flowers show white. If clipped buds are found, apply insecticide and repeat spray 10 days later if bud clipping continues.		
	Actara 25WDG	3 oz	
	Sevin XLR Plus (4F)	2 qt	Other formulations may be available.
leafrollers	Not common pests.		
	Asana XL	4.8-9.6 fl.oz.	
	Aza-Direct	1-2 pts.	
	Brigade 2EC	3.2-6.4 fl. oz.	
	Brigade WSB (10WP)	8-16 oz.	
	<i>Bt (Bacillus thuringiensis)</i>		See Generic Insecticides (pages 139-140) for a list of products that contain <i>Bacillus thuringiensis</i> . See individual product labels for rates and application details.
	Confirm 2F	16 fl. oz.	
	Danitol 2.4EC	10.67-16 fl. oz.	
	Delegate 25WG	3-6 oz.	Target eggs at hatching or small larvae.
	Entrust 2SC	4-6 fl. oz.	
	Entrust 80WP	1.25-2 oz.	
	Intrepid 2F	10-16 fl. oz.	
	Mustang Maxx 0.8EC	4 fl oz.	
	Neemix	0.5-2 gals.	
	Pyganic 5%EC	4.5-18 fl. oz.	
Sevin XLR Plus (4F)	1-2 qts.	Other formulations may be available.	
rose chafer	Not a common pest in most areas.		
	Pyganic 5%EC	4.5-18 fl. oz.	
	Sevin XLR Plus (4F)	1-2 qts.	Other formulations may be available.
raspberry sawfly	Not a common pest.		
	Delegate 25WG	3-6 oz.	
	Entrust 2SC	4-6 fl. oz.	
	Entrust 80WP	1.25-2 oz.	
	Sevin XLR Plus (4F)	1-2 qts.	Other formulations may be available.

■ Raspberry and Blackberry First Bloom through Petal Fall

Apply when first flowers open through when petals fall.

Pest/Problem	Material	Rate/Acre	Comments
anthracnose, spur blight (reds only), cane blight, raspberry leaf spot, Septoria leaf spot, rust diseases (orange rust and late leaf rust), powdery mildew	See Raspberry Leaf Spot and Septoria Leaf Spot of Blackberry and Raspberry, page 115. Same as for Raspberry and Blackberry Pre-bloom, page 109. Note: Quilt Xcel has a 30-day PHI.		
rosette (double blossom)	See Rosette or Double Blossom, page 114.		
Botrytis fruit rot	Make 3 fungicide applications during this period. Apply the first as blooms begin to open, not later than 5% bloom. Make the second at full bloom. And follow with a third as petals begin to fall.		
	Captan 80WDG	2.5 lbs.	Use 45-100 gals. of carrier/acre.
	Captec 4L	0.75-1qt.	
	CaptEstate 68WDG	3.5 lbs.	
	Elevate WDG	1.5 lbs.	
	Pristine	18.5-23 oz.	
	Rovral 4	1-2 pts.	Use a minimum of 100 gals. of carrier /acre. See Fungicide Resistance Management, page 114.
	Switch 62.5WG	11-14 oz.	
Tavano 5%SC/OSO/Ph-D	3.75-13 fl. oz.		

■ Raspberry and Blackberry Post-bloom through Harvest

Apply every 14 days after petal fall as needed.

Pest/Problem	Material	Rate/Acre	Comments
anthracnose, Botrytis fruit rot, spur blight, cane blight, raspberry leaf spot, Septoria leaf spot	See Raspberry Leaf Spot and Septoria Leaf Spot of Blackberry and Raspberry, page 115. Same as for Raspberry and Blackberry Pre-bloom, page 109. Note: Quilt Xcel has a 30-day PHI.		
Botrytis fruit rot (only)	Same as for Raspberry and Blackberry First Bloom through Petal Fall, page 111.		
rust diseases (orange rust and late leaf rust), powdery mildew	Cabrio 20EG	14 oz.	Suppresses rust diseases.
	Luna Privilege	6.84 fl. oz.	Labeled for powdery mildew.
	Pristine	18.5-23 oz.	
	Rally 40WSP	1.25-3.0 oz.	For late leaf rust and powdery mildew, begin applications when disease first appears and repeat on a 10-14 day schedule. See Control of Orange Rust, page 115.
rednecked cane borer	Admire Pro	10.5-14 fl. oz.	Soil applied for systemic control. Do not apply pre-bloom, during bloom, or when bees are foraging. See Rednecked Cane Borer, page 114.
	JMS Stylet Oil	0.5-1 gal.	In May and June look for RNCB adults on primocanes during midmorning. Treat foliage weekly as long as RNCB adults are detected.
sap beetles	bait buckets		Keep berries off the ground and ripe berries picked. Establish bait buckets containing overripe fruit between the berry planting and nearby wooded areas. Empty bait buckets on a daily basis. Few insecticides are registered for sap beetle control, and during picking harvest restrictions practically rule out their use.
	Assail 30SG	4.5-5.3 oz.	

(continued)

Raspberry and Blackberry Post-bloom through Harvest (continued)

Pest/Problem	Material	Rate/Acre	Comments
Japanese beetle, green June beetle	See Insecticide and Miticide PHIs and REIs (pages 135-138).		
	Actara 25WB	4 oz.	
	Assail 30SG	4.5-5.3 oz.	
	Aza-Direct	1-2 pts.	Acts as a repellent.
	Danitol 2.4EC	10.67-16 fl. oz.	
	Malathion	See label	Formulations and rates vary by state. Check labels for specific information.
	Neemix 4.5	7-16 fl. oz.	Acts as a repellent.
	Pyganic 5%EC	4.5-18 fl. oz.	
	Sevin XLR Plus (4F)	1-2 qts.	Other formulations may be available.
	Surround WP	12.5-50 lbs.	May leave noticeable residues on berries.
tarnished plant bug, stink bugs	Actara 25WB	3 oz.	
	Assail 30SG	4.5-5.3 oz.	
	Bifenture 2EC	6.4 fl. oz.	Labeled for brown marmorated stink bug control.
	Pyganic 5%EC	4.5-18 fl. oz.	
	Sevin XLR Plus (4F)	1.5-2 qts.	Other formulations may be available.
thrips (including Eastern flower thrips)	Entrust 80WP	1.25-2 oz.	
	Delegate 25WG	3-6 oz.	
twospotted spider mite	Acramite 50WS	0.75-1 lb.	
	Kanemite 15SC	31 fl. oz.	
	JMS Stylet Oil	3-6 qts. In 100 gals. of water	Spider mites start infestation on leaves at the base of plants and move up as lower leaves are bronzed.
	Savey 50DF	4-6 oz.	
	Zeal 72WP	2-3 oz.	
broad mite	Agri-Mek SC	3.5 fl. oz.	FIFRA Section 2(ee) recommendation. Agri-Mek SC approved for use in Arkansas, Illinois, and Indiana for control of broad mite in caneberry (PHI=7 days). Agri-Mek SC must be mixed with a nonionic surfactant activator type wetting, spreading and/or penetrating spray adjuvant at 0.1-0.5% v/v. By late May, begin weekly scouting for first damage (leaf bronzing and/or cupping) and presence of broad mites on underside of terminal leaflets, especially in primocane-fruiting cultivars. Use a 20x or 30x hand lens to see white, oval, spotted eggs and oval, white (immature) to amber adult broad mites. Apply miticide only if/when you detect new terminal leaf damage and leaflet samples average between one to five active broad mites per leaflet. See Broad Mite, page 113.
Drosophila (also known as fruit flies and vinegar flies), including spotted wing Drosophila	See Spotted Wing Drosophila, page 113.		
	Brigade WSB (10WP)	5.3-16 oz.	
	Danitol 2.4EC	10.67-16 fl. oz.	
	Delegate 25WG	3-6 oz.	
	Entrust 2SC	4-6 fl. oz.	
	Entrust 80WP	1.25-2 oz.	
	Malathion	See label	Malathion formulations and rates vary by state. Check labels for specific information.
	Mustang Maxx	4.0 fl. oz.	

■ Raspberry and Blackberry Post-harvest

Pest/Problem	Material	Rate/Acre	Comments
raspberry leaf spot, Septoria leaf spot, rust diseases (orange rust and late leaf rust), powdery mildew	Post-harvest sprays are probably the most important for control of the leaf spot diseases. When diseases are severe, most defoliation occurs post-harvest. In exceptionally wet seasons, post-harvest fungicide applications may be required to protect first year canes from anthracnose, spur blight, cane blight, and powdery mildew. A good spray program early in the season should help minimize development of these diseases later in the season. Same as for Raspberry and Blackberry Pre-bloom, page 109.		
raspberry crown borer	Apply insecticides after eggs hatch in late October or early November or wait until March. Apply as a soil drench directed at the crown of plants in a minimum of 50 gals. of water per acre prior to a significant rainfall or irrigation.		
	Altacor 35WG	3-4.5 oz.	
	Brigade 2EC	6.4 fl. oz.	
	Brigade WSB (10WP)	16 oz.	

Special Comments on Raspberry and Blackberry Schedule

Spotted Wing Drosophila

Spotted wing Drosophila (SWD) is invasive fruit fly that infests small fruit crops, cherry, nectarine, peach, high tunnel tomatoes, and wild hosts (including pokeweed, autumn olive, crabapple, nightshade, Amur honeysuckle, and wild grape).

SWD is different from other fruit flies in that the female has a stout, toothed ovipositor (egg layer) that enables her to lay eggs under the skin of ripening fruits. Generally, soft-skinned fruits become vulnerable to attack as they begin to soften and turn color during ripening. The larvae tunnel and feed under the fruit skin and can reach 4 millimeters long. There is often a sunken area where the eggs are laid, and damaged fruit may appear to collapse from the internal damage and rots.

SWD completes its life cycle in a little more than a week during optimal temperatures, and there may be ten or more generations per year. Monitor plantings for SWD in the final weeks before harvest, beginning when fruit just starts to turn color. Traps for monitoring and detecting SWD are available. More information about SWD is available from Michigan State University Integrated Pest Management at: www.ipm.msu.edu/swd.htm.

Look for additional insecticide state labels allowing for changes to rates and allowable number of applications. When spraying close to and during the harvest period, be sure to carefully watch the insecticides' pre-harvest intervals (PHIs).

Broad Mite

The broad mite damages terminal leaves, flowers, and fruit on peppers and tomato, and recently became a pest of blackberries, especially primocane-fruiting cultivars. This mite feeds by piercing the bud, leaf, or flower. This feeding injects a toxin that stunts growth, curls and bronzes leaves, and often kills terminal and lateral leaf and flower buds. These symptoms are similar to those of fire blight.

The mite overwinters under blackberry bud scales and in the soil. Eggs are oval and spotted (0.08 mm long). Broad mites are oval and vary from small white immatures to amber adults (0.2mm).

From late May through fall in Arkansas, you can find a buildup of broad mites on the terminal leaves of emerging primocanes. In more northern states, broad mite numbers increase and damage appears later in the summer or early fall.

Broad mites have damaged floricanes-fruiting blackberry cultivars. Infested floricanes have delayed bud break and low vigor in spring. Broad mites can be found on terminal floricanes leaves from April through harvest. primocane terminals can also become infested.

The only recommended miticide is Agri-Mek, which has a 2(ee) supplemental label for blackberries in several states. One application has reduced and maintained broad mite numbers to near zero for up to a month. Additional applications may be needed if mite numbers resurge. You can reapply Agri-Mek once and then you must rotate to a different mode of action. Other products that have significantly reduced broad mite on blackberry include Microthiol Dispers wettable sulfur (10 pounds per acre), 2%

JMS Stylet-Oil, and 1% M-Pede (see page 116). For these products, check safety to blooms by testing a few plants prior to broad application, and do not apply if temperatures are expected to exceed 90°F. See labels for use and rate recommendations.

More information about broad mites (including photos) is available on two University of Arkansas Fruit/Nut Pest Management PDFs: comp.uark.edu/~dtjohnso/AR_News_25_Apr_2016.pdf and comp.uark.edu/~dtjohnso/AR_News_Special_Broad_Mite_14July_2016.pdf.

Brown Marmorated Stink Bug

The brown marmorated stink bug (BMSB) has an extremely wide host range and is a pest of all small fruit. BMSB is attracted to fruits throughout much of the growing season. BMSB has piercing sucking mouthparts, which cause injury that may appear as sunken areas on the fruit. BMSB that are hidden in grape clusters at harvest may taint juice flavor at crush.

Actara, Brigade, Danitol, and Lannate have shown good efficacy in trials; however, multiple applications may be needed for reinfestations.

Raspberry Cane Maggot

The raspberry cane maggot causes wilted tips in May. Cut off wilted tips a few inches below the girdle when first seen. Destroy the removed tips.

Rednecked Cane Borer

Scout for galls before or during the dormant period. Prune out galled canes and burn, bury, or otherwise destroy them to kill overwintered larvae. If more than 5 percent of all canes have galls, an insecticide application immediately after bloom may be warranted.

Adults begin to emerge in May or June. Begin scouting plantings during bloom by looking for adult beetles active during daylight hours. Begin insecticide application(s) after bloom has ended and bees are no longer present. Apply Admire Pro via drip or trickle chemigation or in a soil drench in a minimum of 500 gals. of water per acre. Do not apply pre-bloom or during bloom or when bees are actively foraging.

Phytophthora Root Rot

Ridomil Gold SL is labeled for control of Phytophthora root rot on brambles. The label reads: Apply 1/4 pt. per 1,000 linear feet of row to the soil surface in a 3-foot band over the row. Make one

application in the spring and another in the fall after harvest. Ridomil Gold GR (granular) is also labeled for brambles.

Note: Do not apply Ridomil within 45 days before harvest or illegal residues may result. See the label for more detailed information.

Several phosphorous acid fungicides are registered for Phytophthora root rot control on blueberry, like Aliette, Agri-Fos, ProPhyt, Phostrol, and Topaz. These essentially all have the same active ingredient. . All are foliar sprays. They are highly systemic and move rapidly into leaves and are translocated in the plant to the crown and roots. Read labels for additional information on use and restrictions

There are several other phosphite fungicides on the market, and new ones continue to be introduced. Recommendations for use vary among products. See labels for use recommendations.

Rosette or Double Blossom

Rosette is caused by the fungus, *Cercospora rubi*. It is a serious disease of blackberry in the southern Midwest (Arkansas, Kentucky, Missouri, and Oklahoma). It is a minor disease of raspberries. Abound and Quilt Xcel are the only fungicides labeled for control of this disease on blackberry.

Chemical control of this disease under heavy pressure has not been successful. One cultural practice for infected sites is to mow the planting down before flowering to eliminate spore release and infection of emerging primocanes. Though this sacrifices one year of production, the practice may provide short-term control.

Varieties vary in susceptibility to this disease. Apache, Ouachita, and Triple Crown are resistant. Chester, Hull, and Navaho are tolerant. Chickasaw, Choctaw, Kiowa, Shawnee, and Illini Hardy are highly susceptible. Other cultivars differ in susceptibility, but all will become infected over time.

Fungicide Resistance Management

Elevate, Rovral, Switch, and Pristine should not be used alone for season-long control of Botrytis fruit rot because some Botrytis cinerea strains may develop resistance to these fungicides. Adding (tank mixing) Captan to Elevate, Rovral, Switch, or Pristine should enhance disease control and help prevent fungicide resistance development. Rotating these fungicides in blocks of one or two sprays is a good resistance management strategy.

Control of Orange Rust

All cultivars of black and purple raspberries and most erect and trailing blackberries are very susceptible to orange rust. Unlike all other bramble fungi, this fungus grows systemically throughout the roots, crowns, and shoots of infected plants and is perennial in belowground plant parts. Once a plant is infected, it is infected for life. Plants do not die, but become stunted and weakened, producing little to no fruit. Key control methods include cultural practices such as removing infected plants early in the spring and eradicating nearby wild brambles. Several fungicides are listed in this guide that are used as a protectant.

There appear to be two periods during the growing season when fungicides should control orange rust.

The first one is in the spring when aeciospores (bright orange spores) are being released. Sprays now would control “localized” leaf infections. These sprays should start just before the aeciospores are released (generally early to mid-May) until the infected leaves die and dry up, and spores are no longer present (mid-June through mid-July). As temperatures get above 77°F, aeciospore germination is very slow, and disease development is greatly reduced. In short, during the hot days of summer, infections should not be occurring.

The second infection period is during late summer as temperatures decrease and “systemic” (teliospore) infections occur. These teliospores (and resulting basidiospores) infect the buds of tip-rooted canes or new shoots at the crown of the plant; thus, fungicide applications should be directed toward the base of the canes.

The better the early orange rust spray program is, the fewer of these teliospores will be available in the second infection period.

Even if you achieve complete control of early-season aeciospore infections, some teliospores could still be blown into the planting from infected wild hosts. Rally, Abound, Cabrio, or Pristine applied on a 10- to 14-day schedule during these periods should be beneficial for control. In wet weather, use the shorter interval.

Alternate Rally with Abound, Cabrio, or Pristine in the spray program in order to prevent fungicide resistance development. A good approach would be to alternate them in two-spray blocks. Do not apply more than two sprays without alternating to another class of fungicide.

Raspberry Leaf Spot and Septoria Leaf Spot of Blackberry and Raspberry

The incidence of raspberry leaf spot and Septoria leaf spot appears to be increasing across the Midwest. If not controlled, they can result in severe defoliation of the plant.

The strobilurin fungicides (Abound, Cabrio, Pristine) provide good control of both diseases. Abound is registered for control of raspberry leaf spot and Septoria leaf spot. Some fungicide trials have shown that Captan and Rally also provide some level of control. Post-harvest (late-season) applications are important for controlling these leaf diseases. Most defoliation resulting from these diseases occurs later in the season (post-harvest).

Effectiveness of Insecticides and Miticides for Brambles¹

Chemical	IRAC Group (mode of action)	Common Name	predator mite toxicity	broad mite	green June/Japanese beetle	leafrollers	plant bugs	raspberry crown borer	raspberry fruitworm	raspberry sawfly	rednecked cane borer	rose chafer	sap beetle	stink bugs	strawberry clipper	spotted wing Drosophila	thrips	twospotted spider mite	PHI (days)	REI (hours)
Pyrethroids																				
Asana	3A	esfenvalerate	HT		E	G	E							G					7	12
Brigade/Capture	3A	bifenthrin	HT		G	E	E	E					E	E	E	E		F	3	12
Danitol	3A	fenpropathrin	HT		E	E	E						G	E		E		F	3	24
Mustang Maxx	3A	zeta-cypermethrin	HT		E	E	E							E		E			1	12
Pyganic	3A	pyrethrins	ST			F	F		F	P		F		P		F	P		0	12
Neonicotinoids																				
Actara	4A	thiamethoxam	MT				G							G					3	12
Admire Pro	4A	imidacloprid	MT		F						G						F		12	3/7*
Assail	4A	acetamiprid	ST		G		G						G	F					7	12
Insect Growth Regulators																				
Confirm	18	tebufenozide	ST			E													14	4
Intrepid	18	methoxyfenozide	ST			G													7	4
Knack	7C	pyriproxyfen	ST																7	12
Others																				
Altacor	28	chlorantraniliprole	ST			E		G									F		3	4
Delegate	5	spinetoram	MT			E			E	G			F			E	E		1	12
Dipel	11	B. thuringiensis	ST			F													0	4
Entrust	5	spinosad	ST			G			G	G						G	G		1	4
Malathion	1B	malathion	MT		G											G			12/24*	1
Sevin	1A	carbaryl	HT		G	G	G			G		G		P		G			7	12
Miticides																				
Acramite	UN	bifenazate	ST															G	1	12
Agri-Mek	6		HT	E															7	12
JMS Stylet-Oil (OMRI)	oil		ST	E															0	4
Kanemite	20B	acequinocyl	MT															G	1	12
Microthiol Disperss (OMRI)	UN			E															0	24
M-Pede (OMRI)	insecticidal soap		ST	E															0	12
Savey	10A	hexythiazox	ST															E	3	12
Zeal	10B	etoxazole	MT															E	12	0

¹ P = poor. F = fair. G = good. E = excellent. ST = slightly toxic. MT = moderately toxic. HT = highly toxic. NT = not toxic. Blank indicates not labeled or not recommended. * = restrictions vary. See label for details.

Effectiveness of Fungicides for Control of Bramble Diseases¹

Trade Name	Common Name	FRAC Code ²	Anthraco- nose	Cane blight/spur blight	Raspberry leaf spot/Septo- ria leaf spot	Botrytis fruit rot	Rusts (orange and late leaf)	Powdery mildew	Phytophthora root rot	PHI (Maximum amount/ acre/ season) ³	REI ⁴ (hours)
Abound	azoxystrobin	11	E	E	E	G	E	E		0	4
Aliette	fosetyl-AL	33							E	60	12
Basic copper sulfate	copper sulfate	M	G	G	G			F		0	12
Cabrio EG	pyraclostrobin	11	G	G	G	G	G			0	12
Captan	captan	M	G	G	G	G				3	48
CaptEvate	captan + fenhexamid	M 17	G	G	G	E	G			3	24
Elevate	fenhexamid	17				E				0	12
Pristine	pyraclostrobin + boscalid	11 7	E	E	E	E	E	E		0*	12
ProPhyt, Phostrol, Agri-Fos, Topaz, Legion, Rampart	phosphorous acid	33							E	0*	4
Quilt Xcel	azoxystrobin + propiconazole	11+3	G	G	G	G	G	G		30	12
Rally	myclobutanil	3	-	-	G	-	E	E		1	24
Ridomil Gold SL	mefenoxam	4							E	45	48
Rovral	iprodione	2				E				0*	24
Sulforix, Lime sulfur solution	calcium polysulfide	M	E	G	G					0*	48
Sulfur	sulfur	M	G							0	24
Switch	cyprodinil + fludioxonil	9 12				E				0	12
Tanos	famoxadone + cymoxanil	11 27	G	G	G					0	12
Tilt	propiconazole	3					E	E		30	12

¹ E = excellent. G = good. F = fair. * = restrictions vary. See label for details.

² FRAC code represents the mode of action of the fungicide.

³ Amounts shown in parenthesis are the maximum amounts of the fungicide permitted per season.

⁴ All fungicides have a Restricted-Entry Interval (REI). The restricted-entry interval 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.

NOTES

Strawberry Spray Schedule

■ Strawberry Pre-plant

Pest/Problem	Material	Rate/Acre	Comments
anthracnose, crown rot	Abound	5-8 oz./100 gals. water	Dip entire plants for 2-5 minutes, and transplant as quickly as possible. Do not reuse solution. Delayed planting could cause plant stunting.
	Switch	5-8 fl. oz./100 gals. water	Dip entire plants for 2-5 minutes, and transplant as quickly as possible. Do not reuse solution. Delayed planting could cause plant stunting.
Phytophthora crown rot, Pythium root rot	Aliette	2 pts./100 gals. water	Dip entire plants for 15-30 minutes, and transplant as quickly as possible. Do not reuse solution. Delayed planting could cause plant stunting.
	Phostrol	2.5 pts./100 gals. water	
	ProPhyt	2.5 pts./100 gals. water	

■ Strawberry Early Spring (Pre-bloom)

Apply when new leaves are expanding and blossom buds are visible.

Pest/Problem	Material	Rate/Acre	Comments
powdery mildew, leaf spot, leaf scorch, leaf blight, anthracnose	Abound/Aframe	6.0-15.5 fl. oz.	Registered for control of leaf spot, powdery mildew, and anthracnose.
	Aftershock	2.0-5.7 fl. oz.	Not labeled for leaf spots, scorch, or blight.
	Cabrio 20EG	12-14 oz.	
	Captan 80WP/Captec	1.87-3.75/1.5-3.0 qts.	
	Evito 480SC	2-5.7 fl. oz.	For anthracnose and powdery mildew. Suppressive on Botrytis.
	Flint Extra	2.5-3.0 fl. oz.	Controls powdery mildew and phomopsis. Suppresses anthracnose.
	Fontelis	16-24 oz.	For powdery mildew only. Do not use on Clancy, Jewel and L'amour varieties
	Luna Privilege	3.2-6.84 fl. oz.	For powdery mildew and leaf spot. Higher rate will suppress nematodes. See label for additional information.
	Luna Sensation	4-7.6 fl. oz.	Controls powdery mildew, leaf spot, anthracnose, and phomopsis leaf blight.
	Luna Tranquility	16-27 fl. oz.	Controls powdery mildew. Suppresses leaf spot and phomopsis blight.
	Merivon	4-8 fl. oz.	Higher rates are for control of anthracnose.
	Mettle	3-5 fl. oz.	Will not control anthracnose.
	Orbit 3.6L	4 fl. oz.	
	Pristine	18.5-23 oz.	Registered for control of leaf spot, powdery mildew, and anthracnose.
	Procure 480SC	4-8 fl. oz.	Highly effective for control of powdery mildew only.
	Quadris Top	12-14 fl. oz.	Not labeled for leaf spot, scorch, or blight.
	Quilt Xcel	14 fl. oz.	
	Quintec 2.08F	4-6 fl. oz.	Controls powdery mildew only and must be used in a protectant program.
	Rally 40WSP	2.5-5 oz.	Highly effective for control of powdery mildew and leaf blight. Will not control anthracnose.
	Switch	11.0-14 oz.	Not labeled for leaf spots, scorch, or blight.
Syllit	1.5-2.0 lbs.		
Topguard EQ	5-8 oz.		
Torino	3.4 fl. oz.	Controls powdery mildew only and must be used in a protectant program.	

(continued)

Strawberry Early Spring (Pre-bloom) (continued)

Pest/Problem	Material	Rate/Acre	Comments
red stele	See Leather Rot and Red Stele, page 125.		
strawberry clipper (bud weevil)	Watch for clipper when flower buds start coming out of the crown and when temperatures approach 65°F. Treat if the number of clipped buds per meter of row is 3 or more primary buds, or 30 or more secondary or tertiary buds. Infestations begin at field edge so border spray is often sufficient.		
	Actara 25WG	4 oz.	
	Brigade WSB (10WP)	6.4-32 oz.	
	Danitol 2.4EC	16-21.33 fl. oz.	
	Lorsban 4EC	1 qt.	
	Lorsban 75WG	1.33 lbs.	
	Sevin XLR Plus (4F)	1-2 qts.	
eastern flower thrips	Sample when first blossom buds begin to open. Threshold is 2-10 thrips per blossom. Treat before widespread bloom draws pollinators. Lorsban, Danitol, and Brigade are not labeled specifically for thrips control in strawberries but have been effective in field use at rates listed for clipper or spittlebug and tarnished plant bug.		
	Entrust 2SC	4-6 fl. oz.	Not for use against this pest in Indiana.
	Entrust 80WP	1.25-1.5 oz.	
	Radiant 1SC	6-10 fl. oz.	
	Sivanto 200SL	10.5-14 fl. oz.	
spittlebug, tarnished plant bug (adults)	If a problem, apply when buds first become visible, and make a second application just before the first bloom opens.		
	Admire Pro (4.6F)	1.3 fl. oz.	Foliar spray for spittlebug.
	Assail 30SG	1.9-6.9 oz.	Low rate for spittlebug only.
	Beleaf 50SG	2.8 oz.	For plant bugs only.
	Brigade WSB (10WP)	6.4-32 oz.	
	Danitol 2.4EC	10.67 fl. oz.	
	Rimon 0.83EC	9-12 fl. oz.	Only for plant bug control.
	Sevin XLR Plus (4F)	1.5-2 qts.	Other formulations may be available.
spider mites	Acramite 50WS	0.75-1.0 lb.	
	Agri-Mek 0.15EC	16 fl. oz.	
	Danitol 2.4EC	16-21.33 fl. oz.	
	Kanemite 15SC	21-31 fl. oz.	
	Nealta 1.67SC	13.7 fl. oz.	
	Oberon 2SC	12-16 fl. oz.	
	Portal 0.4EC	2 pts.	
	Savey 50DF	6 oz.	Kills eggs and young nymphs, not adults.
	Zeal 72WP	2-3 oz.	Zeal is primarily an ovicide/larvicide and, if needed, should be used early in the season.
cyclamen mite	Portal 0.4SC	2 pts.	

■ Strawberry Early Bloom through Bloom

Apply from 5-10% bloom until flowers have finished blooming.

Pest/Problem	Material	Rate/Acre	Comments
Botrytis blossom blight and fruit rot	The most critical period for control of Botrytis fruit rot is during bloom.		
	Elevate 50WG	1.5 lbs.	Never use alone for seasonlong Botrytis control because of the potential for pathogen strains to develop resistance. Use 1.0-1.5 lbs. rate in a tank mix.
	Flint Extra	2.5-3.0 fl. oz.	Also controls powdery mildew and phomopsis. Suppresses anthracnose.

(continued)

Strawberry Early Bloom through Bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments	
Botrytis blossom blight and fruit rot (continued)	Fontelis	16-24 fl. oz.	The label states: For use on strawberry (except Clancy, Jewel, and L'Amour varieties). Note: Foliar reddening may occur if applied to some matted row varieties such as Clancy, Jewel, and L'Amour under certain environmental conditions. Discontinue applications if signs of crop injury appear. Not all varieties have been tested.	
	Fracture	24.4-36.6 fl. oz.		
	Kenja 400SC	13.5-15.5 fl. oz.	For powdery mildew and anthracnose.	
	Luna Privilege	6.84 fl. oz.	For Botrytis and other diseases. Higher rate will suppress nematodes. See label for additional information.	
	Luna Sensation	6-7.6 fl. oz.	Higher rate controls Botrytis, along with powdery mildew, leaf spot, anthracnose, and phomopsis leaf blight	
	Luna Tranquility	16-27 fl. oz.	Controls Botrytis, along with powdery mildew. Suppresses leaf spot and phomopsis blight.	
	Merivon	8-11 fl. oz.		
	Rovral 4F	1.5-2.0 pts.	For control of anthracnose leaf spot, Phomopsis rot, and grey mold. For this reason, it is recommended for this spray. Do not exceed one application per season. Use rate of 1.0 pts. in tank mix. Use 100 gals./A carrier.	
	Scala SC	18 fl. oz.	Use 9-18 fl. oz. rate in tank mix.	
	Switch 62.5WG	11-14 oz.	Never use alone for seasonlong Botrytis control because of the potential for pathogen strains to develop resistance. Provides excellent control of Botrytis fruit rot (gray mold) and has been reported to have good activity against anthracnose fruit rot.	
	Topsin M WSB	0.75-1 lb.	Never use alone for seasonlong Botrytis control because of the potential for pathogen strains to develop resistance.	
	OR ANY OF THE ABOVE PLUS ONE OF THE FOLLOWING:			
	Captan 50WP	3-6 lbs.		
	Thiram 65WP	4 lbs.		
	OR ONE OF THE FOLLOWING ALONE:			
	Captan 50WP	3-6 lbs.		
	Captec 4L	1.5-3.0 qts/100 gals. water.		
	CaptEvote 68WG	3.5-5.25 lbs.		A combination of Captan plus Elevate. At the high rate of CaptEvote, the amount of active ingredient of Captan and Elevate are equal to each product used alone.
	Pristine	18.5-23 oz.		Begin applications no later than 10% bloom.
	Protocol	1.33 pts.		
Thiram 24/7	2-6 qts.			
powdery mildew, leaf spot, leaf blight, leaf scorch	Abound/Aframe	6.0-15.5 fl. oz.	Registered for control of powdery mildew and anthracnose.	
	Aftershock	2-5.7 fl. oz.	Labeled for powdery mildew.	
	Cabrio 20EG	14 oz.	Registered for control of leaf spot, powdery mildew, and anthracnose.	
	Evito	2-5.7 fl. oz.		
	Kenja 400SC	13.5-15.5 fl. oz.	Labeled for powdery mildew.	

(continued)

Strawberry Early Bloom through Bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments	
powdery mildew, leaf spot, leaf blight, leaf scorch (continued)	Luna Privilege	6.84 fl. oz.	Refer to regular and supplemental labels.	
	Luna Sensation	4-7.6 fl. oz.		
	Luna Tranquility	16-27 fl. oz.		
	Merivon	4-8 fl. oz.		
	Mettle	3-5 fl. oz.	Will not control anthracnose.	
	Pristine	18.5-23 oz.		
	Procure 480SC	4-8 fl. oz.	Controls powdery mildew only.	
	Protocol	1.33 pts.	Not labeled for powdery mildew. Fungicide resistance may be an issue.	
	Quadris Top	12-14 fl. oz.		
	Quilt Xcel	14 fl. oz.		
	Quintec 2.08F	4-6 fl. oz.		
	Rally 40WSP	2.5-5 oz.	Very effective for control of powdery mildew and Phomopsis leaf blight. Leaf spot is also listed on the label. Not effective for control of Botrytis fruit rot (gray mold).	
	Syllit	1.5-2.0 lbs.		
	Tilt	4 fl. oz.		
	Topsin M	0.75-1.0 lb.	Fungicide resistance may be an issue.	
Torino	3.4 oz.			
anthracnose fruit rot	Abound	6.0-15.5 fl. oz.		
	Aftershock	2.0-5.7 fl. oz.		
	Cabrio 20EG	12-14 oz.		
	Captan 50WP	3-6 lbs.		
	CaptEstate	5.25 lbs.		
	Evito	2.0-5.7 fl. oz.		
	Flint Extra	2.5-3 fl. oz.	PHI=0 days.	
	Kenja 400SC	13.5-15.5 fl. oz.		
	Luna Sensation	6-7.6 fl. oz.	Higher rate controls Botrytis, along with powdery mildew, leaf spot, anthracnose, and phomopsis leaf blight.	
	Orbit	4 oz.		
	Pristine 38WG	18.5-23 oz.		
	Protocol	1.33 pts.		
	Quadris Top	12-14 fl. oz.		
	Quilt Xcel	14 fl. oz.		
	Switch 62.5WG	11-14 oz.		
	Tilt	4 fl. oz.		
	Topguard EQ	5-8 oz.	PHI=21 days.	
	Topsin M WSB	0.75-1.0 lb.		
	OR ANY OF THE ABOVE PLUS:			
	Captan 50WP	6 lbs.	Under heavy disease pressure for anthracnose all fungicides should be combined with Captan. Using Captan close to harvest may result in visible fungicide residues on the fruit and should be avoided.	
insects	SAVE THE BEES! Do not apply insecticides during bloom.			

■ Strawberry Post-bloom to Harvest

Apply every 7-10 days as needed. Be sure to check PHIs. See Fungicide PHIs and REIs (pages 130-133) and Insecticide and Miticide PHIs and REIs tables (pages 135-138).

Pest/Problem	Material	Rate/Acre	Comments
Botrytis fruit rot	Same as for Strawberry Early Bloom through Bloom, pages 120-121. A good layer of straw mulch will reduce berry contact with soil and lessen fruit rot problems, especially leather rot. The wetter the season, the more necessary it is to maintain a thorough spray program. The use of Captan, Thiram or CaptEvate close to harvest may result in visible fungicide residues on the fruit. Elevate, Merivon, Pristine, Switch, or Topsis M alone result in little or no visible residues.		
anthracnose fruit rot	Same as for Strawberry Early Bloom through Bloom, page 122. See note about visible fungicide residue on fruit. See Anthracnose Fruit Rot page 125.		
leather rot	Abound	6.0-15.5 fl. oz.	
	Cabrio 20EG	12-14 oz.	
	phosphorous acid products	See label	See Leather Rot and Red Stele (page 125) for rates and timing.
	Ridomil Gold SL	1 pt.	
powdery mildew, leaf spot, leaf blight, leaf scorch	Same as for Strawberry Early Bloom through Bloom, pages 121-122.		
spittlebug, tarnished plant bug (nymphs)	Make every effort to protect bees by spraying when bees are not active. Follow all harvest restrictions.		
	Admire Pro (4.6F)	1.3 fl. oz.	Foliar spray for spittlebug.
	Assail 30SG	1.9-6.9 oz.	Low rate for spittlebug only.
	Beleaf 50SG	2.8 oz.	For plant bugs only.
	Brigade WSB (10WP)	6.4-32 oz.	
	Danitol 2.4EC	10.67 fl. oz.	
	Rimon 0.83EC	9-12 fl. oz.	
	Sevin XLR Plus (4F)	1.5-2 qts.	Other formulations may be available.
leafrollers, other caterpillars	Assail 30SG	4-6.9 oz.	
	Brigade 10WP (WSB)	6.4-32 oz.	
	<i>Bt (Bacillus thuringiensis)</i>		See See Generic Insecticides (pages 139-140) for a list of products that contain <i>Bacillus thuringiensis</i> . See individual product labels for rates and application details.
	Coragen 1.67SC	3.5-7.5 fl. oz.	
	Entrust 2SC	4-6 fl. oz.	
	Entrust 80WP	1.25-2.0 oz.	
	Radiant 1SC	6-10 oz.	
	Rimon 0.83EC	9-12 fl. oz.	
strawberry sap beetle	As an alternative to insecticides to control sap beetle during harvest, use bait buckets containing over-ripe fruit placed in field between berry patch and wooded area.		
	Assail 30SG	4-6.9 oz.	
	Brigade WSB (10WP)	6.4-32 oz.	PHI=0 days.
	Danitol 2.4EC	16-21.33 fl. oz.	PHI=2 days.
	Rimon 0.83EC	12 fl. oz.	Apply when adults appear and prior to egg hatch.
Drosophila (also known as fruit flies and vinegar flies), including spotted wing Drosophila	Brigade WSB (10WP)	5.3-16 oz.	
	Danitol 2.4EC	16-21.33 fl. oz.	
	Entrust 80WP	1.25-2 oz.	
	Radiant 1SC	6-10 fl. oz.	

(continued)

Strawberry Post-bloom to Harvest *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
slugs	Broadcast baits before berries form, or apply to soil surface in band between rows after berries form. Best if applied in the evening after rain or irrigation.		
	Deadline MP's (4% bait)	10-40 lbs.	
	Sluggo	24-44 lbs.	
crickets	Sevin 5 Bait	40 lbs.	PHI=7 days.
strawberry rootworm (adult beetles)	Insecticides used for control of other strawberry pests are likely to control this pest as well. This pest builds up in perennially grown strawberries, not those replanted yearly and grown on plastic mulch.		

■ Strawberry Harvest

Apply during fruit harvest season.

Pest/Problem	Material	Rate/Acre	Comments
Botrytis fruit rot	Note: If Botrytis is controlled during bloom, the need for additional fungicide applications during harvest is greatly reduced or eliminated. Using some products (such as Captan and Thiram) immediately prior to or during harvest may result in unsightly residues on fruit.		
	Elevate 50WG	1.5 lbs.	PHI=0 days.
	Fontelis	16-24 fl. oz.	The Fontelis label states: For use on strawberry (except Clancy, Jewel, and L'Amour varieties). Note: Foliar reddening may occur if applied to some matted row varieties such as Clancy, Jewel, and L'Amour under certain environmental conditions. Discontinue applications if signs of crop injury appear. Not all varieties have been tested.
	Fracture	20.5-36.6 fl. oz.	
	Luna Privilege	6.84 fl. oz.	Refer to supplemental label.
	Luna Sensation	6-7.6 fl. oz.	Can be used up to day of harvest.
	Luna Tranquility	16-27 fl. oz.	PHI=1 day.
	Merivon	8-11 fl. oz.	PHI=0 days.
	Pristine	18.5-23 oz.	
	Scala SC	18 fl. oz.	
	Switch 62.5WG	11-14 oz.	PHI=0-days.
	Topsin M WSB	0.75-1 lbs.	PHI-1 day.
	OR ANY OF THE ABOVE PLUS:		
Captan 50WP	2-4 lbs.	Adding Captan should result in a higher level of disease control; however, Captan used at higher rates and closer to harvest may leave visible residues on fruit.	
anthracnose fruit rot	See Anthracnose Fruit Rot, page 125. See note on visible fungicide residue on fruit.		
leather rot	See Leather Rot and Red Stele, page 125.		

■ Strawberry Post-harvest and New Plantings

Apply every 10-14 days as needed.

Pest/Problem	Material	Rate/Acre	Comments
leaf spot, leaf scorch, leaf blight	Maintaining healthy plant foliage late into fall results in better spring yields. Leaf diseases can increase, resulting in weak plants and increased primary inoculum for the next season. Extra fungicide sprays after harvest may be required.		
	Captan 50WP	6 lbs.	
	Thiram 24/7	2-6 qts.	
	Topsin M WSB	0.75-1 lb.	

Strawberry Post-harvest and New Plantings (continued)

Pest/Problem	Material	Rate/Acre	Comments
powdery mildew, leaf blight, leaf spot, leaf scorch,	Same as for Strawberry Early Bloom through Bloom, pages 121-122.		
white grubs	Admire Pro	7-10.5 fl. oz.	Admire Pro and Platinum are for post-harvest soil application on perennial strawberries during renovation.
	Platinum 2SC	5-12 fl. oz.	
insects in new plantings, including strawberry root weevils	See notes on page 125.		
leather rot, red stele	See Leather Rot and Red Stele, page 125.		

Special Comments on the Strawberry Schedule

Leather Rot and Red Stele

Ridomil is labeled for control of red stele (caused by *Phytophthora fragariae*) and leather rot (caused by *Phytophthora cactorum*). Treatment for perennial strawberries includes one application in the spring after the ground thaws and before first bloom, and a second application in the fall. For supplemental control of leather rot, an application may be made at fruit set.

Several phosphorous acid fungicides are labeled for control of red stele and leather rot. They all have essentially the same active ingredient. These products include Agri-Fos, Aliette, Legion, ProPhyt, Phostrol, Rampart, and Topaz.

These materials are highly systemic as foliar sprays for leather rot control or as root dip for red stele control. Research at Ohio State University has shown that these products effectively control leather rot when applied weekly in a protectant program. In addition, Agri-Fos provided up to 36 hours of curative activity against leather rot in laboratory and field trials. Rates, recommendations for use, and prices vary among products.

Abound, Cabrio, and Pristine are all effective for control of leather rot when applied in a protectant program.

Anthracnose Fruit Rot

Anthracnose can be severe on both green and ripe (red) strawberry fruit. The disease is favored by high temperature accompanied by rainfall before and during harvest. If anthracnose was a problem last year, or if it is detected this growing season, consider an intensified fungicide spray program.

Abound, Cabrio 20EG, Luna Sensation, Pristine, and Quilt Xcel are registered for control of anthracnose and powdery mildew. These fungicides are reported to have good to excellent activity against anthracnose and are recommended.

All fungicides are at risk for fungicide resistance development in the fungi that cause powdery mildew

and anthracnose. In order to prevent or delay the development of fungicide resistance, do not apply any of these fungicides more than four times per season or in more than two sequential sprays without alternating to a fungicide in a different class of chemistry (different FRAC code). Abound, Cabrio, Pristine, and one component of Quilt Xcel are all in the same class of chemistry (strobilurins) and cannot be alternated with each other as a fungicide resistance management strategy.

Captan is the old standard for anthracnose control, but is not as effective as Abound, Cabrio, or Pristine. Switch is also reported to have some activity against anthracnose. Therefore, alternate Captan or Switch with Abound, Cabrio, Luna Sensation, Pristine, or Quilt Xcel. Under heavy disease pressure, consider using a combination (tank mix) of Abound, Cabrio, Pristine, or Quilt Xcel plus Captan. These materials must be used in a protectant program. Once the disease is present in the field it is difficult to control with fungicides.

Strawberry Root Weevil or Black Vine Weevil

The larvae of these pests damage strawberry roots. Because of the weevils' lack of mobility, infestations do not spread rapidly. Be sure that nursery stock is not infested before planting. Plow under old plantings soon after harvest, and locate new plantings 300 feet away.

Adult weevils can be killed by one or more foliar sprays of Brigade 10WP. Platinum 2SC is labeled for soil application to control root weevil larvae.

Potato Leafhopper

Strawberry foliage can be damaged by adult potato leafhoppers that feed for a short time, then leave. Damaged leaves become crinkled and turn yellow to brown at the margins. Damage is often detected after leafhoppers have left the field.

Carbaryl (Sevin) is labeled for control of this pest. Courier can be used for leafhopper control but affects only immature leafhoppers. Brigade, Danitol, and Diazinon do not list leafhoppers on their labels but should also provide control.

Disease Resistance of Strawberry Cultivars Commonly Grown in the Midwest¹

Cultivar	Verticillium wilt	red stele	leaf disease ²	powdery mildew
Junebearing				
AC Valley Sunset	R	R	R	U
Allstar	T	R	T	T
Annapolis	I	R	S	S
Brunswick	U	R	U	U
Cabot	U	R	T	R
Cavendish	I	R	PR	S
Clancy	U	R	R	R
DarSelect	U	U	T	VS
Daroyal	U	U	U	U
Donna	U	U	U	U
Earliglow	R	R	R	PR
Flavorfest	T	R	R	T
Galletta	U	U	U	U
Glooscap	S	VS	T	T
Guardian	R	R	R	S
Herriot	R	U	PR	U
Honeoye	S	S	PR	T
Itasca	U	R	R	U
Jewel	S	S	PR	R
Kent	S	S	S	T
L'Amour	U	R	PR	T
Lateglow	R	R	R	U
Mayflower	U	U	U	U
Mesabi	R	R	R	R
Mira	U	R	S	R
Northeaster	R	R	I	S
Ovation	U	R	R	VS
Redchief	PR	R	R	R
Seneca	S	S	U	U
Sonata	U	S	U	PR
Surecrop	R	R	T	R
AC Wendy	S	R	T	MR
Winona	T	R	R	T
Day Neutral				
Albion	R	R	T	R
Tribute	PR	R	T	R
Tristar	R	R	T	R
Seascape	U	R	S	R
San Andreas	T	U	S	R
Plasticulture System				
Camarosa	U	U	S	S
Chandler	U	S	S	S
Sweet Charlie	U	U	U	R

¹ I = intermediate. PR = partially resistant. R = resistant. S = susceptible. T = tolerant. U = unknown.

² Includes leaf spot and leaf scorch.

Fungicide Effectiveness for Strawberry Disease Control¹

Fungicide	Phomopsis leaf blight	leaf spot	powdery mildew	gray mold	leather rot	anthracnose fruit rot
Abound	?	?	E	G	E	E
Aliette	0	0	0	0	E	0
Cabrio	?	G	E	G	E	E
Captan	G	G	0	G	F	G
CaptEvate	G	G	0	E	F	G
Elevate	0	0	0	E	0	0
Fontelis	?	?	E	E	0	0
Luna Privilege			E	E		
Luna Sensation		G	E	E	E	E
Luna Tranquility			E	E		
Merivon		E	F	E		E
Mettle	E	G	E	0	0	0
Orbit	E	G	E	0	0	0
Phosphorous acid	0	0	0	0	E	0
Pristine		G	E	E	E	E
Procure	E	?	E	0	0	0
Protocol	G	G	G	G		G
Quadris Top	E	E	E	G	E	E
Quilt Xcel	0	0	E	+	0	G
Quintec	0	0	E	0	0	0
Rally	E	F	E	0	0	0
Ridomil	0	0	0	0	E	0
Rovral		G		E		
Scala	0	0	0	E	0	0
Switch	0	0	0	E	0	G
Torino	0	0	E	0	0	0
Thiram	G	G	0	G	F	F

¹ E = highly effective. G = moderately effective. F = slightly effective. 0 = not effective. ? = activity unknown.

² Never apply Topsin M alone. Always apply in combination with an unrelated fungicide such as Captan or Thiram.

Pre-harvest Restrictions for Fungicides Registered for Use on Strawberry¹

Trade Name	Common Name	FRAC Code ²	Harvest Restrictions Pre-harvest intervals and limitations (Maximum amount/ acre/season) ³	REI ⁴ (hours)
Abound	azoxystrobin	11	0	4
Aftershock	fluoxystrobin	11	1	12
Aliette	fosetyl-AL	33	12 hr.	12
Basic copper sulfate	copper sulfate	M	0	24
Cabrio EG	pyraclostrobin	11	0	12
Captan	captan	M	1	48
CaptEvate	captan + fenhexamid	M	0 (21 lbs.)	24
17	0	24	0*	12
Evito	fluoxystrobin	11	1	12
Fontelis	penthiopyrad	7	0	12
Fracture	Banda de Lupinus albus doce (BLAD)	M	1	4
JMS Stylet Oil	oil	-	0	4
Luna Privilege	fluopyram	7	0	12
Luna Sensation	fluopyram + trifloxystrobin	7 + 11	0	12
Luna Tranquility	fluopyram + pyrimethanil	7 + 9	1	12
Merivon	fluxapyroxad + pyraclostrobin	7 11	0	12
Mettle	tetraconazole	3	0	12
Pristine	pyraclostrobin + boscalid	11 7	0*	12
ProPhyt, Phostrol, Agri-Fos, Topaz, Legion, Rampart	phosphorous acid	33	0	4
Protocol	thiophanate-methyl + propiconazole	1 + 3	21	24
Quadris Top	difenoconazole + azoxystrobin	3 11	0	12
Quilt Xcel	azoxystrobin + propiconazole	11 + 3	0	12
Quintec	quinoxifen	13	1*	12
Rally	myclobutanil	3	1	24
Ridomil Gold SL	mefenoxam	4	0	48
Rovral	iprodione	2	0	24
Scala	pyrimethanil	9	1	12
Sulfur	sulfur	M	0	24
Switch	cyprodinil + fludioxonil	9 12	0	12
Thiram	thiram	M	3	24
Tilt	propiconazole	3	0	12
Topsin M	thiophanate	1	1	24
Torino	cyflufenamid	U6	0	4

¹ * = limited number of applications allowed, or other restrictions apply. Refer to label directions.

² FRAC code represents the mode of action of the fungicide.

³ Amounts shown in parenthesis are the maximum amounts of the fungicide permitted per season.

⁴ All fungicides have a Restricted-Entry Interval (REI), which is the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REIs. Restrictions in REI may prohibit the use of certain pesticides during harvest.

Effectiveness of Pesticides for Control of Strawberry Insects and Mites¹

Trade Name	Common Name	IRAC	clipper	cyclamen mite	eastern flower thrips	leafhoppers	Leafrollers	root weevils	rootworms	slugs	sap beetles	spider mites	spittlebug	tarnished plant bug	white grubs	PHI (days)	REI (hours)
Acramite	bifenazate	UN										E				1	12
Actara	thiamethoxam	4A	E			E		E						E	E	3	12
Admire Pro	imidacloprid	4A				G									E	7/14*	12
Agri-Mek	abamectin	6										E				3	12
Assail	acetamiprid	4A				G			F		G			G		1	12
Beleaf	flonicamid	9C												E		0	12
Brigade	bifenthrin	3A	E		E	G					E	F	E	E		0	12
Coragen	chlorantraniliprole	28					E									1	4
Courier	buprofezin	16				F										3	12
Danitol	fenpropathrin	3A			E	G					G	F	E	E		2	24
Diazinon	diazinon	1B				F	G	F			G		G	F	G	5*	24
Dicofol	dicofol	UN		G								F				2/3	31 days
Dibrom	naled	1B									G					1	48
Entrust	spinosad	5			G		G									1	4
Intrepid	methoxyfenozide	18					G									3	4
Kanemite	acequinocyl	20B										G				1	12
Lorsban	chlorpyrifos	1B	E		E											21*	24
Malathion	malathion	1B									F			G		3	12/24
Metaldehyde	metaldehyde									G						0*	12
Nealta	cyflumetofen	25										G				1	12
Oberon	spiromesifen	23										G				3	12
Platinum	thiamethoxam	4A	E			E		E						E	E	50	12
Portal	fenpyroximate	21		E		F						E				1	12
Radiant	spinetoram	5			G		E									1	4
Rimon	novaluron	15					E				F					1	12
Savey	hexythiazox	10A										E				3	12
Sevin	carbaryl	1A				G	F						G			7	12
Sivanto	flupyradifurone	4D			F											0	4
Sluggo	iron phosphate									G						0	0
Vendex	fenbutatin-oxide (hexakis)	12B										F				1*	48
Zeal	etoxazole	10B										E				1	12

¹ E = excellent. G = good. F = fair. * = restrictions vary. See label for details.

Fungicide PHIs and REIs

■ Fungicide Pre-harvest Intervals and Restricted Entry Intervals for Tree Fruit¹

Consult product labels for complete restrictions and limitations.

Trade Names	Common Names	Pre-harvest Interval (days)					FRAC Code ²	REI ³ (hours)
		Apple	Pear	Peach	Cherry	Plum		
Aliette	fosetyl-AL	14*	14*	—	—	—	33	12
Agri-Fos, Phostrol, ProPhyt, Topaz	phosphorous acid	0	0	0	0	0	33	4
Agri-strep	streptomycin	50	30	—	—	—	25	12
Bayleton	triadimefon	0	0	—	—	—	3	12
Bravo	chlorothalonil	—	—	*	*	*	M	48
Cabrio	pyraclostrobin	0	—	—	—	—	11	12
Captan	captan	0	—	0	0	0	M	⁴
CaptEvate	captan + fenhexamid	—	—	—	0	—	M+17	24
Carbamate	ferbam	7	7	21	0	—	M	24
Dithane M-45	mancozeb	77*	77*	—	—	—	M	24
Elevate	fenhexamid	—	—	0	0	0	17	12
Flint	trifloxystrobin	14*	14*	—	—	—	11	12
Fontelis	penthiopyrad	28	28	0	0	0	7	12
Gem	trifloxystrobin	—	—	1	1	1	11	12
Indar	fenbuconazole	14*	—	0	0	0	3	12
Inspire Super	difenoconazole + cyprodinil	¹⁴	14*	2*	2*	2*	3+9	12
Luna Sensation	fluopyram + trifloxystrobin	14	—	—	1	—	7+11	12
Luna Tranquility	fluopyram + pyrimethanil	72	—	—	—	—	7+9	12
Manzate	mancozeb	77*	77*	—	—	—	M	24
Merivon	fluxapyroxad + pyraclostrobin	0	0	0	0	0	7+11	12
Mycoshield, FireLine	oxytetracycline	—	60	21	—	—	—	*
Orbit	propiconazole	—	—	0*	0*	0*	3	24
Penncozeb	mancozeb	77*	77*	—	—	—	M	24
Polyram	metiram	77*	—	—	—	—	M	24
Pristine	pyraclostrobin + boscalid	0*	0*	0*	0*	0*	11+7	12
Procure	triflumizole	14	14	—	1	—	3	12
Quadris Top	azoxystrobin + difenoconazole	—	—	0	0	0	11+3	12
Quash	metconazole	—	—	14	14	14	3	12
Quintec	quinoxifen	—	—	7*	7*	7*	13	12
Rally	myclobutanil	14	—	7*	7*	—	3	24
Ridomil	mefenoxam	*	—	0	0	0	4	12
Rovral	iprodione	—	—	*	*	*	2	24

(continued)

Fungicide Pre-harvest Intervals and Restricted Entry Intervals for Tree Fruit (continued)

Trade Names	Common Names	Pre-harvest Interval (days)					FRAC Code ²	REI ³ (hours)
		Apple	Pear	Peach	Cherry	Plum		
Vintage	fenarimol	30	30	—	0	—	3	12
Scala	pyrimethanil	72	72	2*	—	2*	9	12
Sovran	kresoxim-methyl	30*	30*	—	—	—	11	12
Sulfur		0	0	0	0	0	M	24
Syllit	dodine	7*	7*	15*	0	—	M	48
Topguard	flutriafol	14*	—	7*	7*	7*	3	12
Topsin-M	thiophanate-methyl	0	1*	1	1	1	1	12
Vangard	cyprodinil	0	0	2	2	2	9	12
Ziram	ziram	14	14	14	14	—	M	48

¹ — = not registered or not recommended. * = Limited number of applications allowed or other restrictions apply — refer to label directions.

² FRAC Code represents the fungicide mode of action. For fungicide resistance management, do not tank mix or alternate fungicides with the same FRAC number in the spray program. M = multi-site inhibitors.

³ All fungicides have an REI, which is the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REIs. REI restrictions may prohibit the use of certain pesticides during harvest.

⁴ The REI for most Captan formulations is 24 hours; however, some product labels still have a 4-day REI. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 32.

■ Fungicide Pre-harvest Intervals and Restricted Entry Intervals (REI) for Small Fruit¹

See Generic Fungicides, page 134. Consult product labels for complete restrictions and limitations.

Trade Name	Common Name	Pre-harvest Intervals (days) (Maximum amount/acre/season) ²				FRAC ³ Code	REI ⁴ (hours)
		Grape	Blueberry	Brambles	Strawberry		
Abound	azoxystrobin	14*	0	0	0	11	4
AFrame	azoxystrobin	14 (92.3 fl. oz.)	0 (48 fl. oz.)	0 (92.3 fl. oz.)	0 (61.5 fl. oz.)	11	4
AFrame Plus	azoxystrobin + propiconazole	—	30 (82 fl.oz.)	30 (105 fl. oz.)	0 (56 fl. oz.)	11 + 3	12
Aftershock	fluoxystrobin	—	—	—	1	11	12
Aliette	fosetyl-AL	15*	0*	60	12 hr.	33	12
Aprovia	benzovindiflupyr	21 (31.5 fl. oz.)	—	—	—	7	12
Basic copper sulfate	copper sulfate	0	—	0	0	M	24
Cabrio EG	pyraclostrobin	—	0 (56 oz.)	0 (56 oz.)	0 (56 oz.)	11	24
Captan (formulations vary)	captan	0 (24 lbs.)	0 (70 lbs.)	3	1	M	48
CaptEvate	captan + fenhexamid	—	0 (21 lbs.)	0 (21 lbs.)	3	M + 17	24/48 ⁵
Dithane, others	mancozeb	66*	—	—	—	M	24
Elevate	fenhexamid	0*	0	0	0*	17	12
Endura	boscalid	14*	—	—	—	7	12
Evito	fluoxystrobin	—	—	—	1	11	12
Flint	trifloxystrobin	14*	—	—	1	11	12
Fontelis	penthiopyrad	—	—	—	0	7	12
Forum	dimethomorph	28*	—	—	—	40	12
Fracture	Banda de Lupinus albus doce (BLAD)	1	—	—	1	M12	4

(continued)

Fungicide Pre-harvest Intervals and Restricted Entry Intervals (REI) for Small Fruit (continued)

Trade Name	Common Name	Pre-harvest Intervals (days) (Maximum amount/acre/season) ²				FRAC ³ Code	REI ⁴ (hours)
		Grape	Blueberry	Brambles	Strawberry		
Indar	fenbuconazole	—	30	—	—	3	12
Inspire Super	difenoconazole + cyprodinil	14*	—	—	0	3 + 9	12
JMS Stylet Oil	oil	0	0	0	0	—	4
Kenja	isofetamid	14 (66 fl. oz.)	—	—	0 (54 fl. oz.)	7	12
Luna Experience	fluopyram + tebuconazole	14 (34 fl. oz.)	—	—	—	7 + 3	12
Luna Privilege	fluopyram	7 (13.7 fl. oz.)	—	—	0 (13.7 oz.)	7	12
Luna Sensation	fluopyram + trifloxystrobin	—	—	—	0 (27.1 oz.)	7 + 11	12
Luna Tranquility	fluopyram + pyrimethanil	—	0 (54.7 fl. oz.)	0 (54.7 fl. oz.)	1 (54.7 oz.)	7 + 9	12
Merivon	fluxapyroxad + pyraclostrobin	—	—	—	0	7 + 11	12
Mettle	tetraconazole	14	—	—	0	3	12
Omega	fluazinam	—	30 (7.5 pts.)	—	—	29	12
OSO	polyoxin D	0 (4.2 oz. a.i.)	0 (4.2 oz. a.i.)	0 (4.2 oz. a.i.)	0 (4.2 oz. a.i.)	19	4
Pristine	pyraclostrobin + boscalid	14*	0*	0*	0*	11 + 7	12 ⁶
Procure	triflumizole	7 (32 oz.)	—	—	1	3	12
ProPhyt, Phostrol, Agri-Fos, Topaz, Legion, Rampart	phosphorous acid	0	0	0*	0	33	4
Proline	prothioconazole	—	—	7 (11.4 fl. oz.)	—	3	12
Protocol	thiophanate-methyl + propiconazole	—	—	—	1 (5.3 pt.)	1 + 3	24
Quadris Top	difenoconazole + azoxystrobin	14*	—	—	0	3 + 11	12
Quash	metconazole	—	—	7 (7.5 oz.)	—	3	12
Quilt Xcel	azoxystrobin + propiconazole	14	30 (82 fl. oz.)	30 (105 fl. oz.)	0 (56 fl. oz.)	11 + 3	12
Quintec	quinoxifen	14*	—	—	1*	13	12
Rally	myclobutanil	14 (1.5 lbs.)	—	1 (10 oz.)	1 (10 oz.)	3	24
Ranman	cyazofamid	30*	—	—	—	21	12
Reason	fenamidone	30 (8.1 fl. oz.)	—	—	—	11	12
Revus	mandipropamid	14	—	—	—	40	12
Revus Top	difenoconazole + mandipropamid	14*	—	—	—	3 + 40	12
Ridomil Gold SL	mefenoxam	—	0	45	0	4	48
Ridomil Gold MZ	mefenoxam + mancozeb	66	—	—	—	4 + M	48

(continued)

Fungicide Pre-harvest Intervals and Restricted Entry Intervals (REI) for Small Fruit *(continued)*

Trade Name	Common Name	Pre-harvest Intervals (days) (Maximum amount/acre/season) ²				FRAC ³ Code	REI ⁴ (hours)
		Grape	Blueberry	Brambles	Strawberry		
Ridomil Gold Copper	mefenoxam + copper	42	—	—	—	4 + M	48
Rovral	iprodione	7*	0*	0*	0*	2	24 (fruit)/48 (grape) ⁷
Scala	pyrimethanil	7	—	—	1	9	12 ⁸
Sovran	kresoxim-methyl	14*	—	—	—	11	12
Sulforix	calcium polysulfide	0	0	0	—	M	48
Sulfur	sulfur	0	0	0	0	M	24
Switch	cyprodinil + fludioxonil	7	0 (56 oz.)	0 (56 oz.)	0 (56 oz.)	9 + 12	12
Tanos	famoxadone + cymoxanil	30	—	0	—	11 + 27	12
Tavano	polyoxin D	0 (4.2 oz. a.i.)	0 (4.2 oz. a.i.)	0 (4.2 oz. a.i.)	0 (4.2 oz. a.i.)	19	4
Tebuzol	tebuconazole	14	—	—	—	3	12
Thiram	thiram	—	—	—	3	M	24
Tilt	propiconazole	—	30	30	0	3	12
Topsin M	thiophanate	14 (4 lbs.)	—	—	1	1	24 (strawberry)/ 48 (grape) ⁹
Torino	cyflufenamid	3*	—	—	0	U6	4
Vanguard	cyprodinil	7*	—	—	—	9	12
Vivando	metrafenone	14 (42.6 fl. oz.)	—	—	—	U8	12
Zampro	ametoctradin + dimethomorph	14 (56 fl. oz.)	—	—	—	45 + 40	12
Ziram	ziram	10*	*	—	—	M	48

¹ — = not registered or not recommended. * = refer to label directions.

² Numbers in parentheses are the maximum amounts of the fungicide permitted per season.

³ FRAC Code represents the fungicide mode of action. For fungicide resistance management, do not tank mix or alternate fungicides with the same FRAC number in the spray program. M = multi-site inhibitors.

⁴ All fungicides have an REI, which is the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REIs. REI restrictions in REI may prohibit the use of certain pesticides during harvest.

⁵ Captan has various formulations; refer to label. CaptEstate has different REIs for each crop. Refer to label.

⁶ REI for Pristine is 5 days when conducting cane tying, cane turning, or cane girdling.

⁷ REI for Rovral is 48 hours on grapes, 24 hours on other fruit crops.

⁸ REI for Scala is 24 hours on grapes, 12 hours on strawberries.

⁹ REI for Topsin M WSB is 24 hours on strawberries, 48 hours on grapes.

Note on Fungicide Resistance Management

Plant pathogenic fungi have been known to develop resistance to fungicides after repeated exposure. To manage fungicide resistance, avoid successive applications of fungicides within the same group or type of chemistry.

Several tables in this guide list the Fungicide Resistance Action Committee codes (FRAC codes), including grape (page 97), blueberry (page 106), brambles (page 117), strawberry (page 128), tree fruit (pages 130-131) and small fruit (pages

131-132). The FRAC codes identify the various fungicide mode of action groups. Rotating to fungicides with a different FRAC code should help avoid development of fungicide resistance in pathogenic fungi.

Strobilurin Fungicides (FRAC code 11) include: azoxystrobin (Abound, Quadris Top, Quilt Xcel), pyraclostrobin (Cabrio, Pristine, Merivon), trifloxystrobin (Flint, Gem, Adament, Luna Sensation), kresoxim-methyl (Sovran), fenamidone (Reason), and famoxadone (Tanos).

Sterol Inhibiting Fungicides (FRAC code 3)

include: triadimefon (Bayleton), tebuconazole (Tebuzol, Adament, Luna Experience), myclobutanil (Rally), triflumizole (Procure), fenarimol (Vintage), tetraconazole (Mettle), fenbuconazole (Indar), difenoconazole (Inspire Super, Quadris Top, Revus Top), and propiconazole (Aframe Plus, Quilt Xcel, Tilt).

These fungicides are also at-risk for resistance development: thiophanate-methyl (Topsin M, T-methyl), fenhexamide (Elevate), boscalid (Endura), metalaxyl (Ridomil), iprodione (Rovral), cyprodinil (Vanguard, Switch), and pyrimethanil (Scala).

These broad-spectrum protectant fungicides (FRAC Code M) and are not considered at-risk for resistance

development: captan (Captan), mancozeb (Dithane, Manzate, Penncozeb), carbamate (Ferbam), thiram (Thiram), ziram (Ziram), fixed copper (several trade names), and sulfur.

Several pre-mix products contain fungicides with different FRAC codes and are an alternative to rotations and tank mixes. Pre-mixes include Adament, Aframe Plus, CaptEstate, Inspire Super, Luna Experience, Luna Sensation, Luna Tranquility, Merivon, Pristine, Protocol, Quadris Top, Revus Top, Ridomil Gold MZ, Ridomil Gold Copper, Switch, Tanos, and Zampro.

■ Generic Fungicides

Common Name	Original Trade Name (Current Manufacturer)	Other Trade Names (Manufacturers)
azoxystrobin	Abound (Syngenta)	Azaka (FMC)
propiconazole	Orbit 41.8L (Syngenta)	Propimax 41.8L (Dow AgriSciences), Bumper 41.8L (Makhteshim)
chlorothalonil	Bravo Weather Stick (Syngenta)	Equus DF (Makhteshim), Chlorothalonil 720 (Arysta Life Science)
captan	Captec 4L (Arysta LifeScience North America LLC)	Has several formulations including 50W
thiophanate methyl	Topsin-M 70WDG (United Phosphorous Inc.)	Thiophanate Methyl 85WSB (Makhteshim), T-Methyl EAG 70WSB (Nufarm), T-Methyl 70W WSB (Arysta Life Science)
iprodione	Rovral 4F (Bayer)	Iprodione 4L AG (Arysta Life Science), Meteor 4L (United Phosphorus Inc.), Nevado 4F (Makhteshim)
mancozeb	Dithane M45 (Dow AgriSciences)	Manzate Max (United Phosphorus, Inc), Penncozeb (several formulations)
mefenoxam	Ridomil Gold SL (Syngenta)	Ultra Flourish (Nufarm)
metalaxyl	Ridomil 2E (Syngenta)	Metastar 2E (Arysta Life Science)
myclobutanil	Rally 40WSP (Dow AgriSciences)	Sonoma 40WSP (Albaugh)
streptomycin	Streptomycin 17 (Loveland Products Canada Inc.)	AG Streptomycin (ADAMA)
tebuconazole	Tebuzol 45DF (United Phosphorous, Inc.)	Orius 3.6F (Makhteshim), Orius 45DF (Makhteshim), TebuStar 3.6 L (Albaugh), TebuStar 45WSP (Albaugh)
fosetyl-Al	Aliette 80WDG (Bayer)	Legion 80WDG (Makhteshim)

Insecticide and Miticide PHIs and REIs

■ Insecticide and Miticide Pre-harvest Intervals and Restricted Entry Intervals (REI) on Tree Fruit¹

See Generic Insecticides, pages 139-140. Consult product labels for complete restrictions and limitations.

Trade Name	Common Name	Pre-harvest Interval (days)					IRAC ²	REI ³ (hours)
		Apple	Pear	Peach	Cherry	Plum		
Acramite	bifenazate	7	7	3	3	3	20	12
Actara	thiamethoxam	14/35	14/35	14	14	14	4A	12
Admire Pro (foliar)	imidacloprid	7	7	0	7	7	4A	12
Admire Pro (soil)	imidacloprid	21	21	21	21	21	4A	12
Agri-Mek (RUP)	abamectin	28	28	21	21	21	6	12
Altacor	chlorantraniliprole	5	5	10	10	10	28	4
Apollo	clofentezine	45	21	21	21	—	10A	12
Apta	tolfenpyrad	—	—	14	14	14	21A	12
Asana (RUP)	esfenvalerate	21*	28*	14*	14*	14*	3A	12
Assail	acetamiprid	7	7	7	7	7	4A	12
Avaunt	indoxacarb	14	28	14	14	14	22	12
Baythroid XL (RUP)	beta-cyfluthrin	7	7	7	7	7	3A	12
BeetleGONE!	<i>B. thuringiensis galleriae</i>	7	7	7	7	7	11A	4
Belay	clothianidin	7	7	21	—	—	4A	12
Beleaf 50 SG	flonicamid	21	21	14	14	14	9C	12
Brigade (RUP)	bifenthrin	—	14	—	—	—	3A	12
Centaur	buprofezin	14	14	14	14	14	16	12
Closer	sulfoxaflor	7	7	7	7	7	11A	4
Confirm	tebufenozide	14	14	—	—	—	18	4
Cyd-X (OMRI)	codling moth granulovirus	0	0	—	—	—	—	4
Danitol (RUP)	fenpropathrin	14	14	3	3	3	3A	24
Delegate	spinetoram	7	7	14	7	7	5	4
Delta Gold (RUP)	deltamethrin	21	21	—	—	—	3A	12
Dimethoate	dimethoate	—	28	—	—	—	1B	48
Dimilin* (RUP)	diflubenzuron	—	14	UPF	UPF	UPF	15	12
Diazinon (RUP)	diazinon	21	21	21	21	21	1B	5 days
Dicofol	dicofol	7	7	—	—	—	—	35 days
Dipel (OMRI)	<i>Bacillus thuringiensis</i>	0	0	0	0	0	11A	4-12
Entrust (OMRI)	spinosad	7	7	14	7	7	5	4
Envidor	spirodiclofen	7	7	7	7	7	23	12
Esteem	pyriproxyfen	45	45	14	14	14	7C	12
Exirel	cyantraniliprole	3	3	3	3	3	28	12
Imidan	phosmet	7	7	14	7	7	1B	72
Intrepid	methoxyfenozide	14	14	7	7	7	18	4
Kanemite	acequinocyl	14	14	—	—	—	20B	12
Lannate (RUP)	methomyl	14	7	4	—	—	1A	*

(continued)

Insecticide and Miticide Pre-harvest Intervals and Restricted Entry Intervals (REI) on Tree Fruit (continued)

Trade Name	Common Name	Pre-harvest Interval (days)					IRAC ^b	REI ^c (hours)
		Apple	Pear	Peach	Cherry	Plum		
Lorsban (RUP, EC only)	chlorpyrifos	UPF*	*	14*	21	14	1B	4 days
Magister	fenazaquin	—	—	—	3	—	21	12
Malathion	malathion	—	—	7	3	—	1B	12-24
Movento	spirotetramat	7	7	7	7	7	23	24
M-Pede (OMRI)	potassium salts of fatty acids	0	0	0	0	0	—	12
Mustang Maxx (RUP)	zeta-cypermethrin	14	14	14	14	14	3A	12
Nealta	cyflumetofen	7	7	—	—	—	25	12
Neemix (OMRI)	azadirachtin	0	0	0	0	0	UN	12
Nexter	pyridaben	7/10	7/10	7/10	7/10	7/10	21A	12
Onager	hexythiazox	28	28	7	7	7	10A	12
Portal	fenpyroximate	14	14	7	7	7	21A	12
Pounce (RUP)	permethrin	*	*	14*	3*	—	3A	12
Proaxis (RUP)	gamma cyhalothrin	21	21	14	14	14	3A	24
Proclaim (RUP)	emamectin benzoate	14	14	—	—	—	6	12
Rimon	novaluron	14	—	8	—	8	15	12
Saf-T-Side	horticultural oil	0	0	0	0	0	—	12
Savey	hexythiazox	28	28	28	28	28	10A	12
Sevin	carbaryl	3	3	3	3	3	1A	12
Sivanto Prime	flupyradifurone	14	14	14	14	14	4D	4
Sunspray	horticultural oil	0	0	0	0	0	—	12
Superior oil (some OMRI)	horticultural oil	*	*	*	*	*	—	12
Supracide (RUP)	methidathion	*	*	*	*	*	1B	72
Surround (OMRI)	kaolin	0	0	0	0	0	—	4
Vendex (RUP)	fenbutatin-oxide	14	14	14	14	14	12B	48
Venom, Scorpion	dinotefuran	—	—	3/21	—	—	4A	12
Vydate (RUP)	oxamyl	14	14	—	—	—	1A	48
Warrior (RUP)	lambda-cyhalothrin	21	21	14	14	14	3A	24
Zeal	etoxazole	14	14	7	7	7	10B	12

¹ — = not registered or not recommended. * = specific pre-harvest intervals or restricted entry intervals vary for different formulation, application rates, crops, or geographical location — refer to label directions. RUP = restricted use pesticide. OMRI = Organic Materials Review Institute — approved for use in organic production. UPF = until petal fall.

² IRAC code represents the mode of action of the insecticide.

³ All insecticides have a restricted entry interval (REI). The restricted-entry interval is the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REI and personal protection equipment (PPE) required for early re-entry. Restrictions in REI may prohibit the use of certain pesticides during harvest.

■ Insecticide and Miticide Pre-harvest Intervals and Restricted Entry Intervals on Small Fruit¹

See Generic Insecticides, pages 139-140. Consult product labels for complete restrictions and limitations.

Trade Name	Common Name	Pre-harvest Intervals (days)				IRAC ² Code	REI ³ (hours)
		Grape	Blueberry	Brambles	Strawberry		
Acramite	bifenazate	14	—	1	1	20	12 hr/5days
Actara	thiamethoxam	5	3	3	3	4A	12
Admire Pro	imidacloprid	0/30*	3/7*	3/7*	7/14*	4A	12
Agri-Mek (RUP)	abamectin	28	—	7	3	6	12
Altacor	chlorantraniliprole	14	1	3	—	28	4
Apollo	clofentezine	21	—	—	—	10A	12
Asana (RUP)	esfenvalerate	—	14	7	—	3	12
Assail	acetamiprid	7	1	1	1	4A	12
Avaunt	indoxacarb	7	7	—	—	22	12
Baythroid (RUP)	cyfluthrin	3	—	—	—	3	12
BeetleGONE!	Bacillus thuringiensis	0	0	0	0	11A	4
Belay	clothianidin	0/30*	—	—	—	4A	12
Beleaf	flonicamid	—	—	—	0	29	12
Brigade (RUP)	bifenthrin	30	1	3	0	3	12
Closer	sulfoxaflor	7	—	—	—	4C	12
Confirm	tebufenozide	—	14	14	—	18	4
Coragen	chlorantraniliprole	—	—	—	1	28	4
Courier	buprofezin	—	—	—	3	16	12
Danitol (RUP)	fenpropathrin	21	3	3	2	3	24
Deadline	metaldehyde	0	0	0	0	—	12
Delegate	spinetoram	7	3	1	—	5	12
Diazinon (RUP)	diazinon	—	7	—	5*	1B	120
Dibrom (RUP)	naled	10	—	—	1	1B	48/72
Dicofol	dicofol	7	—	—	2/3	UN	31/39 days
DiPel ⁴ (OMRI)	<i>B. thuringiensis</i>	0	0	0	0	11A	4
Entrust (OMRI)	spinosad	7	3	1	1	5	4
Envidor	spirodiclofen	14	—	—	—	23	12
Esteem	pyriproxyfen	—	7	—	—	7C	12
Exirel	cyantraniliprole	—	3	—	—	28	12
Imidan	phosmet	7/14	3	—	—	1B	24 hr/14 days
Intrepid	methoxyfenozide	21/30	7	3	3	18	4
Kanemite	acequinocyl	7	—	1	1	20B	12
Knack	pyriproxyfen	21	7	7	—	7C	12
Lannate* (RUP)	methomyl	—	3	—	—	1A	48 hr/7 days*
Lorsban (some RUP)	chlorpyrifos	35*	—	—	21*	1B	24
Malathion	malathion	3*	1*	1	3	1B	12/24
Movento	spirotetramat	7	—	—	—	23	24
Mustang Maxx (RUP)	zeta-cypermethrin	1	1	1	—	3	12
Mycotrol	<i>Beauveria</i>	0	0	0	0	—	4

(continued)

Insecticide and Miticide Pre-harvest Intervals and Restricted Entry Intervals on Small Fruit *(continued)*

Trade Name	Common Name	Pre-harvest Intervals (days)				IRAC ^b Code	REI ^c (hours)
		Grape	Blueberry	Brambles	Strawberry		
Nealta	cyflumetofen	14	—	—	1	25	12
Neemix, Aza-Direct (OMRI)	azadirachtin	0	0	0	0	UN	4/12
Nexter	pyridaben	7/10	—	—	1/10	21A	12
Oberon	spiromesifen	—	—	—	3	23	12
Onager	hexythiazox	7	—	—	—	10A	12
Platinum	thiamethoxam	60	75	—	50	4A	12
Portal	fenpyroximate	14	—	—	1	21	12
Pyganic (OMRI)	pyrethrins	0	0	0	0	3	12
Radiant	spinetoram	—	—	—	1	5	4
Rimon	novaluron	—	8	—	1	15	12
Savey	hexythiazox	—	—	3	3	10A	12
Sevin	carbaryl	7	7	7	7	1A	12
Sivanto Prime	flupyradifurone	0/30*	3	0	0	4D	4/48*
Sluggo (OMRI)	iron phosphate	0	0	0	0	—	0
Surround	kaolin	0	0	0	0	—	4
Vendex (RUP)	fenbutatin-oxide (hexakis)	28*	—	—	1*	12B	48
Venom, Scorpion	dinotefuran	1/28	—	—	—	4A	12
Zeal	etoxazole	14	—	0	1	10B	12

¹ — = not registered or not recommended. * = specific pre-harvest intervals or restricted entry intervals vary for different formulation, application rates, crops, or geographical location — refer to label directions.

RUP = restricted use pesticide. OMRI = Organic Materials Review Institute — approved for use in organic production.

² IRAC code represents the mode of action of the insecticide.

³ All insecticides have a restricted entry interval (REI). The restricted-entry interval is the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REI and personal protection equipment (PPE) required for early re-entry. Restrictions in REI may prohibit the use of certain pesticides during harvest.

⁴ Products that contain *Bacillus thuringiensis* for caterpillar control include Agree, Biobit, CryMax, DiPel, Javelin, Lepinox, and XenTari.

Note on Insecticide Resistance Management

Insects have been known to develop resistance to insecticides after repeated exposure. For insecticide resistance management, avoid successive applications of insecticides within the same group or type of chemistry. The Insecticide Resistance Action Committee codes (IRAC codes) listed in the tables above identify the various insecticide mode of action groups. Rotating to insecticides with a different IRAC code should help avoid development of insecticide resistance.

■ Generic Insecticides

Common Name	Original Trade Name (Current Manufacturer)	Other Trade Names (Manufacturers)
abamectin	Agri-Mek 0.15EC (Syngenta)	Abacus 0.15EC (Rotam) Abamex 0.15ED (Nufarm) Abba 0.15EC (Adama) Abba Ultra 0.30EC (Adama) Borrada 0.15EC (Adama) Epi-Mek 0.15EC (Syngenta) Nufarm Abamectin 0.15EC (Nufarm) Reaper 0.15EC (Loveland) Temprano 0.15EC (Chemtura) Tide Timectin 0.15EC (Tide Intl.) Willowood Abamectin 0.15EC (Willowood) Zoro 0.15EC (FMC)
acephate	Orthene 90SP (Amvac)	Bracket 90 (Winfield) Bracket 90 WSP (Winfield)
acetamiprid	Assail 30SG (United Phosphorous)	Anarchy 30SG (Loveland)
<i>Bacillus thuringiensis</i>	Dipel (Valent)	Agree (Certis) Biobit (Valent) CryMax (Certis) Deliver (Certis) Jackpot WP (Certis) Javelin (Certis) Xentari (Valent)
bifenthrin	Brigade 2EC (FMC) Capture 2EC (FMC)	BBi-Dash 2EC (Adama) Bifen 2AG Gold (Direct AG Source) Bifenture 2EC (United Phosphorous) Discipline 2EC (Amvac) Fanfare 2EC (Adama) Frenzy Veloz 2EC (Real Farm) Revere 2EC (Adama) Ruckus LFR (Helena) Sniper 2EC (Loveland) Tundra 2EC (Winfield) Xpedient 2FC (Amvac)
carbaryl	Sevin XLR Plus, 4L (Tessenderlo Kerley)	Carbaryl 4L (Drexel, Loveland) Carbaryl 15% Bait (Drexel) Carbaryl Cutworm Bait (Drexel)
chlorpyrifos	Lorsban 4E, 15G, 75WDG, Advanced 3.76E (Dow)	Chlorpyrifos 4E (Drexel) Govern 4E (Tenkoz) Hatchet (Dow AgroSciences) Nufos 4E (FMC) Saurus 15G (Helena) Vulcan 3.76E (Adama) Warhawk 4E (Loveland) Whirlwind 4E (Helena) Yuma 4E (Winfield)
cyfluthrin	Baythroid XL 1EC (Bayer)	Tombstone 2E (Loveland) Tombstone Helios 2E (Loveland)

(continued)

Generic Insecticides (continued)

Common Name	Original Trade Name (Current Manufacturer)	Other Trade Names (Manufacturers)
dimethoate	Cygon 4EC (FMC)	Dimate 4EC (Winfield) Dimethoate 400, 4EC (Drexel, Loveland, FMC)
esfenvalerate	Asana XL 0.66EC (Dupont)	S-Fenvalostar 0.66EC (LG Life Sciences) Zyrate 0.66EC (Rotam)
gamma cyhalothrin	Proaxis (Loveland)	Declare (FMC) Proaxis 0.5EC (FMC)
imidacloprid	Admire Pro (Bayer)	Advise 2F (Winfield) Alias 2F (Adama) Couraze 1.6F, 75WP, 2F (FMC) Macho 2FL (Albaugh) Malice 75WSP (Loveland) Midash 2SC (Sharda) Montana 2F (Rotam) Nuprid 1.6F, 2F (Nufarm) Pasada 1.6F (Adama) Prey 1.6F (Loveland) Prokoz Zenith 2F (Bayer) Prokoz Zenith 75WSP (Bayer) Sherpa 1.6F (Loveland) Widow 2F (Loveland) Wrangler 4F (Loveland)
lambda-cyhalothrin	Warrior II 2.08CS (Syngenta)	Grizzly Z 1CS (Winfield) Kendo 1CS (Helm) Lambda-Cy 1EC (United Phosphorus) Lambda T 1EC (Helena) Lamcap (Syngenta) Paradigm 1EC (Adama) Ravage 1EC (Innvictus) Silencer 1EC (Adama)
methoxyfenozide	Intrepid 2F (Dow AgroSciences)	Troubador 2F (Helena)
permethrin	Pounce 3.2EC (FMC)	Arctic 3.2EC (Winfield) Permethrin 3.2EC (Loveland, Helena, Direct Ag, Tenkoz) Perm-Up 3.2EC (United Phosphorus) Perm Star AG (LG Int'l)
pyriproxyfen	Esteem 35WP (Valent) Knack 0.83EC (Valent)	Farewell 0.86 EC (Adama) Pitch (0.83EC (Adama)
zeta-cypermethrin	Mustang Maxx (FMC)	Respect 0.8EC (BASF)

Growth Regulator PHIs and REIs

■ Growth Regulator Pre-harvest Intervals and Restricted Entry Intervals (REI)¹

Trade Name	Common Name	Pre-harvest Interval ² (days)						REI (hours)
		Apple	Pear	Peach	Sweet Cherry	Tart Cherry	Plum	
Apogee	Prohexadione-calcium	45	—	—	³	—	—	12
Amid Thin-W	NAD	21 DAFB ³	7 DAPF ³	—	—	—	—	48
Ethrel/Motivate	ethephon	7	—	—	7	7	—	48
Fruitone N	NAA	2	2	—	—	—	—	48
K-Salt Fruit Fix 200	NAA	7	5	—	—	—	—	24
K-Salt Fruit Fix 800	NAA	7	5	—	—	—	—	24
MaxCel	6-benzladenine	86	86	—	—	—	—	12
Pro-Gib	gibberellic acid (GA3)	—	—	—	Fruit is straw colored	14-28 DAFB	4-5 weeks before harvest	12
Pro-vidé	GA4 + 7	—	—	—	—	—	—	4
Promalin	6BA + GA4 + 7	—	⁴	—	⁴	—	—	4
ReTain	AVG	7	7	7	—	—	7	12
Sucker-Stopper RTU (lawn/garden use)	NAD	DS & SP	DS & SP	—	—	—	—	—
Tree-Hold Sprout Inhibitor A-112	NAA	DS & SP	DS & SP	—	—	—	—	12

¹ — = not registered or not recommended.

² DAFB = days after full bloom, DAPF = days after petal fall. DS = dormant season, SP = during summer pruning when shoots are 6-12 inches tall.

³ Registered in the Midwest only in Indiana and Ohio.

⁴ Non-bearing trees only.

Chemical Weed Control in Fruit Crops

Controlling weeds in fruit plantings is increasingly important, especially as tree fruit production more closely resembles grape and berry crop production. Managing weeds along the crop hedgerows will greatly improve plant establishment and growth. Herbicides can provide good weed control with little labor and frequently at a low cost compared to manual weed control. Herbicides, when used properly, improve plant or tree growth and control insects, diseases, and mice.

Proper Application

To be effective, you must properly select herbicides for the weeds they are intended to control. You must apply them at the proper time, at the proper rate, and with the proper equipment. The degree of weed control depends largely on the operator's skill.

In most cases, herbicide rates given are for overall coverage (broadcast rates). For **band treatment** common in fruit plantings, reduce the amounts according to the portion of area treated. For example, if you want 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 plants if used improperly. Therefore, make sprayer adjustments and calibrations as precise as possible to assure accurate and uniform applications. Use nozzles appropriate for herbicide application at low pressures (20-40 psi) on a fixed boom-type applicator, unless the label has specific recommendations. This type of sprayer is calibrated easily and, when designed properly, will deposit herbicide uniformly.

Consider using one of the recently introduced low-drift nozzles such as the Turbo TeeJet Nozzle or the 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.

While backpack or hand sprayers may be suitable for spot treatment with post-emergence herbicides, do not use them to apply pre-emergent herbicides around fruit plants. The application rate is critical with pre-emergent herbicides and hand sprayers cannot be calibrated well enough for accurate application. Slight application rate errors can cause severe damage to fruit plants.

Calibrate each sprayer carefully and apply herbicides according to the suggested rates. Note that when applying many pre-emergence herbicides to the soil, you should adjust rates according to soil characteristics. Generally, use lower rates on sandy soils with low organic matter, and use higher rates on heavier textured soils and those high in organic matter. With some herbicides, no rate changes are suggested. If you are unsure about an herbicide's effectiveness or possible crop damage, test it on a small portion of the planting before using extensively.

Herbicide Resistance Management

Continued use of the same herbicide can lead to the development of herbicide-resistant weeds, or the establishment of tolerant weeds. Avoid using the same product, or chemically related products for several consecutive years in a row to avoid building up herbicide-resistant weed biotypes. We recommended that you rotate herbicides and include non-chemical controls whenever possible to avoid these problems and improve weed control.

Tank Mixes

Certain herbicides may be combined in suitable tank-mixes. Consult product labels for approved combinations and recommended rates. Do not use tank mixes that are not listed on the label.

By using tank mixes, you can apply a pre-emergence herbicide together with a post-emergence herbicide to provide improved weed control, or you can apply two pre-emergence herbicides at reduced rates, each to gain better weed control and reduce the risks of crop damage. **Always follow label recommendations.**

Timing of Applications

Weed management may require multiple applications each year. Timing is very important for best results.

Often, growers apply a post-emergence herbicide in early spring to control winter annuals and perennials before they flower. The timing of this application may be too early for maximum pre-emergence herbicide effectiveness. So it is often wise to follow the first application with a second application of a tank mix of post- and pre-emergence herbicides about three weeks after the first. This will control any weeds that have emerged since the first application and put the pre-emergence in place at the right time

so that it will last through the main period of weed emergence.

Spot treatments with suitable post-emergence herbicides will keep the planting weed-free for most of the season. Always observe pre-harvest intervals. Many pre-emergence herbicides can be applied in spring or fall, and some labels suggest a split application. Fall applications can be very effective at managing weeds.

Site Preparation Before Planting

Most perennial weeds cannot be controlled effectively in the spring before planting or once the crop is planted. Growers should strive to eradicate established perennial weeds during site preparation in the season prior to establishing the crop.

You should apply glyphosate (a nonselective systemic herbicide) products such as Roundup, Touchdown, and many other formulations, in the summer prior to planting when weeds are actively growing. Applying glyphosate just before harvesting winter wheat or rye (this is known as a pre-harvest treatment) is an excellent way to control creeping perennials such as Canada thistle and goldenrod.

Treatments applied to stubble can also be highly effective. Fields that are in hay or pasture should be allowed to grow in the spring or fall until the grass is at least 8 inches tall. Ideally, perennial broadleaf weeds should be approximately at the bud to early flowering stage at the time of treatment. Summer and early fall applications of glyphosate may be more effective against perennial broadleaf weeds than spring applications.

Allow five to seven days for glyphosate to translocate throughout the root system before plowing under. This should be followed by repeated shallow cultivations as green “flushes” of weed seedlings appear. An alternative is to apply paraquat (Gramoxone) or glufosinate (Rely or generics) for contact nonselective weed control as flushes of weed seedlings appear.

Trade Name and Active Ingredient (a.i.)

Herbicide labels list the chemical names of the active ingredients and the percentage or amount of the active ingredients as “a.i.” Herbicides come in various formulations and under various trade names. For the sake of brevity, only the original trade name is listed in this guide. See table on pages 167-168 for other trade names registered for use on fruit crops.

Always read each label carefully as rates and labeled crops may differ between labels with similar active ingredients. Be sure to follow the recommended rates as they are listed on the label of the product you plan to use.

Use Restrictions

Federal regulations control herbicide use and prescribe the crops upon which the herbicides can be used and the timing and rates for which these materials are registered. Be sure to use only registered materials at the recommended rates. Herbicides are covered by Worker Protection Standards where they apply. Labels include restricted-entry intervals (REI) and personal protective equipment (PPE) information. Product labels are the final authority — follow them carefully.

Good Rules to Remember

1. The rates recommended in this guide are mid-range rates applicable for medium to fine soils. Always refer to labels for full details about rates depending on soil type, organic matter content, age of plants, etc.
2. Applying post-emergence herbicides under stress conditions to weeds (such as high temperatures in midsummer, drought, cool temperatures in the spring, etc.) may result in poor weed control.
3. Use a fixed-spray boom, appropriate nozzles, and low pressure for even application without drift.
4. Only spray when there is little or no wind (less than 5 mph).
5. Adjust rates according to bandwidth.
6. Follow herbicide restrictions on new plantings. Allow plants to become well-established and the soil well-settled around plants before application.
7. Use herbicide sprayers for herbicides only.
8. Clean sprayers thoroughly when changing herbicides, especially when you have used 2,4-D, Chateau, or Prowl.
9. Store pesticides in locked storage. Do not allow liquid pesticides to freeze.
10. Protect the environment — avoid surface or ground water contamination. Dispose of excess spray material carefully and according to label directions. Do not allow grazing in treated areas.
- 11. Read the label. Understand it thoroughly. Follow its directions.**

■ Herbicide Recommendations for Apple and Pear

Weed Problem	Material & Rate per Acre	Notes and Comments
Pre-emergence		
annual grasses and broadleaves	Alion (Indaziflam 1.67 lbs. a.i./gal) at 5.0-6.5 fl. oz. in minimum of 10 gals. of water	Trees must be established at least 3 years after transplanting. Avoid direct or indirect spray contact with crop foliage, green bark, roots, or fruit as it may cause localized crop injury and death. Allow at least 30 days between applications. Do not exceed 10.3 fl. oz. per acre in a 12-month period. Do not apply to frozen ground. Do not apply within 25 feet of ponds, rivers, streams, or wetlands. Spot spraying is not recommended. Shake container well before use. PHI=14 days
annual and perennial grasses and broadleaves	Casoron CS (dichlobenil 1.4 lb a.i./gal.) at 1.4-2.8 gals. in 7-100 gals. of water	Apply from late fall to early spring prior to weed emergence or when weeds are less than 2 inches tall. Apply when temperatures are below 70°F. Do not use on light sandy soils. Do not use until 1 year after transplanting. Do not use in nurseries.
annual broadleaves and suppression of grasses	Chateau SW (flumioxazin 51% a.i.) at 6-12 oz. in 15-75 gals. of water	Do not apply to trees established less than 1 year unless protected from spray contact by nonporous wraps. Do not apply after bud break on apples unless using a hooded or shielded sprayer. Do not apply to fine textured soils. Do not exceed 2 applications in a growing season or make a sequential application within 30 days of the first application. Do not apply when plants are under stress. Do not apply within 300 yards of nondormant pears. Do not incorporate. Do not allow drift to contact foliage or green bark. Do not exceed 24 oz. per season. Minimum 30 days between applications. PHI=60 days.
annual broadleaves and suppression of grasses	Goal 2XL (oxyfluorfen 2 lbs. a.i./gal.) at 2-8 pts. in minimum of 40 gals. of water (see Generic Herbicides, page 167)	Dormant Application Only: Effective both pre-emergence (5-8 pts.) and post-emergence (2-8 pts.) as directed spray on weeds larger than 4 inches. Do not apply from bud swell until harvest completion. Can be mixed with other pre-emergence herbicides or with Roundup or Gramoxone. Do not exceed 8 pts. per year.
annual grasses and broadleaves	Karmex DF (diuron 80% a.i.) at 4 lbs. in 25-40 gals. of water (see Generic Herbicides, page 167)	Effective both pre-emergence and post-emergence (min. 70°F with high humidity). Apply under trees established at least 1 year. Do not treat trees grafted on full-dwarf rootstocks. Do not exceed 1 application/year. Apple Only: May be tank mixed with Sinbar (1.5-2 lbs. 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 SC (pronamide 35.6% a.i.) at 2.5-9.5 pts. in 40-50 gals. of water. Rate depends on weed pressure and soil type. See table on label.	Apply as a directed spray in the fall after harvest prior to soil freeze-up. Rainfall or irrigation are required to activate. Do not apply more than 9.5 pts./A/year or make more than 1 application per year. Age restriction: Kerb SC may not be applied to (1) trees less than 1 year old, (2) fall-transplanted stock transplanted less than 1 year old, or (3) spring-transplanted stock transplanted less than 6 months. Restricted use pesticide.
annual grasses and broadleaves	Matrix FNV (rimsulfuron 25% a.i.) at 4 oz. in minimum of 10 gals. of water	Apply only to crops that have been established for 1 full growing season and are in good health and vigor. Weeds are controlled for 60-90 days after application. Matrix will burn down small, actively growing weeds less than 1 inch tall. When weeds are present at application, a labeled burndown herbicide, such as glyphosate, paraquat, or glufosinate, with an appropriate adjuvant will improve control. Avoid direct or indirect contact with crop foliage or fruit, except undesirable suckers. Do not use Matrix FNV in a spray solution with a pH below 4.0 or above 8.0. Best results are obtained when the soil is moist at the time of application and 0.5 inch of rainfall or sprinkler irrigation occurs within 2 weeks of application. PHI=7 days.

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Herbicide Recommendations for Apple and Pear *(continued)*

Weed Problem	Material & Rate per Acre	Notes and Comments
annual grasses and broadleaves	Princep 4L (simazine 4 lbs. a.i./gal.) at 2-4 qts. in minimum of 40 gals. of water (see Generic Herbicides, page 167)	Apply under trees established at least 1 year. Apply in spring before weeds emerge avoiding contact with fruit, foliage, or stems. Do not apply more than 4 qts. per acre per calendar year. PHI = 150 days for apples.
broadleaves	Sandea (halosulfuron-methyl 75% a.i.) 0.5-1 oz. in minimum of 15 gals. of water	Apple Only: Apply a single or sequential application based on weed pressure. Apply to bare ground for best results. If small weeds are present, mix with a post-emergence broad-spectrum herbicide.
annual grasses and broadleaves	Sinbar WDG (terbacil 80% a.i.) at 0.5-4 lbs. in minimum of 20 gals. of water (see Generic Herbicides, page 167)	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. Non-bearing: (young, newly planted) Apple: 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. Do not exceed 1 lb./year. Do not use on soils with <1% organic matter.
annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (norflurazon 78.6% a.i.) at 5 lbs. in minimum of 20 gals. 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 of 0.5 inch is needed within 4 weeks. Do not contact fruit or foliage. Do not apply after bud break on sandy loam soils. Check label for maximum amount allowed per year depending on soil type. Apple: Can be applied immediately after planting. Pear: Minimum 12 months after planting east of the Mississippi River before first application; minimum 18 months after planting west of the Mississippi before first planting. PHI = 60 days.
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water (see Generic Herbicides, page 167)	Make a single band or broadcast application to the ground beneath trees before weeds emerge. Apply alone to weed-free soil or post-emergence mixed with Roundup or Gramoxone. Rainfall or irrigation (0.5 inch) is required for activation. Minimum 2.5 months between applications. Do not exceed 12 qts./year.
Post-emergence		
annual broadleaves	Aim 2 EC (carfentrazone 2 lbs. a.i./gal.) at 2 fl. oz. in 20 gals. of water	Apply any time during the season. Always add NIS 0.25% v/v or crop oil 1% v/v. Mix with Roundup or Gramoxone for broader weed control. Do not exceed 7.9 fl. oz./year. Minimum 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) at 3 pts. in 5-25 gals. of water (see Generic Herbicides, page 167)	Apply as directed spray to annuals 1-2 inches high and to perennials up to early bud stage. Do not allow spray to contact leaves, fruit, or limbs of tree. Use coarse spray and low pressure to avoid drift. Non-bearing trees must be established at least 1 year. On bearing trees, do not apply during bloom or after or before irrigation. Do not apply to bare ground. Do not exceed 2 applications/year. Maximum 75 days between applications. PHI=14 days.

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Herbicide Recommendations for Apple and Pear *(continued)*

Weed Problem	Material & Rate per Acre	Notes and Comments
annual broadleaves and suppression of grasses	Chateau WDG (flumioxazin 51% a.i.) at 6-12 oz. in 15-75 gals. of water	Do not apply to trees established less than 1 year unless protected from spray contact by nonporous wraps. Do not apply after bud break on apples unless using a hooded or shielded sprayer. Do not apply to fine textured soils. Do not exceed 2 applications in a growing season or a sequential application within 30 days of the first application. Do not apply when plants are under stress. All applications to pears or within 100 meters of pears must be made when they are dormant and 2 months before spring bud break. Apply alone pre-emergence or tank mix with Roundup or Gramoxone post-emergence 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. Do not exceed 24 oz. per season. Minimum 30 days between applications. PHI=60 days.
annual broadleaves	Goal 2XL (see Generic Herbicides, page 167)	See Pre-emergence section (page 144) for details.
most annual grasses and broadleaf weeds and top kill of perennial weeds	Gramoxone (paraquat 2 lbs. a.i./gal.) at 2.5-4 pts. in minimum of 10 gals. of water (see Generic Herbicides, page 167)	Apply as directed spray to actively growing weeds. Repeat applications are necessary to give sustained control. Apply as a coarse spray. Always add NIS 0.25% v/v or crop oil 1% v/v. Do not allow spray to contact leaves, fruit, or green stems. Do not exceed 5 applications/year. PHI=28 days. Restricted use pesticide.
annual grasses and broadleaves	Karmex DF (see Generic Herbicides, page 167)	See Pre-emergence section (page 144) for details
annual and perennial grasses	Poast 1.5EC (sethoxydim 1.5 lbs. a.i./gal.) at 1.5-2.5 pts. in 25 gals. of water	Apply as a directed spray to actively growing grass before they exceed maximum recommended heights. Always add crop oil 1.25% v/v. Do not exceed 2.5 pts./application or exceed 7.5 pts./season. PHI=14 days.
annual and perennial grasses and broadleaves	Rely 280 (glufosinate 2.34 lbs. a.i./gal.) at 48-82 fl. oz. in minimum of 20 gals. of water (see Generic Herbicides, page 167)	Apple Only: Apply as a directed spray to actively growing weeds. Avoid spray drift or mist contact with green bark, stems, or foliage as injury may occur. Only trunks with callused, mature brown bark should be sprayed unless protected by nonporous wraps, grow tubes, or waxed containers. Maximum rate is 164 fl. oz./ acre in a 12-month period. Do not make spot or directed spray applications to tree trunks or to apple suckers as tree injury may occur. PHI=14 days.
annuals and some perennial grasses and broadleaves	Roundup WeatherMax, Roundup PowerMax 5.5EC (glyphosate 5.5 lbs. a.i./gal.) at 11 fl. oz.-3.3 qts. in 10-40 gals. of water (see Generic Herbicides, page 167)	Rate depends on weed species and stage of growth. See label for details. Do not exceed 7 qts./acre/year. Apply as preplant broadcast application or in fall for control of roots and rhizomes of perennial weeds or as a directed spray or wiper application (20-100% solution) to actively growing weeds in established plantings. Always add AMS 8.5-17 lbs./100 gals. in hard water or drought conditions. Do not allow spray to contact any part other than mature bark. Avoid application to suckers and recent pruning wounds. Does not provide residual control. Can be mixed with labeled pre-emergence herbicides. PHI=1 day.
broadleaves and nutsedge	Sanda (halosulfuron-methyl 75% a.i.) 0.5-1 oz. in minimum of 15 gals. of water	Apple Only: For best results, use an NIS with post-emergence applications. Avoid spray drift on tree foliage and fruit and do not apply when temperatures exceed 85°F. Do not apply to trees established less than 1 year. Do not exceed 2 oz./12-month period. May not control ALS-resistant weeds. Make a single application using a minimum of 0.75 oz./acre of Sandea when nutsedge is fully emerged at the 3- to 5-leaf stage. A second application may be made later in the season for secondary nutsedge emergence

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Herbicide Recommendations for Apple and Pear *(continued)*

Weed Problem	Material & Rate per Acre	Notes and Comments
annuals and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lb. a.i./gal.) at 3-10% spray mix	For contact nonselective 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.
most annual and perennial grasses	Stinger (clopyralid 3 lbs. a.i./gal.) at 1/3-2/3 pts.	Make one or two applications per crop year. Apply only to trees 1 year or older. Avoid direct contact with foliage, fruit, or tree trunks. Do not apply during bloom east of the Rocky Mountains. PHI=30 days.
annual and perennial broadleaves	Treevix (saflufenacil 0.7 lb. a.i.) at 1 oz. in 20-40 gals. of water	Trees must be established for 12 months prior to application. May be applied as a single application or up to 3 times per season with a separation of 21 days between sprays. Do not exceed 3.0 oz./acre/cropping season. Trunk shields should be used until trees have been established for 2-3 years. For optimum burndown, use with methylated seed oil (MSO), ammonium sulfate (AMS), or urea ammonium nitrate (UAN) adjuvant. Do not use an NIS as a substitute for MSO. Only apply when wind is 10 MPH or less and is blowing away from nontarget areas. Rainfast in 1 hour. Do not use in tree nurseries. PHI=0 days.
Age restriction: Kerb SC may not be applied to (1) trees less than 1 year old, (2) fall-transplanted stock transplanted less than 1 year old, or (3) spring-transplanted stock transplanted less than 6 months. Restricted use pesticide.	Venue (Pyraflufen ethyl 2% a.i.) at 0.7-4.0 fl. oz. plus other labeled herbicides in minimum of 10 gals. of water	Apply as a directed spray during dormant period and prior to bloom. Avoid contact with foliage and green bark. More effective on weeds less than 4 inches tall and 3 inches in diameter. Use higher rate and spray volume for larger weeds. Do not exceed 3 applications or 6.8 fl. oz./acre/season. Allow a minimum of 30 days between applications. Adding COC or NIS is recommended. May be mixed with 2, 4-D, glyphosate, or grass herbicides for enhanced control. Spray water pH needs to be less than 7.5. On non-bearing trees the PHI is 12 months.

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

Weed Problem	Material & Rate per Acre	Notes and Comments
Pre-emergence		
annual grasses and broadleaves	Alion (Indaziflam 1.67 lbs. a.i./gal.) at 5.0-6.5 fl. oz. in minimum of 10 gals. of water	Trees must be established at least 3 years after transplanting. Avoid direct or indirect spray contact with crop foliage, green bark, roots, or fruit as it may cause localized crop injury and death. Allow at least 30 days between applications. Do not exceed 10.3 fl. oz./acre in a 12-month period. Do not apply to frozen ground. Do not apply within 25 feet of ponds, rivers, streams, or wetlands. Spot spraying is not recommended. Shake container well before use. PHI=14 days
annual and perennial grasses and broadleaves	Casoron CS (dichlobenil 1.4 lbs. a.i./gals.) at 1.4-2.8 gals. in 7-100 gals. of water	Cherry Only: Apply from late fall to early spring prior to weed emergence, or when weeds are less than 2 inches tall. Apply when temperatures are below 70°F. Do not use on light sandy soils or until 1 year after transplanting. Do not use in nurseries.
annual broadleaves and suppression of grasses	Chateau WDG (flumioxazin 51% a.i.) at 6--12 oz in 15-75 gal of water	Do not apply to trees established less than 2 years unless protected from spray contact by nonporous wraps. Do not apply during the period after flowering through leaf drop, unless shielded application equipment ensures that spray drift will not contact crop foliage. Do not apply to fine-textured soils. Do not apply within 100 meters of nondormant pears. Apply alone pre-emergence or tank mix with Gramoxone post-emergence 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. Do not exceed 24 oz./season or exceed 2 applications/growing season. Minimum 30 days between applications. PHI=60 days.

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Herbicide Recommendations for Peach, Nectarine, Plum, and Cherry (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual broadleaves and suppression of grasses	Goal 2XL (oxyfluorfen 2 lbs. a.i./gal.) at 5-8 pts. in minimum of 40 gals. of water (see Generic Herbicides, page 167)	Dormant Application Only: Effective both pre-emergence (5-8 pts.) and post-emergence (2-8 pts.) as a directed spray on weeds larger than 4 inches. Do not apply from bud swell until harvest completion. Can be mixed with other pre-emergence herbicides or with Roundup or Gramoxone. Do not exceed 8 pts./year.
annual grasses and broadleaves	Karmex DF diuron (80% a.i.) at 2-5 lbs. in 25-40 gals. of water (see Generic Herbicides, page 167)	Peach Only: Effective both pre-emergence and post-emergence (minimum 70°F with high humidity). Apply under trees established at least 3 years. May be tank mixed with Sinbar (2 lbs. 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. Do not exceed 1 application/year. PHI for IL and MO=20 days. PHI for others=3 months.
annual and perennial grasses and certain broadleaves	Kerb SC (pronamide 35.6% a.i.) at 2.5-9.5 pts. in 40-50 gals. of water. Rate depends on weed pressure and soil type. See table on label.	Apply as a directed spray in the fall after harvest prior to soil freeze-up. Rainfall or irrigation are required to activate. Do not apply more than 9.5 pts./A/year or make more than 1 application per year. Age restriction: Kerb SC may not be applied to (1) trees less than 1 year old, (2) fall-transplanted stock transplanted less than 1 year old, or (3) spring-transplanted stock transplanted less than 6 months. Restricted use pesticide.
Age restriction: Kerb SC may not be applied to (1) trees less than 1 year old, (2) fall-transplanted stock transplanted less than 1 year old, or (3) spring-transplanted stock transplanted less than 6 months. Restricted use pesticide.	Matrix FNV (rimsulfuron 25% a.i.) at 4 oz. in minimum of 10 gals. of water	Apply only to crops that have been established for 1 full growing season and are in good health and vigor. Weeds are controlled for 60-90 days after application. Matrix will burn down small actively growing weeds less than 1 inch tall. When weeds are present at application, a labeled burndown herbicide, such as paraquat, with an appropriate adjuvant will improve control. Avoid direct or indirect contact with crop foliage or fruit, except undesirable suckers. Do not use Matrix FNV in a spray solution with a pH below 4.0 or above 8.0. Best results are obtained when the soil is moist at the time of application and 0.5 inch of rainfall or sprinkler irrigation occurs within 2 weeks of application. PHI=14 days.
annual grasses and broadleaves	Princep 4L (simazine 4 lbs. a.i./gal.) at 1.6-4 qts. in minimum of 40 gals. of water (see Generic Herbicides, page 167)	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, Sweet Cherry Only: use only in MO and states east of the Mississippi River.
annual grasses and broadleaves	Sinbar WDG (terbacil 80% a.i.) at 0.5-4 lbs. in minimum of 20 gals. of water (see Generic Herbicides, page 167)	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. Do not exceed 1 lb./year. Do not use on soils with <1% OM.
annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (noraflurazon 78.6% a.i.) at 3.75-5 lbs. in minimum of 20 gals. 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 of 0.5 inch is needed within 4 weeks. Do not contact fruit or foliage. Do not apply after bud break on sandy loam soils. Check label for maximum amount allowed per year depending on soil type. Peach, Nectarine: minimum 6 months after planting before first application. Plum: minimum 12 months after planting before first application. Cherry: minimum 18 months after planting before first application. PHI=60 days.

Herbicide Recommendations for Peach, Nectarine, Plum, and Cherry (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water (see Generic Herbicides, page 167)	Make a single band of broadcast application to the ground beneath trees before weeds emerge. Apply alone to weed-free soil or post-emergence mixed with Roundup or Gramoxone. Minimum 0.5 inch rainfall or irrigation required for activation. Minimum 2.5 months between applications. Do not exceed 12 qts./year.
annual grasses and broadleaves	Treflan HFP 4EC (trifluralin 4 lbs. a.i./gal.) at 1.5-4 pts. in 5-40 gals. of water (see Generic Herbicides, page 167)	Peach, Plum Only: Incorporate within 24 hours to reduce loss of activity. New Plantings: Apply 1.25-2 pts. and incorporate before transplanting. Established Plantings: Apply 2-4 pts. and incorporate prior to period of weed germination or after removal of weeds with tillage of herbicides.
Post-emergence		
annual broadleaves	Aim 2EC (carfentrazone 2 lbs. a.i./gal.) at 2 fl. oz. in 20 gals. of water	Apply any time during the season. Add NIS (2 pts./100 gals.) or COC (1 gal./100 gals.). Mix with Roundup or Gramoxone for broader weed control. Do not exceed 7.9 fl. oz./year. Minimum 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	Amine 4 (2,4-D) or Saber at 3 pts. in 5-25 gals. of water (see Generic Herbicides, page 167)	Apply as directed spray when annuals are 1-2 inches high and when perennial weeds are in pre-bud to early bud stage. Do not allow spray to contact leaves, fruit, or limbs of tree. Use coarse spray and low pressure to avoid drift. Non-bearing trees must be established 1 year. Do not apply during bloom, or after or before irrigation. Do not apply on bare ground. Do not exceed 2 applications/year. Minimum 75 days between applications. PHI on bearing trees=40 days.
most annual and perennial grasses	Fusilade DX (Fluazifop-P-butyl 2 lbs. a.i./gal.) at 16-24 fl. oz. in 20-40 gals. of water	Apply post-emergence as a directed spray avoiding contact with tree foliage to young actively growing grasses. Add a COC at 1% v/v (1 gal./100 gals.) or NIS at 0.25-0.5% v/v (1-2 qts./100 gals.) in the finished spray volume. Do not exceed 72 fl. oz./acre/season. PHI=14 days.
annual broadleaves	Goal 2XL (see Generic Herbicides, page 167)	See Pre-emergence section (page 147) for details.
most annual grasses and broadleaf weeds and top kill of perennial weeds	Gramoxone (paraquat 2 lbs. a.i./gal.) at 2.5-4 pts. in minimum of 10 gals. of water (see Generic Herbicides, page 167)	Apply as directed spray to actively growing weeds. Repeat applications are necessary to give sustained control. Apply as a coarse spray. Always add NIS 0.25% v/v or crop oil 1% v/v. Do not allow spray to contact leaves, fruit, or green stems. Do not exceed 3 applications/year. PHI for peach=14 days. PHI for nectarine, plum, cherry:28 days. Restricted use pesticide.
annual grasses and broadleaves	Karmex DF	See Pre-emergence section (page 147) for details.
annual and perennial grasses	Poast 1.5E (sethoxydim 1.5 lbs. a.i./gal.) at 1.5-2.5 pts. in 25 gals. of water	Apply as a directed spray to actively growing grasses before they exceed maximum recommended heights. Always add crop oil 1.25% v/v. Do not exceed 2.5 pts./application or 5 pts./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.
annuals and some perennial grasses and broadleaves	Roundup WeatherMax, Roundup PowerMax 5.5EC (glyphosate 5.5 lbs. a.i./gal.) at 11 fl. oz.-3.3 qts. in 10-40 gals. of water (many other formulations) (see Generic Herbicides, page 167)	Rate depends on weed species and growth stage. 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 lbs./100 gals. in hard water or drought conditions. Do not allow spray to contact any part other than mature bark. Avoid application to suckers and recent pruning wounds. Use extreme care to ensure that no part of peach tree is contacted with spray. Apply only near trees that have been planted in the orchard for 2 or more years. Does not provide residual control; can be mixed with labeled pre-emergence herbicides. PHI=17 days.

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Herbicide Recommendations for Peach, Nectarine, Plum, and Cherry (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lbs. a.i./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.
most annual and perennial grasses	Select Max (clethodim 0.97 lbs. a.i./gal.) at 9-16 fl. oz.	Apply post-emergence as a directed spray to young, actively growing grasses. Do not exceed 16 fl. oz./A in a single application or per season. A minimum 14-day interval is required for repeat applications. Add NIS at 0.25% v/v or COC/MSO at 1 qt/A or 1% v/v Labeled on bearing peach only. PHI=14 days.
most annual and perennial grasses	Stinger (clopyralid 3 lbs. a.i./gal.) at 1/3-2/3 pts.	Make one or two applications per crop year. Apply only to trees 1 year or older. Avoid direct contact with foliage, fruit, or tree trunks. Do not apply during bloom east of the Rocky Mountains. PHI=30 days.

■ Herbicide Recommendations for Non-bearing Fruit Trees Only

Weed Problem	Material & Rate per Acre	Notes and Comments
Pre- and Post-emergence		
annual broadleaves and yellow nutsedge	Broadloom (bentazon 4 lbs. a.i./gal.) at 1.5-2 pts. in minimum of 20 gals. of water.	Apply as a directed post-emergence spray. Always add COC 1% v/v. Avoid spraying stems, bark, or foliage. Do not exceed 2 pts./application or exceed 4 pts./season. PHI=1 year.
most annual and perennial grasses	Fusilade DX (Fluazifop-P-butyl 2 lbs. a.i./gal.) at 16-24 fl. oz. in 20-40 gals. of water	For non-bearing apple and pear that will not be harvested within 1 year after application. Apply post-emergence as a directed spray avoiding contact with tree foliage to young actively growing grasses. Add COC at 1% v/v (1 gal./100 gals.) or NIS at 0.25-0.5% v/v (1-2 qts./100 gals.) in the finished spray volume. Do not exceed 72 fl. oz./acre/season.
most broadleaves	Gallery 75DF (isoxaben 75% a.i.) at 0.66-1.33 lb in minimum of 10 gal of water	Apply in late summer to early fall; or pre-emergence 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 (½ inch) is needed within 21 days of application. Not effective on germinated weeds. Minimum 60 days between applications. Maximum rate is 4 lb per acre.
annual grasses and certain broadleaves	Prowl 3.3EC (pendimethalin 3.3 lbs. a.i./gal.) Short-term weed control: at 2.4 qts. in minimum of 20 gals. of water Long-term weed control: 4.8 qts. f in minimum of 20 gals. of water	Do not apply if buds have started to swell. May be applied preplant incorporated, preplant surface, or pre-emergence. 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 (diquat 2 lbs. a.i./gal.) at 1.5-2 pts. in minimum of 15 gals. of water	Apply post-emergence as a directed spray using a shield for contact burn of weeds. Complete coverage is essential for good control. Can be used during site preparations and up to 1 year of harvest. Do not allow contact with green stems, foliage, or fruits. Do not use for food or feed for 1 year after application.

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Herbicide Recommendations for Non-bearing Fruit Trees Only *(continued)*

Weed Problem	Material & Rate per Acre	Notes and Comments
most annual and perennial grasses	Select Max (clethodim 0.97 lbs. a.i./gal.) at 9-16 fl. oz. in a minimum of 10-40 gals. of water	Apply post-emergence as a directed spray to young, actively growing grasses. Do not apply more than 16 fl. oz./A in a single application, or more than 64 fl. oz./A per season. For repeat applications use a minimum of a 14-day interval. Always add NIS at 0.25% v/v. Do not use COC. Rainfast in 1 hour.
annual grasses and broadleaves	Showcase 1.25G (granular) (trifluralin + isoxaben + oxyfluorfen 1.25 lbs. a.i./50-lb. bag) at 100-200 lbs.	For use on stone fruits only (not labeled for apple or pear). Use as a dormant application for stone fruits only. Apply prior to weed germination or immediately after cultivation.
annual grasses and certain broadleaves	Snapshot 2.5TG (isoxaben + trifluralin 2.5% a.i.) at 100-200 lbs.	Apply pre-emergence on weed-free clean soil. For best results 0.5 inch rain or irrigation is needed within 3 days of application. Not effective on germinated seeds. Minimum 60 days between applications. Do not exceed 600 lbs./year.
annual and perennial broadleaves	Venue (Pyraflufen ethyl 2% a.i.) at 0.7-4.0 fl. oz. plus other labeled herbicides in a minimum of 10 gals. of water	Apply as directed spray during dormant period and prior to bloom. Avoid contact with foliage and green bark. More effective on weeds less than 4 inches tall and 3 inches in diameter. Use higher rate and spray volume for larger weeds. Do not exceed 3 applications or exceed 6.8 fl. oz./acre in one season. Allow a minimum of 30 days between applications. Adding COC or NIS is recommended. May be mixed with 2,4-D, glyphosate, or grass herbicides for enhanced control. Spray water pH needs to be less than 7.5. PHI on non-bearing trees=12 months.

■ Herbicide Recommendations for Grape

Weed Problem	Material & Rate per Acre	Notes and Comments
Pre-emergence		
annual and perennial grasses and broadleaves	Alion (indaziflam 19.05%) (1.67 lbs./gal.) at 5 fl. oz.	Only use in established vineyards at least 5 years after planting and on vines that exhibit normal growth and good vigor. Do not use on sandy soil or soils with 20% or more gravel content. Ensure that there is 12 inches of soil barrier between the surface and the major portion of the root system. Age Restriction: Do not apply to vines less than 5 years old.
annual and perennial grasses and broadleaves	Casoron CS (dichlobenil 15.3% a.i.) at 1.4-2.8 gals.	Apply from late fall through early spring. Applications should be made prior to weed emergence, or when emerged weeds are less than 2 inches tall. Use only on well established plants. Age Restriction: Do not apply to vines less than 1 year old.
annual broadleaves and suppression of grasses	Chateau SW (flumioxazin 51% a.i.) at 6-12 oz. in 10-30 gals. of water	Do not apply after bloom unless with a hooded or shielded application. Apply alone pre-emergence or tank mix with Roundup or Gramoxone post-emergence. Do not incorporate. Do not allow drift to contact foliage or green bark. Do not exceed 24 oz./season. Minimum 30 days between applications. Also has post-emergence activity. PHI=60 days. Age Restriction: Do not apply to vines established less than 2 years unless they are trellised at least 3 ft. from the ground or are protected by nonporous wraps, grow tubes, or waxed containers.
annual grasses and broadleaves	Devrinol 2-XT (napropamide 2 lbs. a.i./gal.) at 2 gals. per acre (other formulations are available)	Apply from late fall (prior to soil freezing) to early spring (prior to weed emergence). Apply to a weed-free soil surface or tank mix with a suitable post-emergence herbicide. May be applied to newly planted and established crops. Do not exceed 2 gals./acre per crop cycle. PHI=70 days.

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Herbicide Recommendations for Grape (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual broadleaves and suppression of grasses	Goal 2XL (oxyfluorfen 2 lbs. a.i./gal) at 5-8 pts. in minimum of 10 gals. of water (see Generic Herbicides, page 167)	Dormant Application Only: Effective both pre-emergence (5-8 pts.) and post-emergence (2-8 pts.) as a directed spray on weeds less than 4 inches tall. Do not apply from bud swell to harvest. Can be mixed with other pre-emergence herbicides, or with Roundup or Gramoxone. Do not exceed 8 pts./year. Age Restriction: Do not apply to grapes established less than 3 years unless vines are on a trellis wire a minimum of 3 ft. above ground.
annual grasses and broadleaves	Karmex DF (diuron 80% a.i.) at 2-6 lbs. in 25-40 gals. of water (see Generic Herbicides, page 167)	Age Restriction: Use on vineyards established at least 3 years and trunks at least 1.5 inches in diameter. Apply as a directed spray to soil under trellis in early spring prior to weed germination. Do not exceed 1 application/year. On soils low in organic matter (1-2%), severe injury may result if heavy rainfall occurs soon after treatment.
annual and perennial grasses and certain broadleaves	Kerb SC (pronamide 35.6% a.i.) at 2.5-9.5 pts. in 40-50 gals. of water. Rate depends on weed pressure and soil type. See table on label.	Apply as a directed spray in the fall after harvest prior to freeze-up, or in early winter when temperatures are below 55°F. Rainfall or irrigation are required to activate. Do not exceed 1 application per year or exceed 9.5 pts./A/year. Age restriction: Do not apply to vines less than 1 year old. Restricted use pesticide.
Age restriction: Do not apply to vines less than 1 year old. Restricted use pesticide.	Matrix FVN or SG (rimsulfuron 25% a.i.) at 4 oz. in a minimum of 10 gals. of water	Apply as a banded application to the base of the vines. Best results are obtained when the soil is moist at the time of application and 0.5 inch of rainfall or sprinkler irrigation occurs within 2 weeks after application. Age Restriction: Do not apply to vines established less than one year. PHI=14 days.
annual and perennial grasses and broadleaves	Mission (flazasulfuron 25% a.i.) at 2.14-2.85 oz. in 15-50 gal of water	Pre emergence: Apply as a directed spray to soil beneath vines to prevent injury to foliage and bark of young vines. You must use a protective for third year vines to minimize injury potential. Post emergence: Apply to weeds less than 4 inches tall and before tillering of grasses in sufficient volume to get thorough coverage. Always use an adjuvant. Do not exceed 2 applications at the 2.85 oz rate per acre per year. Age Restriction: Apply to grapes established 3 years or more. PHI=75 days.
annual grasses and broadleaves	Princep 4L (simazine 4 lbs. a.i./gal) at 2-4 qts. in 25-40 gals. of water (see Generic Herbicides, page 167)	Age Restriction: Use on vineyards established at least 3 years. Apply to soil under trellis between harvest and early spring before weeds emerge. Apply alone to weed-free soil or tank mix with Roundup or Gramoxone. Do not exceed 1 application/year.
annual grasses and certain broadleaves	Prowl H ₂ O (pendimethalin 3.8 lbs. a.i./gal) at 3.2-6.3 qts. in minimum of 20 gals. of water (see Generic Herbicides, page 167)	Apply only to dormant grapevines. Do not apply if buds have started to swell. In bearing vineyards, this product may be applied any time after fall harvest, during winter dormancy, and in the spring. In non-bearing vineyards this product may be applied preplant incorporated, preplant surface, or pre-emergence. 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 certain broadleaves	Snapshot 2.5TG (isoxaben+trifluralin 2.5% a.i.) at 100-200 lbs.	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Rainfall or irrigation of 0.5 inch is needed within 3 days of application. Not effective on germinated weeds. Minimum 60 days between applications. Do not exceed 600 lbs./12-month period. Do not apply to new transplants until soil has settled and with no cracks.
annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (norflurazon 78.6% a.i.) at 1.25-5 lbs. in minimum of 20 gals. of water	Apply as a directed spray to settled and firm soil from fall to early spring before weeds emerge. Rainfall or irrigation is needed within 4 weeks of application. Do not contact fruit or foliage. Do not apply after bud break on sandy loam or other coarse-textured soils. Check label for maximum amount allowed per year depending on soil type. Age Restriction: Allow a minimum of 24 months after planting before first application. PHI=60 days.

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Herbicide Recommendations for Grape (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water (see Generic Herbicides, page 167)	Make a single band or broadcast application to the ground beneath vines before weeds emerge. Apply alone to weed-free soil or post-emergence mixed with Roundup or Gramoxone. Min. 0.5 inch of rainfall or irrigation is required for activation. Minimum of 2.5 months between applications. Do not exceed 12 qts./year.
annual grasses and broadleaves	Treflan HFP 4EC (trifluralin 4 lbs. a.i./gal.) at 1-4 pts. in 5-40 gals. of water (see Generic Herbicides, page 167)	In a new planting, apply 1-4 pts. and incorporate within 24 hours. In an established planting, apply 2-4 pts. prior to weed germination or immediately after removal of weeds with tillage or other herbicides and incorporate within 24 hours. PHI=60 days.
annual and perennial broadleaves	Trellis (isoxaben 75% a.i.) at 0.67-1.33 lbs. in minimum of 10 gals. of water (see Generic Herbicides, page 167)	Non-bearing: Apply any time before target weeds germinate or immediately after cultivation. PHI=1 year. Bearing: Apply before target weeds germinate or immediately after cultivation. Do not exceed 2 applications/crop year or exceed 1.33 lbs. (1.0 lb. isoxaben)/acre/crop year. PHI=165 days.
annual and perennial grasses and broadleaves	Zeus Prime XC (carfentrazone-ethyl 3.5% and sulfentrazone 31.8% a.i.) at 7.7-15.2 fl. oz. per acre in minimum of 10 gals. of water	Apply as a broadcast or banded soil application directed to the base of the trunks of bushes or vines. If weeds are present, tank mix with a post-emergence herbicide to eliminate emerged weeds. Apply a single broadcast application at 15.2 fl. oz. per acre (0.41 lb. a.i./acre). May be applied as a banded treatment twice per year. Do not exceed 15.2 fl. oz. (0.41 lb. a.i)/acre/year. Minimum of 60 days between applications. Do not apply after bud break except with hooded or shielded sprayer. PHI=3 days. Age Restriction: Apply to crops that have been growing for at least 2 years and are in good condition.
annual and perennial grasses and broadleaves	Zeus XC (sulfentrazone 39.6% a.i.) at 8-12 fl. oz. per acre in a minimum of 10 gals. of water	Apply as a broadcast or banded soil application directed to the base of the trunk of bushes or vines. If weeds are present, tank mix with a post emergence herbicide to eliminate emerged weeds. Apply a single broadcast application at 8-12 fl. oz./acre (0.25-0.375 lb. a.i./acre). May be applied as a banded treatment twice per year. Minimum 60 days between applications. Do not exceed 12 fl. oz. (0.375 lb a.i)/acre/ year. Do not apply after bud break except with hooded or shielded sprayer. PHI=3 days. Age Restriction: Apply to crops that have been growing for at least 3 years and are in good condition.
Post-emergence		
annual broadleaves	Aim 2EC or Aim 2EW (carfentrazone 2 lbs. a.i./gal.) at 1-2 fl. oz. in 20 gals. of water	Apply any time during the season as a post-emergence directed spray or as a hooded spray treatment. Always add NIS at 0.5% v/v or COC at 1% v/v. Mix with Roundup or Gramoxone or labeled pre-emergence herbicides for broader weed control. Do not exceed 7.9 fl. oz./year. Minimum 14 days between applications. PHI=3 days. Sucker Management: Apply when suckers are green. Do not allow spray to contact desirable fruit, foliage, or green bark.
most annual and perennial grasses	Fusilade DX 2EC (fluazifop-p 2 lbs. a.i./gal.) at 16-24 fl. oz. in 25 gals. of water	Apply as a directed spray to actively growing grasses before tillering. Always add COC at 0.5-1% v/v or NIS at 0.25-0.5% v/v. Avoid contact with grape foliage. Rainfast in 1 hour. Do not exceed 24 fl. oz./application/acre or exceed 72 fl. oz./acre/year. Minimum 14 days between applications. PHI=50 days.
annual broadleaves	Goal 2XL	See Pre-emergence section (page 151) for details.
most annual grasses and broadleaves and top kill of perennial weeds	Gramoxone (paraquat 2 lbs. a.i./gals.) at 2.5-4 pts. in minimum of 10 gals. of water (see Generic Herbicides, page 167)	Apply as directed spray to actively growing weeds. Repeat applications are necessary to give sustained control. Avoid contact with desired new shoots, fruit, or foliage. Apply as a coarse spray. Always add NIS at 0.25% v/v or COC at 1% v/v. Best results with flat fan nozzles. Do not exceed 5 applications/year. Sucker Management: Apply when suckers are less than 8 inches tall. Do not allow spray to contact desirable fruit, foliage, or green bark. Restricted use pesticide.

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Herbicide Recommendations for Grape (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual and perennial grasses and broadleaves	Mission (flazasulfuron 25% a.i.)	See Pre-emergence section (page 151) for details.
annual and perennial grasses	Poast 1.5EC (sethoxydim 1.5 lbs. a.i./gal.) at 1.5-2.5 pts. in minimum of 5 gals. of water	Apply as a directed spray to actively growing grasses before tillering. Always add COC at 1% v/v. Do not exceed 2.5 pts./application or exceed 5 pts./season. PHI=50 days.
annual grasses and broadleaves	Reglone (diquat 2 lbs. a.i./gal.) at 1.5-2 pts. in minimum 15 gals of water	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray using a shield for contact burn of weeds. Complete coverage is essential for good control. Always use NIS at 0.5% v/v. Can be used during site preparation and up to 1 year of harvest. Do not allow contact with green stems, foliage or fruits. PHI=1 year.
annual and perennial grasses and broadleaves	Rely 280 (glufosinate 24.5% a.i. (2.34 lbs./gal.)) at 48-82 fl. oz. in minimum of 15 gals. of water (see Generic Herbicides, page 167)	Spray only trunks with callused, mature, brown bark unless protected from spray contact by nonporous wraps, grow tubes, or waxed containers. Apply as a directed spray to actively growing weeds. Do not exceed 246 fl. oz./acre/year. For spot application, mix 1.7 fl. oz./gal. PHI=14 days. Sucker Control: apply a split application approximately 4 weeks apart of 56 fl. oz./acre in a minimum of 15 gals./acre. Do not make spot or directed sprays to trunks. Suckers should not exceed 12 inches long.
annuals and some perennial grasses and broadleaves	Roundup WeatherMax 5.5EC (glyphosate 5.5 lbs. a.i./gal.) at 11 fl. oz. to 3.3 qts. in 10-40 gals. of water (see Generic Herbicides, page 167)	Apply as a directed spray or wiper application to actively growing weeds in established plantings. Rate depends on equipment used, weed species, and stage of growth. See label for details. Always add ammonium sulfate at 8.5-17 lbs./100 gals. in hard water or drought conditions (see label). Do not allow spray to contact any part other than mature bark. Does not provide residual control; can be mixed with labeled pre-emergence herbicides. PHI=14 days.
annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lbs. a.i./gal.) at 3-10% spray solution	For contact nonselective control or burndown of a broad spectrum of actively growing weeds. Use low rate for annual weed control and high rate for maximum vegetative burndown. Use as a directed spray or shielded spray. Can be mixed with Roundup.
most annual and perennial grasses	Select Max (clethodim 0.97 lb. a.i./gal.) at 9-16 fl. oz. (see Generic Herbicides, page 167)	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray to actively growing grasses before tillering. Do not use if rain is expected within 1 hour. Always add NIS at 0.25% v/v. Do not use COC. May be applied as a spot treatment at 0.32-0.64 fl. oz. per gal. Do not exceed 32 fl. oz./year.
annual broadleaves	Venue (pyraflufen ethyl 0.177 lb. a.i./gal.) at 0.7-4.0 fl. oz.	Use as a directed spray from dormancy, prior to bloom. Repeat if needed. Keep off green stems and foliage. Do not exceed 6.8 fl. oz./acre/growing season.

■ Herbicide Recommendations for Blueberry

Weed Problem	Material & Rate per Acre	Notes and Comments
Pre-emergence		
annual grasses and broadleaves	Callisto (mesotrione 4 lbs. a.i./gal.) at 3.0-6.0 fl. oz.	Apply pre-emergence or early post-emergence. For improved post-emergence control, apply split applications at 3.0 fl. oz. at least 14 days apart. Do not exceed 2 applications/year or exceed 6 fl. oz./year. Do not apply after the onset of bloom. Include a COC tolerated by blueberries if applied post-emergence to weeds.
annual and perennial grasses and broadleaves	Casoron CS (dichlobenil 15.3% a.i.) at 1.4-2.8 gals.	Apply from late fall through early spring. Applications should be made prior to weed emergence, or when emerged weeds are less than 2 inches tall. Use only on well-established plants. Do not apply during new shoot emergence. Age Restriction: Do not apply to plants less than 1 year old.

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Herbicide Recommendations for Blueberry (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual broadleaves and suppression of grasses	Chateau SW (flumioxazin 51% a.i.) at 6-12 oz.	Apply as a uniform band directed at the base of the bush. Avoid direct spray contact to foliage or green bark. Preferred application timing is in the fall. Do not exceed 6 oz./acre/application. Do not make a sequential application within 30 days of the first application. Do not exceed 12 oz./acre/12-month period. Age Restriction: Do not apply to plants less than 2 years old unless they are protected by nonporous wrap, grow tubes or waxed containers. PHI=7 days.
annual grasses and broadleaves	Devrinol 2-XT (napropamide 2 lbs. a.i./gal.) at 2 gals./acre (see Generic Herbicides, page 167)	Apply to a weed-free soil surface or tank mix with a suitable post-emergence herbicide. May be applied to newly planted and newly established crops. Do not exceed 2 gals./acre/crop cycle.
most broadleaves	Gallery 75DF (isoxaben 75% a.i.) at 0.66-1.33 lbs. in minimum of 10 gals. of water (see Generic Herbicides, page 167)	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Apply in late summer to early fall; or in early spring prior to weed germination or anytime immediately after cultivation. Do not apply to new transplants until soil has settled with no cracks present. Rainfall or irrigation of 0.5 inch is needed within 21 days of application. Not effective on germinated weeds. Minimum of 60 days between applications. Do not exceed 4 lbs./acre/12-month period.
annual grasses and broadleaves	Karmex DF (diuron 80% a.i.) at 1.5-4 lbs. in 25-40 gals. of water Selected states only	Age Restriction: Use only in fields established at least 1 year. Apply as a band treatment at the base of bushes. Do not apply to exposed roots. For AR and MO Only: Apply 1.5-2 lbs. in spring and repeat after harvest in the fall. Always add NIS at 0.25% v/v. For IN and OH Only: Apply 2-4 lbs. in late spring. Alternatively, apply 2 lbs. in fall and repeat in spring.
annual and perennial grasses and certain broadleaves	Kerb SC (pronamide 35.6% a.i.) at 2.5-5.0 pts. in 20-50 gals. of water. Rate depends on weed pressure. See table on label.	Apply as a directed spray in the fall after harvest prior to freeze-up, or in early winter when temperatures are below 55°F. Rainfall or irrigation are required to activate. Do not exceed 1 application per year or 5.0 pts./A/year. Age restriction: Do not apply to vines less than 1 year old. Restricted use pesticide.
Age restriction: Do not apply to newly transplanted blueberries until roots are well established. Restricted use pesticide.	Princep 4L (simazine 4 lbs. a.i./gal.) at 2-4 qts. in minimum of 40 gals. of water (see Generic Herbicides, page 167)	Apply in spring before weeds emerge and before canes leaf out, or make a split application of 2 qts. in spring plus 2 qts. in fall. Do not apply when fruit is present, or illegal residues may result. For plants established less than 6 months, apply half the above rate.
annual broadleaf weeds and nutsedge	Sanda (halosulfuron 75%) at 0.5-1 oz. in minimum of 15 gals. of water	Apply with ground equipment as a broadcast application to the ground on either side of the row. Apply as a single or sequential application depending on weed pressure. If small weeds are present, mix with a post-emergence broad-spectrum-type herbicide to maximize and enhance the spectrum of control. For post-emergence nutsedge control, make a single application when nutsedge is fully emerged. Or, make 2 sequential applications. Apply the first to the initial nutsedge flush when it has reached the 3-5-leaf stage. If a second application is needed it can be applied later in the season. Avoid contact with blueberry bushes. Minimum of 45 days between applications. Do not exceed 2 oz./acre/year. PHI=14 days. Age Restriction: Do not apply to plants established less than 1 year.
annual grasses and broadleaves	Sinbar 80WP (terbacil 80% a.i.) at 2-3 lbs. in minimum of 25 gals. of water	Age Restriction: Use only on plantings established at least 1 year. Best results when applied shortly before or after weed emergence. Avoid contact of foliage or fruit with spray or mist. Apply either in the spring or after harvest in the fall before weeds emerge or during early stage of seedling regrowth. Do not use on soils where roots are exposed. Do not use on sand or loamy sand with 1-3% organic matter. Use rate varies by soil type.

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Herbicide Recommendations for Blueberry (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual grasses and certain broadleaves	Snapshot 2.5TG (isoxaben+trifluralin 2.5% a.i.) at 100-200 lbs.	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Do not apply to new transplants until soil has settled. For best results, 0.5 inch of rain or irrigation is needed within 3 days of application. Not effective on germinated weeds. Minimum 60 days between applications. Do not exceed 600 lbs./12-month period.
annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (norflurazon 78.6% a.i.) at 2.5-5 lbs. in minimum of 20 gals. of water	Apply as a directed spray to settled and firm soil from fall to early spring before weeds emerge. Rainfall or irrigation of 0.5 inch is needed within 4 weeks. Do not contact fruit or foliage. Do not apply after bud break on sandy loam soils. Check label for maximum amount allowed per year depending on soil type. Minimum 6 months after planting before first application. PHI=60 days.
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water (see Generic Herbicides, page 167)	Make a single band or broadcast application to the ground beneath plants before weeds emerge. Apply alone to weed-free soil or post-emergence mixed with Roundup or Gramoxone. Minimum 0.5 inch of rainfall or irrigation is required for activation. Minimum 2.5 months between applications. Do not exceed 12 qts./year.
annual grasses and broadleaves	Velpar 2L (hexazinone 2 lbs. a.i./gal.) at 0.5-1 gal. in 20 gals. of water	Apply to pruned blueberries in the spring before leaf emergence as a directed soil application. Some clones are susceptible to injury. PHI=90 days. Age Restriction: Use on plantings established at least 3 years.
annual and perennial grasses and broadleaves	Zeus Prime XC (carfentrazone-ethyl 3.5% and sulfentrazone 31.8% a.i.) at 7.7-15.2 fl. oz. per acre in minimum of 10 gals. of water	Apply as a broadcast or banded soil application directed to the base of the trunks of bushes or vines. If weeds are present, tank mix with a post-emergence herbicide to eliminate emerged weeds. Apply a single broadcast application at 15.2 fl. oz./acre (0.41 lb. a.i./acre). May be applied as a banded treatment twice per year. Do not exceed 15.2 fl. oz. (0.41 lb. a.i.)/acre/year. Minimum of 60 days between applications. Do not apply after bud break except with hooded or shielded sprayer. PHI=3 days. Age Restriction: Apply to crops that have been growing for at least 2 years and are in good condition.
annual and perennial grasses and broadleaves	Zeus XC (sulfentrazone 39.6% a.i.) at 8-12 fl. oz. per acre in a minimum of 10 gals. of water.	Apply as a broadcast or banded soil application directed to the base of the trunk of bushes or vines. If weeds are present, tank mix with a post-emergence herbicide to eliminate emerged weeds. Apply a single broadcast application at 8-12 fl. oz./acre (0.25-0.375 lb. a.i./acre). May be applied as a banded treatment twice per year. Minimum of 60 days between applications. Do not exceed 12 fl. oz. (0.375 lb. a.i.)/acre/year. Do not apply after bud break except with hooded or shielded sprayer. PHI=3 days. Age Restriction: Apply to crops that have been growing for at least 3 years and are in good condition.
Post-emergence		
annual broadleaves	Aim 2EC or Aim 2EW (carfentrazone 2 lbs. a.i./gal.) at 1-2 fl. oz. in 20 gals. of water	Apply broadcast at base of canes during dormant stage or with hooded shields between rows during growing season. Always add NIS at 0.25% v/v or COC at 1% v/v. Do not exceed 2 fl. oz. during dormant season or exceed 6.1 fl. oz. during growing season. Minimum 14 days between applications. PHI=1 day.
most annual and perennial grasses	Fusilade DX 2EC (fluazifop-p 2 lb a.i./gal.) at 16-24 fl. oz. in 25 gals. of water	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray to actively growing grasses before tillering. Always add COC at 1% v/v or NIS at 0.25% v/v. Avoid contact with foliage. Rainfast in 1 hour. Do not exceed 72 fl. oz./year. Minimum 5 days between applications. PHI=1 year.

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Herbicide Recommendations for Blueberry (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
most annual grasses and broadleaves and top kill of perennial weeds	Gramoxone (paraquat 2 lbs. a.i./gal.) at 2-4 pts. in minimum of 50 gals. of water (see Generic Herbicides, page 167)	Apply as directed spray to actively growing weeds before emergence of new canes or shoots. Repeat applications are necessary to give sustained control. Apply as a coarse spray to avoid drift injury. Avoid contact with desired new shoots, fruit, or foliage. Always add NIS at 0.25% v/v or COC at 1% v/v. Do not exceed 5 applications/year. Restricted use pesticide.
annual and perennial grasses	Poast 1.5EC (sethoxydim 1.5 lbs. a.i./gal.) at 1.5-2.5 pts. in minimum of 5 gals. of water	Apply as a directed spray to actively growing grasses before tillering. Always add COC at 1% v/v. Do not exceed 2.5 pts./application or exceed 5 pts./season. PHI=30 days.
annual grasses and broadleaves	Reglone (diquat 2 lbs. a.i./gals.) at 1.5-2 pts. in minimum of 15 gals. of water	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray using a shield for contact burn of weeds. Complete coverage is essential for good control. Always add NIS at 0.06-0.5% v/v. Can be used during site preparation and up to 1 year of harvest. Do not allow contact with green stems, foliage, or fruits. PHI=1 year.
annual and perennial grasses and broadleaves	Rely 280 (glufosinate 24.5% a.i. (2.34 lbs./gal.) at 48-82 fl. oz. in minimum of 15 gals. of water (see Generic Herbicides, page 167)	Apply as a directed spray to actively growing weeds. Do not apply on desirable foliage or drift on foliage, green, or uncultivated bark. Coverage of all foliage is necessary for optimum control. Do not exceed 164 fl. oz./acre/year. PHI=14 days.
annuals and some perennial grasses and broadleaves	Roundup WeatherMax 5.5EC (glyphosate 5.5 lbs. a.i./gal.) at 0.5-5.3 qts. in 10-40 gals. of water (see Generic Herbicides, page 167)	Apply as a directed spray or wiper application to actively growing weeds in established plantings. Always add ammonium sulfate at 8.5-17 lbs./100 gals. in hard water or drought conditions. Do not allow spray to contact any part other than mature bark. For applications within rows of berries, use only selective equipment (directed spray, hooded sprayer, shielded sprayer, or wiper application) in order to minimize the potential for overspray or drift of this product onto the crop. For berry crops, hooded or shielded sprayers must be fully enclosed (including top, sides, front, and back). Only wiper applications or shielded sprayers capable of preventing all contact of this product with the crop may be used. Rate depends on weed species and stage of growth. Does not provide residual control. Can be mixed with labeled pre-emergence herbicides. PHI=14 days.
annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lbs. a.i./gal.) at 3-10% spray solution	For contact nonselective control or burndown of a broad spectrum of actively growing weeds. Use low rate for annual weed control and high rate for maximum vegetative burndown. Use as a directed spray or shielded spray. Can be mixed with Roundup.
most annual and perennial grasses	Select Max (clethodim 0.97 lb. a.i./gal.) at 9-16 fl. oz. (see Generic Herbicides, page 167)	Apply as a directed spray to actively growing grasses before tillering. Do not use COC. Always add NIS at 0.25% v/v. May be applied as a spot treatment at 0.32-0.64 fl. oz./gal. Rainfast in 1 hour. Do not exceed 32 fl. oz./year. PHI=14 days.

■ Herbicide Recommendations for Brambles

Weed Problem	Material & Rate per Acre	Notes and Comments
Pre-emergence		
annual and perennial grasses and broadleaves	Casoron CS (dichlobenil 15.3% a.i.) at 1.4-2.8 gals.	Apply from late fall through early spring. Applications should be made prior to weed emergence, or when emerged weeds are less than 2 inches tall. Use only on well-established plants. Do not apply during new shoot emergence. Age Restriction: Do not apply to plants less than 1 year old.

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Herbicide Recommendations for Brambles (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual grasses and broadleaves	Devrinol 2-XT (napropamide 2 lbs. a.i./gal.) at 2 gals./acre (see Generic Herbicides, page 167)	Apply to a weed-free soil surface or tank mix with a suitable postemergent herbicide. May be applied to newly planted and newly established crops. Do not apply more than 2 gals./acre/crop cycle.
most broadleaves	Gallery 75DF (isoxaben 75% a.i.) at 0.66-1.33 lb. in minimum of 10 gals. of water (see Generic Herbicides, page 167)	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Apply in late summer to early fall, or in early spring prior to weed germination, or anytime immediately after cultivation. Do not apply to new transplants until soil has settled with no cracks present. Rainfall or irrigation of 0.5 inch is needed within 21 days of application. Not effective on germinated weeds. Minimum 60 days between applications. Do not exceed 4 lbs./acre/12-month period.
annual grasses and broadleaves	Karmex DF (diuron 80% a.i.) at 3 lbs. in 25-40 gals. of water Selected states only	Age Restriction: Apply in fields established at least 1 year. Do not exceed 1 application/year. Do not spray exposed roots to avoid injury. IN and OH only: Apply 3 lbs. in late spring for raspberries. If used post-emergence, avoid contact with foliage. Best results if temperature is at least 70°F with high humidity.
annual grasses and broadleaves	Princep 4L (simazine 4 lbs. a.i./gal.) at 2-4 qts. in minimum of 40 gals. of water (see Generic Herbicides, page 167)	Apply in spring before weeds emerge and before canes leaf out. Or, make a split application of 2 qts. in spring plus 2 qts. in fall. Do not apply when fruit is present, or illegal residues may result. On plants established less than 6 months, apply at half the rate.
annual broadleaf weeds and nutsedge	Sandea (halosulfuron) 75% at 0.5-1 oz. in minimum of 15 gals. of water	Apply with ground equipment as a broadcast application to the ground on either side of the row. Apply as a single or sequential application depending on weed pressure. If small weeds are present, mix with a postemergent broad-spectrum-type herbicide to maximize and enhance the spectrum of control. For postemergent nutsedge control, make a single application when nutsedge is fully emerged, or in 2 sequential applications. Make first application to the initial nutsedge flush when it has reached the 3-5-leaf stage. If a second application is needed it can be applied later in the season. Apply prior to primocane emergence or after cane burning. Avoid contact with canes. Minimum 45 days between applications. Do not exceed 2 oz./acre/year. PHI=14 days. Age Restriction: Do not apply to plants established less than 1 year.
annual grasses and broadleaves	Sinbar WDG (terbacil 80% a.i.) at 1-2 lbs. in minimum of 20 gals. of water	Make a single band or broadcast application as a directed spray to soil beneath the canes in the fall or early spring before fruit set and shortly before or after weed emergence. Avoid contact of foliage or fruit with spray or mist. Do not use on soils where roots are exposed. Age Restriction: Use only on plantings established at least 1 year. PHI=70 days.
annual grasses and certain broadleaves	Snapshot 2.5TG (isoxaben+trifluralin 2.5% a.i.) at 100-200 lbs.	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. For best results, 0.5 inch of rain or irrigation is needed within 3 days of application. Not effective on germinated weeds. Do not apply to new transplants until soil has settled. Minimum 60 days between applications. Do not exceed 600 lbs./12-month period.
annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (norflurazon 78.6% a.i.) at 2.5-5 lbs. in minimum of 20 gals. of water	Apply as a directed spray to settled and firm soil from fall to early spring before weeds emerge. Rainfall or irrigation of 0.5 inch within 4 weeks to activate. 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. Age Restriction: Minimum 12 months after planting before first application. PHI=60 days.

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Herbicide Recommendations for Brambles (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water (see Generic Herbicides, page 167)	Make a single band or broadcast application to the ground beneath vines before weeds emerge. Apply alone to weed-free soil or post-emergence mixed with Roundup or Gramoxone. Rainfall or irrigation of 0.5 inch is required for activation. Minimum 2.5 months between applications. Do not exceed 12 qts./year.
annual and perennial grasses and broadleaves	Zeus Prime XC (carfentrazone-ethyl 3.5% and sulfentrazone 31.8% a.i.) at 7.7-15.2 fl. oz./acre in minimum of 10 gals. of water	Apply as a broadcast or banded soil application directed to the base of the trunks of bushes or vines. If weeds are present, tank mix with a post-emergence herbicide to eliminate emerged weeds. Apply a single broadcast application at 15.2 fl. oz. (0.41 lb. a.i.)/per acre. May be applied as a banded treatment twice per year. Do not exceed 15.2 fl. oz. (0.41 lb. a.i.) /acre/year. Minimum 60 days between applications. Do not apply after bud break except with hooded or shielded sprayer. PHI=3 days. Age Restriction: Apply to crops that have been growing for at least 2 years and are in good condition.
annual and perennial grasses and broadleaves	Zeus XC (sulfentrazone 39.6% a.i.) at 8-12 fl. oz./acre in a minimum of 10 gals. of water	Apply as a broadcast or banded soil application directed to the base of the trunk of bushes or vines. If weeds are present, tank mix with a post-emergence herbicide to eliminate emerged weeds. Make a single broadcast application at 8-12 fl. oz. (0.25-0.375 lb. a.i.)/acre. May be applied as a banded treatment twice per year. Minimum of 60 days between applications. Do not exceed 12 fl. oz. (0.375 lb. a.i.)/acre/year. Do not apply after bud break except with hooded or shielded sprayer. PHI=3 days Age Restriction: Apply to crops that have been growing for at least 3 years and are in good condition.
Post-emergence		
annual broadleaves	Aim 2EC or Aim 2EW (carfentrazone 2 lbs. a.i./gal.) at 1-2 fl. oz. in 20 gals. of water	Apply with hooded shields between rows during growing season. Always add NIS at 0.25% v/v or COC at 1% v/v. Do not exceed 25.6 fl. oz./year. Minimum 14 days between applications. PHI=15 days. Primocane Control: Apply when primocanes are 6 inches at 6.4 fl. oz. in minimum of 20 gals. of water at intervals 14-21 days. Direct sprays to bottom 18 inches of canes.
most annual and perennial grasses	Fusilade DX 2EC (fluazifop-p 2 lbs. a.i./gal.) at 16-24 fl. oz. in 25 gals. of water	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray to actively growing grasses before tillering. Always add COC at 1% v/v or NIS at 0.25% v/v. Avoid contact with foliage. Rainfast in 1 hour. Do not exceed 72 fl. oz./year. Minimum 5 days between applications. PHI=1 year.
most annual grasses and broadleaves and top kill of perennial weeds	Gramoxone (paraquat 2 lbs. a.i./gal.) at 2-4 pts. in minimum of 50 gals. of water (see Generic Herbicides, page 167)	Apply as directed spray to actively growing weeds before emergence of new canes or shoots. Repeat applications are necessary to give sustained control. Apply as a coarse spray to avoid drift injury. Avoid contact with desired new shoots, fruit, or foliage. Always add NIS at 0.25% v/v or COC at 1% v/v. Do not exceed 5 applications/year. Restricted use pesticide.
annual grasses and broadleaves	Karmex DF	See Pre-emergence (page 157) for details.
annual and perennial grasses	Poast 1.5EC (sethoxydim 1.5 lbs. a.i./gal.) at 1.5-2.5 pts. in minimum of 5 gals. of water	Apply as a directed spray to actively growing grasses before tillering. Always add COC at 1% v/v. Do not exceed 5 pts/season. May be used as a spot treatment at 1-1.5% solution. PHI=45 days.

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Herbicide Recommendations for Brambles (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual grasses and broadleaves	Reglone (diquat 2 lbs. a.i./gal.) at 1.5-2 pts. in minimum of 15 gals. of water	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray using a shield for contact burn of weeds. Complete coverage is essential for good control. Always use NIS at 0.06-0.5% v/v. Can be used during site preparation and up to 1 year of harvest. Do not allow contact with green stems, foliage or fruits. PHI=1 year.
annuals and some perennial grasses and broadleaves	Roundup WeatherMax 5.5EC (glyphosate 5.5 lbs. a.i./gal.) at 0.5-5.3 qts. in 10-40 gals. of water (see Generic Herbicides, page 167)	Apply as a directed spray or wiper application to actively growing weeds in established plantings. Always add ammonium sulfate at 8.5-17 lbs./100 gals. in hard water or drought conditions. Do not allow spray to contact any part other than mature bark. For applications within rows of berries, use only selective equipment (directed spray, hooded sprayer, shielded sprayer, or wiper application) in order to minimize the potential for overspray or drift of this product onto the crop. For berry crops, hooded or shielded sprayers must be fully enclosed (including top, sides, front, and back). Only wiper applications or shielded sprayers capable of preventing all contact of this product with the crop may be used. Rate depends on weed species and stage of growth. Does not provide residual control. Can be mixed with labeled pre-emergence herbicides. PHI=14 days.
annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lbs. a.i./gal.) at 3-10% spray solution	For contact nonselective control or burndown of a broad spectrum of actively growing weeds. Use low rate for annual weed control and high rate for maximum vegetative burndown. Use as a directed spray or shielded spray. Can be mixed with Roundup.
most annual and perennial grasses	Select Max (clethodim 0.97 lb. a.i./gal.) at 9-16 fl. oz. (see Generic Herbicides, page 167)	Apply post-emergence as a directed spray to young actively growing grasses. Do not exceed 16 fl. oz./A in a single application or 64 fl. oz./A per season. A minimum 14-day interval is required for repeat applications. Always add NIS at 0.25% v/v. Do not use COC. Rainfast in 1 hour. PHI=7 days.

■ Herbicide Recommendations for Strawberry

Weed Problem	Material & Rate per Acre	Notes and Comments
Pre-emergence		
annual broadleaves and suppression of grasses	Chateau SW (flumioxazin 51% a.i.) at 3 oz.	Pre-transplanting: Apply a minimum of 30 days before transplanting and before laying plastic. Can be mixed with Gramoxone or Roundup. Pre-emergence on Dormant Plants: Can be applied over the top of established or newly planted dormant strawberries. Add COC at 1% v/v or NIS at 0.25% v/v to help control emerged broadleaf weeds. Do not apply to frozen ground. Shielded or Hooded Application in Row Middles: Do not apply after fruit set and not over strawberry plants. Apply prior to weed emergence.
annual grasses and some broadleaves	Dacthal 6F (DCPA 6 lbs. a.i./gal.) at 8-12 pts. in minimum of 20 gals. of water	At Planting: Apply 12 pts. at transplanting. Can be preplant incorporated. Clean cultivate or hoe if necessary before treatment. Established: Apply in early fall or in early spring immediately after mulch removal. Clean cultivate or hoe if necessary before treatment. Applications may be made directly over the plants without injury. Do not apply from bloom through harvest.

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Herbicide Recommendations for Strawberry *(continued)*

Weed Problem	Material & Rate per Acre	Notes and Comments
annual grasses and certain broadleaves	Devrinol 2-XT (napropamide 2 lbs. a.i./gal.) at 2 gals./acre (see Generic Herbicides, page 167)	<p>Established Plantings (spring): Apply after removing straw mulch. Water into soil to a depth of 2-4 inches (by rainfall or irrigation) within 24-72 hours of application.</p> <p>Established Plantings (fall): Apply before putting winter protective mulch over plants. Water into soil to a depth of 2-4 inches (by rainfall or irrigation) within 24-72 hours of application. Do not apply to frozen ground. Do not exceed 2 gals./acre/crop cycle.</p> <p>Strawberries Not Grown with Plastic: Apply to a weed-free soil surface. May be applied to newly transplanted crops. Delay application until the desired number of daughter plants has become established. Do not exceed 2 gals./acre/crop cycle. Do not apply from bloom through harvest.</p> <p>Strawberries Grown with Plastic Mulch on Plant Beds: Apply to a weed-free soil before laying plastic mulch. Incorporate to a depth of 2 inches within 24-72 hours of application and before laying plastic. May also be applied to soil between beds. Do not exceed 2 gals./acre/crop cycle. Do not apply from bloom through harvest.</p>
annual broadleaves, especially winter annuals	Goal 2XL (oxyfluorfen 2 lbs. a.i./gal.) at 1-2 pts. in minimum of 40 gals. of water (see Generic Herbicides, page 167)	<p>Fallow Bed Preparation Only: Apply with Roundup for control of winter annual broadleaves a minimum of 30 days before transplanting. Fallow bed should be worked thoroughly to a depth of 2.5 inches prior to planting.</p>
annual grasses and certain broadleaves	Prowl H ₂ O 3.8E (pendimethalin 3.8 lbs. a.i./gal.) at 1.5-3.0 pts. in minimum of 10 gals. of water. Rate depends on soil type. See label for details.	<p>Apply as a broadcast spray before transplanting or after transplanting but before growth starts. May not be used on beds that will be covered in plastic. A second application may be used in a band between rows up to 35 days before harvest. Do not allow the spray to contact strawberry foliage. May be applied to strawberries in fall or winter dormancy prior to the onset of new growth. May be applied to perennial strawberries during renovation after foliage has been mowed, but prior to the onset of new growth. Adequate rainfall or irrigation after application prior to weed emergence will provide the most benefit. Do not exceed 3 pts./application or exceed 6 pts./season. PHI=35 days. Do not use if row is later to be covered with plastic.</p>
annual grasses and broadleaves	Sinbar 80WP (terbacil 80% a.i.) at 2-8 oz. in minimum of 20 gals. of water	<p>Planting Year: Apply 2-3 oz. immediately after transplanting but before runners start to root. Application of 2-6 oz. can also be made to dormant plants in late summer or early fall for control of winter annual weeds. If transplants have started to develop new foliage in the spring, or are not dormant in late summer or early fall at time of application, then 0.5-1 inch of rain or irrigation is necessary to wash Sinbar off. Do not use on soils with less than 0.5% organic material, as plant injury can occur.</p> <p>Harvest Years: Apply 4-8 oz. after post-harvest renovation and before new growth begins in midsummer. An additional 4-8 oz. prior to mulching in late fall is recommended to extend weed control through harvest of the following year. Do not exceed 8 oz./season. PHI=110 days.</p> <p>Note: Strawberry varieties differ in sensitivity to Sinbar, and significant plant injury is possible. Conduct a field test before adoption as a normal practice, particularly for new varieties.</p>

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Herbicide Recommendations for Strawberry (continued)

Weed Problem	Material & Rate per Acre	Notes and Comments
annual broadleaf weeds, grasses and nutsedge	Spartan 4F (sulfentrazone 39.6%) at 4-8 oz. in 20-40 gals. of water	Apply prior to planting, post-transplant before new leaves emerge from dormant crowns or during dormancy. Do not exceed 8 fl. oz./acre/application or exceed 12 oz. (0.375 lb. a.i.)/acre/year. Rate depends on soil texture. Some cultivars may be sensitive. See label. Some states may have supplemental or Special Local Need labels. PHI=70 days.
Post-emergence		
annual broadleaves	Aim 2EC or Aim 2EW (carfentrazone 2 lbs. a.i./gal.) at 0.5-2 fl. oz. in minimum of 10 gals. of water	Apply with hooded shields between rows during growing season to actively growing weeds. Best results when weeds are <4 inches and rosettes <3 inches across. Always add NIS at 0.25% v/v or COC at 1% v/v. Do not exceed 6.1 fl. oz./year. Minimum 14 days between applications. PHI=0 days.
annual and some perennial broadleaves	2,4-D amine (4 lbs. a.i./gal.) at 2-3 pts. in 25-50 gals. of water (see Generic Herbicides, page 167)	For Established Plantings Only: Apply in early spring when strawberries are dormant or immediately after last picking. Do not apply unless possible injury to the crop is acceptable. Do not tank mix with Poast. Several 2,4-D amine products are available, but only a few are labeled for strawberry. Check label for specific use directions.
most annual and perennial grasses	Fusilade DX 2EC (fluazifop-p 2 lbs. a.i./gal.) at 16-24 fl. oz. in 25 gals. of water	Non-bearing Only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray to actively growing grasses before tillering. Always add COC at 1% v/v or NIS at 0.25% v/v. Avoid contact with foliage. Rainfast in 1 hour. Do not exceed 72 fl. oz./year. Minimum 5 days between applications. PHI=1 year.
annual broadleaves	Goal 2XL	See Pre-emergence section (page 160) for details.
most annual grasses and broadleaves and top kill of perennial weeds	Gramoxone (paraquat 2lbs. a.i./gal.) at 2-4 pts. in minimum of 20 gals. of water (see Generic Herbicides, page 167)	Apply as a directed spray between rows, using shields to protect strawberry plants. Do not allow spray to contact foliage. Add NIS at 0.25% v/v or COC at 1% v/v. Do not exceed 3 applications/year. PHI=21 days. Restricted use pesticide.
most annual and perennial grasses (post-emergence only)	Poast 1.5EC (sethoxydim 1.5 lbs. a.i./gal.) at 1-2.5 pts. in 25 gals. of water	Apply to actively growing grasses before tillering. Always add COC at 1% v/v. May be used as a spot treatment at 1-1.5% spray solution. Do not exceed 2.5 pts./application or exceed 2.5 pts./season. Caution: Application of Poast up to six weeks after Sinbar application can occasionally cause strawberry leaf injury. PHI=7 days.
annuals and some perennial grasses and broadleaves	Roundup WeatherMax 5.5EC (glyphosate 5.5 lbs. a.i./gal.) at 0.5-5.3 qts. in 10-40 gals. of water (see Generic Herbicides, page 167)	Apply as pre-plant broadcast application or in fall prior to planting for control of roots and rhizomes of perennial weeds or as a directed spray or wiper application (20-100% solution) to actively growing weeds between rows in established plantings. Always add ammonium sulfate 8.5-17 lb./100 gals. in hard water or drought conditions. Do not allow spray to contact any desired plants. Does not provide residual control; can be mixed with labeled pre-emergence herbicides. Rate depends on weed species and stage of growth. PHI=14 days.
annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lbs. a.i./gal.) at 3-10% spray solution	For contact nonselective control or burndown of a broad spectrum of actively growing weeds. Use low rate for annual weed control and high rate for maximum vegetative burndown. Use as a directed spray or shielded spray. Can be mixed with Roundup.

(continued)

Herbicide Recommendations for Strawberry (continued)

most annual and perennial grasses	Select Max (clethodim 0.97 lb. a.i./gal.) at 9-16 fl. oz. (see Generic Herbicides, page 167)	Apply as a directed spray to actively growing grasses before tillering. Always add COC at 1% v/v. Rainfast in 1 hour. Do not exceed 64 fl. oz./year or exceed 16 fl. oz./application. Minimum 14 days between applications. May be applied as a spot treatment at 0.32-0.64 fl. oz./gal. PHI=4 days.
annual and perennial broadleaves	Spur (clopyralid 3 lbs. a.i./gal) at 2/3 pts. (see Generic Herbicides, page 167)	For perennial strawberries only. Make 1 application after harvest. Make only 1 application per crop year. Do not tank mix with other herbicides. Not registered in all states, but has 24(c) special local needs registration in several states. Check with your state chemist office.
annual grasses and broadleaves	Ultra Blazer 2E (acifluorfen 2 lbs. a.i./gal.) at 1.5 pts. in minimum of 20 gals. of water	May be applied up to the maximum application rate of 1.5 pts./acre/ application using ground equipment. Make broadcast applications in 20 -40 gals. water per acre. Reduce rates proportionally for band or strip treatment. Do not apply more than 3 pts./acre/season. Apply with NIS or COC. Annual Strawberries Grown on Plastic Mulch: Make 1 banded application before laying plastic and after final land preparation, and prior to transplanting the crop. For application between rows of plastic mulch, apply as a direct-shielded application between mulched beds. Do not allow contact with strawberry plants. PHI=60 days. Perennial Strawberry (matted row): Make 2 applications: the first can be made after the last harvest or following bed renovation. The second can be made when plants are dormant during late fall to early spring. PHI=120 days.

■ Herbicides Registered for Weed Control in Small Fruit

Trade Name	Common Name	HRAC/WSSA ¹	Crop Use	Risk of Resistance	Signal Word	REI (hours)
Pre-emergence control of grasses and/or broadleaf weeds						
Alion	indaziflam	L/21	grape	medium	caution	12
Callisto	mesotrione	F2/27	blueberry	medium	caution	12
Casoron, Norosac	dichlobenil	L/20	blueberry, brambles, grape	medium	caution	12
Chateau	flumioxazin	E/14	grape, strawberry	medium	caution	12
Dachtal	DCPA	K1/3	strawberry	low	caution	12
Devrinol	napropamide	K3/15	blueberry, brambles, grape, strawberry	low	caution	24
Gallery, Trellis	isoxaben	L/21	nonbearing blueberry, brambles, grape	medium	caution	12
Goal	oxyfluorfen	E/14	grape, strawberry	medium	warning	24
Karmex	diuron	C2/7	blueberry, brambles, grape	medium	caution	12
Kerb (RUP)	pronamide	K1/3	blueberry, grape	low	caution	24
Matrix	rimsulfuron	B/2	grape	medium	caution	4
Mission	flazasulfuron	B/2	grape	medium	caution	12
Princep	simazine	C1/5	blueberry, brambles, grape	medium	caution	12
Prowl H ₂ O	pendimethalin	K1/3	strawberry, grape	low	caution	12

(continued)

Herbicides Registered for Weed Control in Small Fruit (continued)

Trade Name	Common Name	HRAC/WSSA ¹	Crop Use	Risk of Resistance	Signal Word	REI (hours)
Sandea	halosulfuron	B/2	blueberry	low	caution	12
Sinbar	terbacil	C1/5	blueberry, brambles, strawberry	medium	caution	12
Snapshot	isoxaben + trifluralin	L/21 + K1/3	nonbearing grape, blueberry, brambles	medium	caution	12
Solicam	norflurazon	F1/12	blueberry, brambles, grape	medium	caution	12
Surflan	oryzalin	K1/3	blueberry, brambles, grape	low	caution	24
Treflan	trifluralin	K1/3	grape	low	caution	12
Velpar	hexazinone	C1/5	blueberry	medium	danger	48
Zeus XC, Spartan	sulfentrazone	E/14	grape, blueberry, brambles, strawberry	medium	caution	12
Zeus Prime XC	carfentrazone-ethyl + sulfentrazone	E/14	grape, blueberry, brambles	medium	caution	12
Post-emergence control of grasses						
Fusilade	fluazifop	A/1	nonbearing blueberry, brambles, grape & strawberry, bearing grape	high	caution	12
Poast	sethoxydim	A/1	blueberry, brambles, grape, strawberry	high	warning	12
Scythe	pelargonic acid	Z/17	blueberry, brambles, grape, strawberry	low	warning	12
Select Max	clethodim	A/1	strawberry, brambles, nonbearing blueberry, & grape	high	warning	12
Post-emergence control of broadleaf weeds						
Aim	carfentrazone	E/14	grape, blueberry, brambles, strawberry	medium	caution	12
Amine 4	2,4-D amine	O/4	strawberry	low	danger	48
Goal	oxyfluorfen	E/14	grape, strawberry	medium	warning	24
Spur	clopyralid	O/4	strawberry	medium	caution	12
Venue	pyraflufen ethyl	E/14	grape	medium	caution	12
Post-emergence control of grasses and broadleaf weeds						
Gramoxone (RUP)	paraquat	D/22	blueberry, brambles, grape, strawberry	medium	poison	12
Roundup	glyphosate	G/9	blueberry, brambles, grape, strawberry	low	caution	12
Reglone	diquat	D/22	nonbearing grape, blueberry, brambles	medium	medium	24
Rely	glufosinate	H/10	grape, blueberry	low	warning	12
Ultra Blazer	acifluorfen	E/14	strawberry	medium	danger	48

¹ Herbicide Resistance Action Committee/Weed Science Society of America classification.

Relative Effectiveness of Herbicides for Small Fruit Crops¹

Herbicide	Grasses					Annual Broadleaves															Perennial Weeds						
	barnyardgrass	crabgrass	foxtails	goosegrass	panicum, fall	chickweed	cocklebur	groundsel, common	henbit	lambsquarters	maretail	morningglory, annual	mustards	nightshades	palmer amaranth	pigweed	purslane	ragweed	shepherdspurse	smartweeds	velvetleaf	waterhemp	dandelion	johnsongrass	nutsedge, yellow	thistle, Canada	woodsorrel, yellow
Pre-emergence																											
Alion	G	G	G	G	G	G	N	G	F	F	G	F	G	N	N	G	G	F	G	G	G	N	G	N	N	N	F
Callisto	N	N	N	N	N	G	G	N	N	G	F	F	N	G	F	G	N	G	N	G	G	G	N	N	F	N	N
Casoron	N	G	G	G	G	G	F	G	G	G	F	N	G	N	N	G	G	G	G	G	G	N	G	N	N	G	G
Chateau	N	N	N	N	N	F	F	N	N	G	G	F	N	G	F	G	G	F	G	F	F	F	N	N	N	N	N
Dacthal	G	G	G	G	G	F	N	N	N	F	N	N	N	N	N	F	F	N	N	N	N	N	N	N	N	N	N
Devrinol	G	G	G	G	G	G	F	N	N	F	N	N	N	N	N	G	G	N	N	N	N	N	N	N	N	N	N
Gallery, Trellis	N	N	N	N	N	G	F	G	G	G	F	N	G	G	N	G	G	G	N	N	G	N	N	N	N	N	G
Goal	N	N	F	F	N	N	F	G	F	G	F	F	G	G	N	G	F	N	F	F	F	F	N	N	N	N	F
Karmex	G	G	F	G	F	G	F	G	G	G	F	F	G	G	N	G	G	G	G	N	P	N	N	N	N	N	N
Kerb	G	N	F	G	G	G	N	N	G	G	N	G	G	G	N	N	G	F	G	F	N	N	N	N	N	N	N
Matrix	G	G	G	N	G	N	F	G	G	F	G	N	G	F	N	F	G	F	F	F	F	N	G	N ²	F	F	N
Mission	N	N	G	N	N	G	N	G	G	G	F	N	F	N	N	G	G	G	G	N	N	N	G	N	G	N	N
Princep	G	G	G	G	G	G	N	G	G	G	N	G	G	G	N	G	G	G	G	N	F	N	N	N	F	N	N
Prowl	G	G	G	G	G	G	N	N	N	G	N	N	N	N	G	F	F	N	G	F	F	G	N	N ²	N	N	N
Sandea	N	N	N	N	N	N	F	G	N	G	F	N	G	N	N	G	F	G	G	G	G	N	N	N	G	N	N
Sinbar	G	G	G	N	G	G	N	F	G	G	N	N	G	G	N	G	G	G	G	G	N	N	G	F	F	N	N
Snapshot	G	G	F	G	G	G	F	G	G	G	F	F	G	F	N	G	N	N	G	F	G	N	G	F	N	N	G
Solicam	G	G	G	G	G	G	G	F	F	G	F	N	G	F	F	G	F	G	G	N	G	F	N	F	F	N	N
Surflan	G	G	G	G	G	G	N	F	G	G	N	N	N	F	N	G	G	F	G	F	F	N	N	N ²	N	N	N
Treflan	G	G	G	G	G	N	N	N	G	F	N	N	F	N	F	G	G	N	N	N	N	N	N	F	N	N	F
Zeus Prime XC	G	G	G	G	G	G	N	G	G	G	N	G	G	G	F	G	G	N	G	G	N	G	N	N	G	G	N
Zeus XC, Spartan	N	G	N	G	N	G	N	G	N	G	N	G	G	G	F	G	G	N	G	F	F	F	G	F	G	G	F
Post-emergence																											
2,4-D	N	N	N	N	N	F	F	G	N	F	G	G	G	G	F	F	N	G	G	F	F	F	G	N	N	F	N
Aim	N	N	N	N	N	N	F	G	F	G	N	G	G	G	F	G	G	F	F	F	G	F	N	N	N	F	N
Chateau	N	N	N	N	N	G	N	N	N	G	G	F	N	F	F	F	G	F	G	F	G	F	N	N	N	N	N
Fusilade	G	G	G	G	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	F ²	N	N	N
Goal	N	F	F	F	N	N	F	G	G	G	F	F	G	G	N	G	F	N	F	F	F	F	N	N	N	N	F
Gramoxone	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	N	G	G	G	N	F	N	N	N
Mission	N	G	G	N	N	G	N	G	G	G	G	N	G	N	N	G	G	G	G	N	N	N	F	N	G	G	N
Poast	G	G	G	G	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	F	N	N	N
Rely	G	N	G	G	G	G	G	N	N	G	G	G	G	G	F	G	G	G	G	G	F	F	G	F ²	F	G	N
Roundup	G	G	G	G	G	G	G	G	G	G	F	G	G	G	F	G	G	G	G	G	G	F	G	F	F	G	G
Select	G	G	G	G	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Spur	N	N	N	N	N	N	F	G	N	N	G	N	N	G	N	N	N	G	N	F	N	N	G	N	N	G	N
Ultra Blazer	N	N	G	N	G	N	F	N	N	G	N	G	G	G	G	G	G	G	N	G	G	G	N	F ²	N	N	N
Venue	N	N	N	N	N	G	G	N	G	G	F	G	N	G	F	G	G	G	G	G	G	F	G	N	N	N	N

¹ G = good. F = fair. N = not listed, based on product labels.

² Provides partial control of seedling johnsongrass.

■ Pre-harvest Intervals for Tree Fruit Herbicides

Crop Use	Trade Name	Common Name	HRAC/WSSA Code ¹	Risk of Resistance	Signal Word	Pre-harvest Interval
Pre-emergence						
apple pear, cherry	Casoron	diclobenil	L/20	medium	Caution	
apple, pear, peach, nectarine, plum, cherry	Alion	indaziflam	L/21	low	Caution	14 d
	Chateau	flumioxazin	E/14	medium	Caution	60 d
	Goal	oxyfluorfen	E/14	medium	Warning	
	Matrix	rimlulfuron	B/2	high	Caution	7 d apple, pear; 14 d stone fruit
	Karmex	diuron	C2/7	medium	Caution	
	Kerb (RUP)	pronamide	K1/3	low	Caution	
	Princep	simazine	C1/5	medium	Caution	
	Solicam	norflurazon	F1/12	medium	Caution	14 d
	Surflan	oryzalin	K1/3	low	Caution	
apple, peach	Sinbar	terbacil	C1/5	medium	Caution	60 d
peach, plum	Treflan	trifluralin	K1/3	low	Caution	
non-bearing	Gallery	isoxaben	L/21	medium	Caution	
	Prowl	pendimethalin	K1/3	low	Caution	
	Showcase	trifluralin + isoxaben + oxyfluorfen	K1,L,E/3, 21,14	medium	Caution	1 yr
	Snapshot	trifluralin + isoxaben	K1,L/3,21	medium	Caution	
Post-emergence						
apple, pear, peach, nectarine, plum, cherry	Aim	carfentrazone	E/14	medium	Caution	3 d
	Amine	2,4-D amine	O/4	low	Danger	14 d
	Fusilade	fluazifop-P	A/1	high	Caution	1 yr
	Goal	oxyfluorfen	E/14	medium	Warning	
	Gramoxone (RUP)	paraquat	D/22	medium	Poison	
	Karmex	diuron	C2/7	medium	Caution	
	Poast	sethoxydim	A/1	high	Warning	14 d
	Roundup	glyphosate	G/9	low	Caution	1 d apples, pears; 17 d stone fruit
	Scythe	pelargonic acid	—	—	Warning	
	Stinger	clopyralid	O/4	low	Caution	30 d
apple	Rely or Cheetah	glufosinate	H/10	low	Warning	14 d
	Sandea	halosulfuron	B/2	medium	Caution	14 d
apple, pear	Treevix	saflufenacil	E/14	low	Caution	0 d
peach	Select Max	clethodim	A/1	high	Warning	14 d
non-bearing	Broadloom	bentazon	C3/6	medium	Caution	1 yr
	Reglone	diquat	D/22	medium	Warning	
	Select Max	clethodim	A/1	high	Warning	

¹Herbicide Resistance Committee/Weed Science Society of America classification.

■ Generic Herbicides¹

Common Name	Original Trade Name (Current Manufacturer)	Other Trade Names (Manufacturers)
2,4-D amine	Amine4 2,4-D (Tenkoz)	2,4-D Amine 4 (Winfield Solutions) 2,4-D Amine (Helena) Havoc Amine (Innvictis Crop Care) Clean Amine (Loveland Products) Opti-Amine (Helena) Saber (Loveland Products) Shredder Amine 4 (Winfield Solutions) Defy Amine 4 (Makhteshim) 2,4-D Amine 4 (Tacoma Ag) 2,4-D Amine Weed Killer (UCPA) Amine 4 2,4-D Weed Killer (Loveland Industries)
acifluorfen	Ultra Blazer (United Phosphorus)	Levity (Innvictis Crop Care) Levity (Innvictis Crop Care) Acifluorfen 2E (Tacoma Ag) Avalanche Ultra (Winfield Solutions) Bentazon 4 (Tacoma Ag)
bentazon	Broadloom (United Phosphorus)	Bentazon 4 (Tacoma Ag)
clethodim	Select 2 EC (Valent USA)	Clethodim (Crop Smart) Clethodim 2E (Albaugh/Agri Star) Arrow 2 EC (Makhteshim) Intensity (Loveland Industries) Envoy (Valent USA) Section 2EC (Winfield Solutions) Select Max (Valent USA)
clopyralid	Stinger 3EC	Spur (Albaugh) Clop yr AG (United Phosphorus) Garrison (Nufarm Americas)
diquat	Reglone (Syngenta)	Diquat 2L/2L AG (Solera Source Dynamics) Diquash Ag (Sharda-USA) Rowrunner AG (Rotam North America)
diuron	Karmex DF (Makhteshim Agan of North America)	Alligare Diuron 80 DF (Alligare, LLC) Diuron 4L (Makhteshim)
flumioxazin	Chateau WDG (Valent USA)	BroadStar (Valent USA) Tuscany (Nufarm)
glufosinate-ammonium	Rely 280 (Bayer CropScience)	Glufosinate 280SL (Willowood USA) Forfeit 280 (Loveland Industries) Reckon 280 SL (Solera Source Dynamics) Cheetah (Nufarm Americas) Lifeline (United Phosphorus) Surmise (Albaugh/Agri Star)
glyphosate	Roundup WeatherMAX/PowerMAX (Monsanto)	Numerous products
hexazinone	Velpar DF CU/L CU (DuPont)	Velossa (Helena)
isoxaben	Gallery 75 DF (Dow Agrosiences)	Trellis and Trellis SC (Dow Agrosiences)
mesotrione	Callisto (Syngenta)	Explorer (Syngenta)
napropamide	Devrinol 10G (United Phosphorus)	Devrinol 2 EC/2 XT/2 G/50 DF (United Phosphorus) Strawberry & Fruit Tree Weeder (Lawn & Garden Products)
oryzalin	Surflan AS	Oryzalin 4 (Quali-Pro) Oryzalin 4 (Alligare) Oryzalin 4 AS (Makhteshim) Prozalin 4L (Prokoz) Surflan A.S. Agricultural (United Phosphorus) Surflan A.S. Specialty (United Phosphorus) Surflan WDG Specialty (United Phosphorus) Surflan XL 2G (United Phosphorus) XL 2G (Helena)

(continued)

Generic Herbicides¹ (continued)

Common Name	Original Trade Name (Current Manufacturer)	Other Trade Names (Manufacturers)
oxyfluorfen	Goal 2XL (Dow AgroSciences)	Oxystar 2E (Albaugh/Agri Star) Collide (United Phosphorus) Oxyfluorfen 2E Herbicide (Solera Source Dynamics) Oxyfluorfen 4SC (Solera Source Dynamics) Oxyflo 2EC (Willowood USA) Oxyflo 4SC (Willowood USA) Oxiflo 2EC (FarmSaver.com) Galigan 2E , Galigan H2O (Makhteshim)
paraquat	Gramoxone Inteon/Max/SL/SL 2.0 (Syngenta)	Cyclone SL 2.0 (Syngenta) Paraquat 3SL (Willowood USA) Paraquat Concentrate 43.2% (Solera Source Dynamics) Bonfire (United Phosphorus) Devour (Innvictis Crop Care) Firestorm (Chemtura Corp.) Para-SHOT 3.0 (Sharda USA) Parazone 3SL (Makhteshim) Quik-Quat (Drexel Chemical Co.)
pendimethalin	Prowl 3.3EC (BASF)	Pendulum 3.3EC (BASF Corp.) Helena Pendimethalin (Helena Chemical Co.) Acumen (Tenkoz) Pre-M Aquacap Herbicide (Lesco) PendiPro 3.3 EC (Independent Agribusiness Professionals) Pin-Dee 3.3 T & O (Drexel Chemical) Satellite HydroCap (United Phosphorus) Stealth (Loveland Industries)
pronamide	Kerb 50 WP (Dow AgroSciences)	Pronamide 50 WSP (Willowood USA)
rimsulfuron	Matrix FNV (Dupont)	Matrix SG (Dupont) Sil-MATRIX (PQ)
sethoxydim	Poast (BASF)	Poast (Micro Flo) Sethoxydim SPC (Nufarm Americas) Hi-Yield Grass Killer (Voluntary Purchasing Groups) Grass Getter (Lawn and Garden Products)
simazine	Princep 4L (Syngenta)	Princep Caliber 90 (Syngenta) Sentry Simazine 4L (United Suppliers) Sentry Simazine 90DF (United Suppliers) Simazine 4L (several producer/suppliers) Simazine 90 DF (Monterey Ag Resources) Simazine 90 DF (Winfield Solutions) Simazine 90 WDG (Winfield Solutions) SIM-TROL 4L (Sipcam Agro USA) SIM-TROL 90DF (Sipcam Agro USA)
sulfentrazone	Zeus (FMC) strawberry, grape	Spartan 4F (FMC) strawberry only
trifluralin	Treflan HFP (Dow AgroSciences)	Trifluralin HFP (Helena) Trifluralin 10G (several producers/suppliers) Treflan TR-10 (Dow AgroSciences) Treflan 5G (Lesco) TriAP 10G or 4HF (Independent Agribusiness Professionals) Trifluralin 4EC (several producers/suppliers) Aceto Trifluralin 4 EC (Aceto Agricultural Chemicals) Cornbelt Trifluralin EC (Van Diest Supply) Preen Garden Weed Preventer (Lebanon Seaboard) Trust (Winfield Solutions) Weed & Grass Preventer 5% TF (The Andersons)

¹ Check label to make sure product is labeled for the crop that it is to be used on.

Suggested record keeping form for restricted-use pesticides.

<i>Farm name and address:</i> _____								
Date & State of Growth	Crop	Chemical Applied (trade name, formulation and EPA registration number)	Rate per Acre	Total Applied	Location & Size of Block	Target Pest(s)	Name of Applicator & Certification Number	Wind, Weather, Notes

Suggested record keeping form for restricted-use pesticides.

Farm name and address: _____

Date & State of Growth	Crop	Chemical Applied (trade name, formulation and EPA registration number)	Rate per Acre	Total Applied	Location & Size of Block	Target Pest(s)	Name of Applicator & Certification Number	Wind, Weather, Notes

Fruit Grower Newsletters

Arkansas

University of Arkansas Division of Agriculture Cooperative Extension Service offers *Arkansas Fruit and Nut News* (comp.uark.edu/~dtjohnso/Arkansas_Fruit_Newsletter.html). It is published monthly or as needed to Arkansas growers at no cost. It provides timely information about fruit and nut production practices, disease and insect/mite activity, and upcoming meetings. Contact Donn Johnson, AGRI 320 Department of Entomology, Division of Agriculture, University of Arkansas System, Fayetteville, AR 72701; (479) 575-2501; email: dtjohnso@uark.edu.

Illinois

University of Illinois Extension publishes *Illinois Fruit & Vegetable News* (ipm.illinois.edu/ifvn). This newsletter covers production practices and insect and disease management. For more information, contact Local Food Systems and Small Farms Educators: Bronwyn Aly (1715 College Ave., Carmi, IL 62821, (618) 382-2662, baly@illinois.edu); or Nathan Johanning (402 Ava Road, Murphysboro, IL 62966, (618) 687-1727. For disease and insect diagnostics and management recommendations, contact the University of Illinois Plant Clinic at S-417 Turner Hall 1102 S. Goodwin Ave, Urbana IL 61801, (217) 333-0519; plantclinic@illinois.edu.

Indiana

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

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

Iowa

You can find general horticulture information and Iowa State University Plant and Insect Diagnostic Clinic updates at hortnews.extension.iastate.edu. Subscribe to Horticulture & Home Pest News to receive email alerts when we post new information — go to the News tab.

Kentucky

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

Minnesota

The U of M Fruit Blog and Minnesota Enology Blog keep growers informed of the latest developments in fruit and wine research and outreach. They are available at fruit.cfans.umn.edu.

Missouri

The Grape and Wine Institute (GWI) at the University of Missouri publishes an electronic newsletter, *The Midwest Winegrower* (gwi.missouri.edu/publications). The newsletter includes educational articles about grape growing and winemaking; insect, disease, and weed management; industry news; and notices of events in the region. Contact Tammy Jones (jones-tammy@missouri.edu) or Dean Volenberg (volenbergd@missouri.edu): GWI, 214 Walters Hall, Columbia, MO 65211; 573-882-0476.

Nebraska

The University of Nebraska-Lincoln Extension publishes a quarterly newsletter, *Nebraska VineLines* (viticulture.unl.edu/vinelines). It covers production practices, news of the industry, and insect, disease, and weed management. For information, contact Paul Read, Department of Agronomy and Horticulture, University of Nebraska, Lincoln, NE 68983-0724; (402) 472-5136.

Ohio

The *Ohio Grape-Wine Electronic Newsletter* (OGEN) is available at www.oardc.ohio-state.edu/grapeweb. To subscribe, email Diane Kinney at kinney.63@osu.edu.

Ohio Fruit News is available through Department of Plant Pathology, Entomology, Horticulture and Crop Science, and South Centers, The Ohio State University. To subscribe, email Rachel Medina at medina.72@osu.edu.

Pesticide Drift Communication Tools

Several states involved in this spray guide have web-based mapping tools that enable producers of pesticide sensitive crops avoid drift injury by communicating with agricultural chemical applicators.

DriftWatch.org serves Colorado, Delaware, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Carolina, Wisconsin, and Saskatchewan.

Oklahoma's Pesticide Drift Risk Advisor can be accessed through the Agweather website at agweather.mesonet.org.

The Ohio Sensitive Crop Registry is available at www.agri.ohio.gov/scr.

Check with the state department of agriculture in your state about similar tools.

Using a Plant Diagnostic Lab

The best way to identify insects, plants, and plant diseases, or to diagnose plant and pest problems, is to send a sample to a diagnostic laboratory. The National Plant Diagnostic Network website (www.npdn.org) lists diagnostic laboratories by state and region. Contact individual laboratories for specific submission and fee information (see pages 173-174).

To ensure an accurate diagnosis, it's important to collect and ship your specimens properly. Here are a few guidelines for collecting and shipping specimens to a diagnostic lab. *Your state will have specific instructions for collecting and shipping samples — check your local clinic's website for details.*

1. Collect fresh specimens. Send a generous amount of material, if available.
2. Ship specimens in a crush-proof container immediately after collecting. If holdover periods are encountered, keep specimen cool. Ship packages to arrive on weekdays.
3. Incomplete information or poorly selected specimens may result in an inaccurate diagnosis or inappropriate control recommendations. Badly damaged specimens are often unidentifiable and additional sample requests can cause delays.

Submitting Plant Specimens for Disease/Injury Diagnosis

Herbaceous Plants. For generally declining, wilting, or dying plants, send several whole plants showing a range of symptoms (early through more advanced) with roots and adjacent soil intact if possible. Dig the plants carefully so the root system remains intact. Place roots and surrounding soil in a plastic bag and fasten it to the base of the stem with a twist tie or string. Wrap the plants in dry newspaper and place in a crush-proof container for shipment. Do not add water or moist paper towels.

Leaves/fruit/woody tissues. When localized infections (such as leaf spots, fruit rots, or cankers) are suspected, send specimens representing early and moderate stages of disease. Press leaves flat between heavy paper or cardboard (do not tape leaves to paper) and wrap fruits and woody tissue in dry paper. For large fruit, wrap each individually in newspaper. Do not place fruit in a plastic bag. Pack firmly in a crush-proof container so that fruit will not be bruised during shipping.

Submitting Insect Specimens

Package insects carefully so they aren't crushed when they arrive at the lab. Do not tape insects to paper or package them loosely in envelopes. Separate and label the specimens if you send more than one type in the same package. Provide the appropriate information for each specimen.

Tiny or Soft-bodied Specimens. Submit such specimens (aphids, mites, thrips, caterpillars, grubs, spiders) in a small, leak-proof bottle or vial that is 1 ounce or less filled with with 70 percent alcohol (in Kansas submit in vinegar). Rubbing alcohol (isopropyl) is suitable and readily available. Do not submit insects in water, formaldehyde, or without alcohol; they will ferment and decompose.

Hard-bodied Specimens. Submit such specimens (flies, grasshoppers, cockroaches, wasps, butterflies, beetles) dry in a crush-proof container. As noted above, do not tape insects to paper or place them loose in envelopes.

Submitting Samples for Nematode Analysis

If you suspect a nematode problem, contact your clinic for state-specific submission information (see pages 173-174).

In general nematode identification requires collection of at least one quart of soil from the root zone of

affected plants. Include roots if the plants are actively growing.

Place the entire sample in a plastic bag. Do not add water or allow it to dry out. Protect the sample from extreme heat (for example, don't leave samples

inside a parked vehicle in direct sunlight). It is often helpful to collect a second, similar sample from a nearby area where plant growth appears normal.

Attach a label, note, or tag identifying the sample to the outside of each bag or package.

Selected University Diagnostic Labs

Arkansas

Plant Health Clinic
University of Arkansas
2601 N. Young Ave.
Fayetteville, AR 72704
(479) 575-7601
www.uaex.edu/farm-ranch/pest-management/plant-health-clinic

Contact:

Sherrie Smith, ssmith@uaex.edu

Illinois

University of Illinois Plant Clinic
S-417 Turner Hall
1102 S. Goodwin Ave.
University of Illinois
Urbana, IL 61801
(217) 333-0519
web.extension.illinois.edu/plantclinic
plantclinic@illinois.edu
www.facebook.com/UofIPlantClinic

Contacts:

Diane Plewa, dplewa@illinois.edu
(217) 300-3441
Suzanne Bissonnette, sbissonn@illinois.edu
(217) 333-2478

Indiana

Plant and Pest Diagnostic Laboratory
Purdue University
LSPS 101
915 W. State Street
West Lafayette, IN 47907-2054
(765) 494-7071
Fax: (765) 494-3958
ppdl.purdue.edu
www.facebook.com/PurduePPDL

Contacts:

Tom Creswell, creswell@purdue.edu
Gail Ruhl, ruhlg@purdue.edu

Iowa

Iowa State University Plant and Insect Diagnostic Clinic
327 Bessey Hall — the clinic will be moving in Spring 2018. Contact us or visit our website for up-to-date information
Iowa State University
Ames, IA 50011
(515) 294-0581
Fax: (515) 294-9420
clinic.ipm.iastate.edu
pidc@iastate.edu
www.facebook.com/ISUPIDC

Contacts:

Lina Rodriguez Salamanca, Plant Pathologist
lina@iastate.edu
Laura Jesse, Entomologist
ljesse@iastate.edu

Kansas

Plant Disease Diagnostic Lab
1712 Claflin Road
4032 Throckmorton PSC
Manhattan, KS 66506
(785) 532-5810
Fax: (785) 532 5692
www.plantpath.k-state.edu/extension/diagnostic-lab
clinic@ksu.edu

Contact:

Judith O'Mara, jomara@ksu.edu

Kentucky

Serving central and eastern Kentucky:
Plant Disease Diagnostic Laboratory
Agricultural Science Building-North
University of Kentucky
Lexington, KY 40546-0091
(859) 257-8949
Fax: (859) 323-1961
plantpathology.ca.uky.edu/extension/diagnostic-laboratories

Contact:

Julie Beale, jbeale@uky.edu

Serving western Kentucky:
Plant Disease Diagnostic Laboratory
Department of Plant Pathology
UK Research and Education Center
P.O. Box 469
1205 Hopkinsville Street
Princeton, KY 42445
(270) 365-7541 Ext. 228
Fax: (270) 365-2667
plantpathology.ca.uky.edu/extension/diagnostic-laboratories
extension/pdd_lab.html

Contact:

Brenda Kennedy, bkennedy@uky.edu

Minnesota

Plant Disease Clinic
University of Minnesota
495 Borlaug Hall
1991 Upper Buford Circle
St. Paul, MN 55108
(612) 625-1275
pdc.umn.edu
pdc@umn.edu

Missouri

Temporarily closed. Please check website for updates.

University of Missouri — Plant Diagnostic Clinic
28 Mumford Hall
Columbia, MO 65201
(573) 882-3019
plantclinic@missouri.edu
plantclinic.missouri.edu

Nebraska

Plant & Pest Diagnostic Clinic
448 Plant Sciences
P.O. Box 830722
University of Nebraska-Lincoln
Lincoln, NE 68583-0722
cropwatch.unl.edu/plantdisease/unl-diagnostic-clinic-lincoln
(402) 472-2559
Fax: (402) 472-2853

Contact:

Kyle Broderick, kbroderick2@unl.edu

Ohio

C. Wayne Ellett Plant and Pest Diagnostic Clinic
Ohio State University
8995 E. Main St., Bldg. 23
Reynoldsburg, OH 43068
(614) 292-5006
Fax: (614) 466-9754
ppdc.osu.edu

Contact:

Nancy Taylor, taylor.8@osu.edu or
ppdc@cfaes.osu.edu

Oklahoma

Plant Disease and Insect Diagnostic Lab
Department of Entomology & Plant Pathology
127 Noble Research Center
Oklahoma State University
Stillwater, OK 74078
entopl.okstate.edu/pddl
(405) 744-9961
Fax: (405) 744-7373

Contacts:

Jennifer Olson, jen.olson@okstate.edu
Jana Slaughter, gotbugs@okstate.edu

West Virginia

Plant Diagnostic Clinic
West Virginia University
G102 South Agriculture Sciences Bldg.
Morgantown, WV 26506-6108
anr.ext.wvu.edu/pests/plant-diagnostic-clinic
(304) 293-8838
Fax: (304) 293-6954

Contact:

MM (Mafuz) Rahman, mm.rahman@mail.wvu.edu

Wisconsin

Plant Disease Diagnostics Clinic
Department of Plant Pathology
1630 Linden Drive
University of Wisconsin-Madison
Madison, WI 53706-1598
pddc.wisc.edu
(608) 262-2863
Fax: (608) 263-2626

Contact:

Brian Hudelson, bdh@plantpath.wisc.edu

Pesticide Applicator Safety Education Programs

Below are the state pesticide education programs that provide training and educational materials for becoming a certified pesticide applicator. Find other state pesticide safety education programs at www.ipmcenters.org/contacts/PSEPDirectory.cfm.

University of Arkansas

www.uaex.edu/farm-ranch/pest-management/education-licensing.aspx

University of Illinois

web.extension.illinois.edu/psep

Iowa State University

www.extension.iastate.edu/psep

Kansas State University

www.k-state.edu/pesticides-ipm

University of Kentucky

pest.ca.uky.edu/PSEP/welcome.html

University of Missouri

pat.missouri.edu

Missouri State University

www.

University of Nebraska - Lincoln

pested.unl.edu

Ohio State University

pested.osu.edu

Oklahoma State University

pested.okstate.edu

Purdue University

ppp.purdue.edu

West Virginia Department of Agriculture

agriculture.wv.gov/divisions/regulatoryandenvironmental/pesticides/Pages/Certification-and-Licensing.aspx

University of Wisconsin

ipcm.wisc.edu/pat

Pesticide Emergency and Poison Control Centers

Nationwide phone numbers:

Pesticide Poisoning: Call the **Poison Center**
(800) 222-1222
This number will automatically connect you to
the poison center nearest you.

National Pesticide Information Retrieval System
(NPIRS): (765) 494-6616

National Pesticide Information Center:
(800) 858-7378
CHEMTREC (800) 424-9300

■ Arkansas

Arkansas Poison Center: (800) 222-1222
Arkansas State Plant Board: (501) 225-1595
Pesticide training, licensing, and education
for applying restricted use pesticides.

■ Illinois

Illinois Poison Control Centers Emergency
Nationwide: (800) 222-1222
Emergency TTY/TDD: (312) 906-6185

■ Indiana

Indiana Poison Center: (800) 222-1222,
Pesticide Poisoning
Indiana Department of Environmental
Management: (765) 233-7745,
Pesticide Spill Reporting
Purdue Pesticide Programs: (765) 494-4566,
General Information
Office of Indiana State Chemist: (765) 494-1492,
Pesticide Certification and Training
Environmental Protection Agency Region 5:
(312) 886-5220

■ Iowa

Iowa Statewide Poison Control Center Emergency
Phone Number: (800) 222-1222
Administrative Phone Number: (712) 279-3710
www.iowapoison.org
poisonpal@iowapoison.org
A joint effort by St. Luke's Regional Medical Center,
Iowa Health System and University of Iowa Hospitals
and Clinics: 2720 Stone Park Blvd., Sioux City, Iowa
51104

■ Kansas

Poison Control Center, University of Kansas
Hospital:
(800) 222-1222
Kansas City residents may phone: (913) 588-6633
Emergency TDD: (913) 588-6639
www.kumed.com/poison
poisoncenter@kumc.edu

■ Kentucky

Kentucky Regional Poison Control Center:
(800) 222-1222
Metro Louisville residents may phone:
(502) 589-8222
KY Environmental Response: (800) 928-2380
or (502) 564-2380

■ Minnesota

Minnesota Poison Control System
Emergency or Urgent Question: (800) 222-1222
Local Number: (612) 873-3141
www.mnpoison.org
Hennepin County Medical Center, 701 Park Avenue,
Mail Code RL, Minneapolis, MN 55415

■ Missouri

Missouri Poison Center: (800) 222-1222
St. Louis residents may phone: (314) 772-5200
www.cardinalglennon.com/Pages/Poison.Center.aspx

■ Nebraska

Nebraska Regional Poison Center: (800) 222-1222
Anyone with a poisoning emergency can call the toll-free
telephone number for help. Personnel at the Resource
Center will give you first-aid information and direct you
to local treatment centers if necessary.

■ Ohio

Ohio Poison Exposure Centers: (800) 222-1222
TDD number: (800) 253-7955
All calls will be automatically routed to the regional Ohio
Poison Exposure Center closest to you. This number
should be called to receive medical assistance if you are
involved in a pesticide exposure poisoning.

■ Oklahoma

The Oklahoma Poison Control Center:
(800) 222-1222
www.oklahomapoison.org

■ West Virginia

West Virginia Poison Control Center:
(800) 222-1222
Charleston, WV residents may call: (304) 388-4211
Pollution, Toxic Chemical & Oil Spills, National:
(800) 424-8802
West Virginia Department of Natural Resources:
(800) 642-3074

■ Wisconsin

(800) 222-1222 (statewide, emergency)
Madison (608) 262-3702 (non-emergency)
Milwaukee (414) 266-2222 (non-emergency)

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 in)	30.5 centimeters
	1 Yard (3 ft)	0.91 meters
	1 Mile (5,280 ft)	1.6 kilometers
Area	1 Square Inch	6.5 square centimeters
	1 Square Foot (144 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.

Notes

Notes

Midwest Fruit Pest Management Guide 2018

The *Midwest Fruit Pest Management Guide 2018* was developed by the Midwest Fruit Workers Group.

This publication combines two longtime guides that have become familiar to countless growers: the annual *Midwest Small Fruit and Grape Spray Guide* and the annual *Midwest Tree Fruit Spray Guide*.

Printed copies of this publication are available from the Purdue Extension Education Store, www.edustore.purdue.edu. A free PDF download also is available from the Education Store, or from your state's cooperative extension service.

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