

Midwest Fruit Pest Management Guide 2019-2020

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About This Guide

The ***Midwest Fruit Pest Management Guide*** 2019-20 was developed by the Midwest Fruit Workers Group.

Members of the Midwest Fruit Workers Group decided to combine these publications to address the needs of many producers who grow many different crops. We hope this new combined publication makes it easier for producers to find the accurate information they need for managing pests in fruit crops. ***We believe this new format provides 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 every other 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 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 of printing, 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. It is available from the Purdue Extension Education Store, www.edustore.purdue.edu.

Your responsibility as a pesticide user is 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.

Midwest Fruit Pest Management Guide 2019-2020

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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 with 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 158-159. 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 no contamination of crops or

- water supply can occur. Do not reuse 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.

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.
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 on product labels. Pesticide labels include specific information about use, personal protective equipment, environmental precautions, and storage and disposal. The label's purpose is to provide clear directions to allow maximum product benefit while minimizing risks to human health and the environment.

Every pesticide label includes the following 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, and follow pesticide label directions to ensure effective pest control,

personal safety, environmental protection, and legal compliance.

Pesticide labels include two 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 have 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 is often 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. Pesticide labels address greenhouse applications in one of three ways:

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

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 riskier 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.

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.

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 but 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 helps convert from the rate per 100 gallons to the rate per gallon. Take care to measure pesticide amounts accurately, because errors are 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 there are no leaks. Take the nozzles apart, clean them, and check for worn nozzle tips.

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

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).

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

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

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

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

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. 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 achieve a satisfactory spray pattern only 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 to make a proper spray mix. Failing to calibrate the sprayer 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 using 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 are using 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. Select the correct size nozzles and whirlplates by using a table that 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.

Arrange nozzles in the sprayer manifold so approximately *two-thirds of the total flow comes from nozzles in the upper half* of the manifold, and *one-third 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 an 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. 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 (pH above 7.0). Both well and pond water in the Midwest tend to be alkaline. 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 especially vulnerable to alkaline hydrolysis.

To ensure the maximum effectiveness of pesticide applications, check the pH of spray mixes in the spray tank and add buffering agents if necessary to adjust the pH to neutral (7.0). Many commercial buffering agents are available, and the list is too long to include all of them. Most adjuvants (see definition in the

next section) are multipurpose 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 gals. 1/4 cup, slightly rounded

per 300 gals. 3/4 cup, rounded

per 500 gals. 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. Mixing wettable powders with emulsifiable concentrates may result in 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. Insect pests also 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 94 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, starting fungicide applications early to protect new growth is essential. That said, successful growers understand the limits of what fungicides can do, and they consider pesticide cost and the risk of disease when deciding which fungicide to use and when to use it.

With proper timing and application, captan, mancozeb, Syllit plus mancozeb or captan, or captan plus

mancozeb ("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, Merivon, Pristine, Procure, Rally, or Sovran, which can improve management and best utilize these fungicides' systemic nature.

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 pesticides: 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 1/4-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), SI fungicides (Rally, Indar, Topguard, and Procure) and SDHI fungicides (Aprovia, Fontelis), along with pre-mix 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 4 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 32.		

(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 33.
	Captan 80WG PLUS Mancozeb 75DF	2-2.5 lbs.	This highly recommended tank mix (often called “captoze”) 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. It is better deployed later in the season.
	Polyram 80DF	6 lbs.	See Note About Mancozeb and Polyram (EBDC Products), page 24.
	Rhyme	6.5 oz.	Although labeled for scab as early as green tip, this product is better deployed later in the season as it also controls powdery mildew, rust, and summer rots.
	Scala 5SC	7-10 fl. oz.	Most effective at temperatures below 70°F.
	wettable sulfur	See label	Sulfur is formulated as dusts, liquids, and wettable powders (e.g., wettable sulfur, Microthiol Disperss, Cosavet, Microfine Kumulus, Liquid Sulfur Six, and Dusting Sulfur). Formulations can vary from 80% to 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: Captan 80WDG Mancozeb 75D	1.5-3 pts.	If your orchard has a long history of Syllit (Cyrex) use, fungicide resistance may be a problem.
		2.0 lbs.	
		2.25 lbs.	
	Vanguard 75WG	5 oz.	Most effective at temperatures below 70°F.
	Ziram 76DF	6 lbs.	
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 ensure thorough coverage of all woody tissue.
	Lorsban Advanced 4E	0.5-4 pts.	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 75WG	2-2.67 lbs.	
	Supracide 25WP	4-12 lbs.	
	Diazinon AG 600WBC	Must be applied as a dilute spray. (12.75 fl. oz./100 gal. water in >300 gal./acre).	

Apple Green Tip (continued)

Pest/Problem	Material	Rate/Acre	Comments
San Jose scale, European red mite eggs, aphid eggs (continued)	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 ensure thorough coverage of all woody tissue.
	Lorsban Advanced 4E	0.5-4 pts.	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 75WG	2-2.67 lbs.	
	Supracide 25WP	4-12 lbs.	
	Diazinon AG 600WBC	Must be applied as a dilute spray. (12.75 fl. oz./ 100 gals. water in >300 gals./acre).	

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 14. 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 controls 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.	Vydate at 4-8 pts/A controls aphids
	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 80 WDG	5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 33.
	Captan 80 WDG PLUS Mancozeb 75DF	2.5-4lbs.	This tank mix is often called "captoze." See notes for Apple Green Tip, page 14.
		3 lbs.	
	Mancozeb 75DF	6 lbs.	See Note About Mancozeb and Polyram (EBDC Products), page 24.
	Polyram 80DF	6 lbs.	See Note About Mancozeb and Polyram (EBDC Products), page 24.
	Rhyme	6.5 oz.	Continue applications through the duration of primary scab on a 7-10 day interval. Mix with mancozeb or captan for resistance management.
	Scala 5SC	7-10 fl. oz.	77-day PHI.
	wettable sulfur	See label	See comments for Apple Green Tip, page 14.
	Syllit FL PLUS ONE OF THE FOLLOWING: Captan 80WDG Mancozeb 75DF	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 33.
		2.25 lbs.	
	Vanguard 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.	
	Captan 80 WDG PLUS Mancozeb 75DF	2.5-4 lbs.	
		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.

(continued)

Apple Tight Cluster *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
scab, rust, powdery mildew 7-10-day interval <i>(continued)</i>	Mancozeb 75DF	6 lbs.	See Note About Mancozeb and Polyram (EBDC Products), page 24. Not effective for powdery mildew.
	Polyram 80DF	6 lbs.	
	Merivon	4-5.5 fl. oz.	Do not use with captan or EC-formulated products; less effective on rust.
	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 Trionic	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.
	Rhyme	6.5 oz.	Initiate applications at green tip or when environmental conditions are favorable for primary scab development. Continue applications through the duration of primary scab on a 7-10 day interval. Mix with mancozeb or captan for resistance management.
	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: Captan 80WDG Mancozeb 75DF	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.
		2 lbs.	
		2.25 lbs.	
	Topguard Fungicide Specialty Crops	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, Rhyme, Bayleton, Rubigan, Indar, Inspire Super, Procure, Mancozeb, Polyram, Ziram, Flint, Sovran, Topguard Fungicide Specialty Crops, and Pristine control rust; Topsin-M and Captan do 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.	
	Versys Inscalis 0.83SC	1.5 fl. oz.	

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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	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) kill predaceous mites that feed on European red mite and twospotted spider mite, thereby triggering outbreaks of these pests. Use pyrethroids only if the potential for plant bug and stink bug damage is high.
	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.	
	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 33 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 2 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 MARYBLTY. 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.
	Labeled but not recommended The products below are registered for fire blight control, but are only needed in orchards with a history of streptomycin resistance.		
	FireLine 17WP Firewall	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 23 for information about how to use traps to determine optimal insecticide timing.
codling moth (control)	See Mating Disruption for Codling Moth Control, page 31. Additional products and formulations also are available; however, they 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. 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 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	Petal fall is a key time to control 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 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	0.5-1 lb.	
	Belay 2.13SC	4-6 fl. oz.	
spotted tentiform leafminer (larvae)	The products listed above for all three pests OR		Treat if miners average two or more per leaf and larvae are still in the initial sap-feeding stage on the underside of the leaves.
	Epi-Mek 0.15EC	10-20 fl. oz.	Apply with horticultural oil or a penetrating surfactant.

(continued)

Apple Petal Fall *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
spotted tentiform leafminer (larvae) <i>(continued)</i>	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 leaf-hopper	The products listed above for all three pests OR		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 XLO	2 pts.	
	Epi-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.
	Versys Inscalis 0.83SC	1.5 fl. oz.	Use 3.5 fl. oz. for woolly apple aphid control.
mites	Apollo 4SC	4-8 fl. oz.	
	Savey 50DF	3-6 oz.	
	Epi-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 XLO	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 32.
	Nealta 1.67SC	13.7 fl. oz.	
For thinning summer varieties	See Chemical Thinning of Apples, page 36.		
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 33 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)	Aprovia	5.5-7 fl. oz.	The addition of a spreader or penetrating adjuvant such as organo-silicon blends with either non-ionic surfactants (NIS) or vegetable oils (COC; not mineral); or NIS with 90% concentration is recommended. These include but are not limited to Widespread Max or Bond.
	Captan 80WDG	5 lbs.	
	Captan 80WG PLUS Mancozeb 75DF	2-2.5 lbs. 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: Captan 80WDG	1-1.5 lbs. 3 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. Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 33.
	Mancozeb 75DF	3 lbs.	77-day PHI. 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 orchards with minimal issues of fungicide resistance	For powdery mildew control after second cover, make applications based on field history and orchard scouting. Fungicide Resistance Management: See comments on page 32.		
	Aprovia	5.5-7 fl. oz.	The addition of a spreader or penetrating adjuvant such as organo-silicon blends with either non-ionic surfactants (NIS) or vegetable oils (COC; not mineral); or NIS with 90% concentration is recommended. These include but are not limited to Widespread Max or Bond.
	Bayleton 50WP	2-8 oz.	Not effective for scab control.
	Flint 50WG	2-2.5 oz.	
	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 13.
	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	14.5-18.5 oz.	Do not exceed 2 sequential applications.

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Apple First and Second Cover (continued)

Pest/Problem	Material	Rate/Acre	Comments
scab, rust, powdery mildew, fruit rots, sooty blotch, flyspeck (continued)	Procure 480SC, Trionic	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.	
	Rhyme	4-6.5 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.	30-day PHI.
	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 Fungicide Specialty Crops	Rusts and powdery mildew: 8-12 fl. oz. Scab: 13 fl. oz.	Does not contain azoxystrobin. 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 33.
	Mancozeb 75DF	3 lbs.	77-day PHI. 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 50-250 degree days after biofix; see Mating Disruption for Codling Moth Control, page 31. 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.
	Entrust SC	6-10 fl. oz.	
	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, Assail, Belay, 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, Lannate, Proclaim, Avaunt, Intrepid, or Rimon as listed at Apple Petal Fall, page 20.		
mites	Same as for mites at Apple Petal Fall, page 21. See Insecticide and Miticide PHIs and REIs, pages 124-125.		

(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 Prime	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 36.		
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 33. 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. The application of mancozeb from bloom through first cover contributes to the prevention of bitter rot in highly susceptible varieties, like Honeycrisp:

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 using the 3 lb. per acre rate.

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.

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 quarter to half-inch green tip, and continue on a 7- to 10-day schedule through bloom. **DO NOT:** (1) apply more than 6 lbs. Mancozeb per acre per application; (2) apply more than 24 lbs. 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 lbs. per acre per application; (2) apply within 77 days of harvest; (3) apply more than 21 lbs. 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.**

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.	
	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.	
	Flint Extra	2.5-2.9 fl. oz.	28-day PHI..
	Fontelis	16-20 fl. oz.	28-day PHI.
	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	14.5-18.5 oz.	12-hour PHI.
	Rhyme	4-6.5 oz.	Do not apply within 14 days of harvest.
	Sercadis	3.5-4.5 oz.	
	Sovran 50WG	4-6.4 oz.	
	Topguard Fungicide Specialty Crops	powdery mildew: 8-12 fl. oz. Scab: 13 fl. oz.	Does not contain azoxystrobin. Not labeled for sooty blotch or flyspeck.
	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.	14-day PHI.
sooty blotch, flyspeck only	ProPhyt (phosphorous acid) PLUS	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 4 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 33.
	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. Third and fourth covers are key times to control second generation Oriental fruit moth.		
apple maggot	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. 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. Sevin also kills predaceous mites and can trigger pest mite outbreaks.		

(continued)

Apple Third Cover (continued)

Pest/Problem	Material	Rate/Acre	Comments
apple maggot (continued)	Imidan 70W	2.1-5.75 lbs.	
	Sevin XLR Plus (4L)	1.5-3 qts.	
	Assail 30SG	8 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 scale, 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. Epi-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.		
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, page 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.

(continued)

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.	
	Bacillus thuringiensis (Agree, Dipel, Deliver, others)		Bacillus thuringiensis kills 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 70W	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.	
	Versys Inscalis 0.83SC	3.5 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 27. 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 but are not limited to Agri-Fos, ProPhyt, Phostrol, and Rampart. Several others also may be available or introduced in the near future. Their active ingredient, phosphorous acid, 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.

Managing the Shoot Blight Phase of Fire Blight with Apogee

Apogee is used on apple trees for two reasons:

- To reduce shoot growth because trees are overly vigorous because of crop loss, inappropriate rootstock, tree spacing, or excessive nitrogen fertilization.
- To reduce the risk and reduce susceptibility to fire blight.

Apogee (prohexadione calcium) inhibits gibberellin biosynthesis, which stops terminal growth early. Apogee can decrease the length of shoots by 30 to 60 percent. Apogee does not affect blossom blight occurrence, but when used effectively, reduces the occurrence of shoot blight. Shoots with inhibited growth are less susceptible to fire blight. The decrease in blight susceptibility does not occur until about 10 to 14 days after application. Note that apple varieties differ in their susceptibility to damage from Apogee. Do not apply Apogee to Empire or Winesap varieties, because it causes cracking on these varieties.

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 (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. This means if you spray the tops of trees, Apogee has 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 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.

Applying Apogee in the same season as ProVide reduces the effectiveness of both growth regulators.

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 does 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 (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. Apogee is rainfast after 8 hours. (REI is 12 hours; PHI is 45 days.)

Application Rates for Vegetative Growth Control in Apples

Application Timing	Apogee plant growth regulator Rate per 100 gallons of Dilute Spray ¹ (oz)	Apogee Rate per acre ² (oz)	Restrictions
Medium to high vigor trees Apply at 1-3 inches of new shoot growth. For best results, make subsequent applications at 1- to 4-week intervals and before or immediately after the shoots show signs of regrowth.	6 to 12	18 to 36	DO NOT apply more than 48 oz./A (3 lbs.) of Apogee within any 21-day interval. DO NOT apply more than 99 oz./A (6.2 lbs.) of Apogee per year.
Low vigor trees Apply at 1-3 inches of new shoot growth. For best results, make subsequent applications at 1- to 4-week intervals and before or immediately after the shoots show signs of regrowth.	3 to 8	9 to 24	
Long growing season Apply at 1 to 3 inches of new shoot growth. Make second and third applications at 7- to 14-day intervals. Make subsequent applications as needed at 10- to 14-day intervals.	3 to 8	9 to 24	

¹Refer to the **Application Instructions** section for rate calculations on the label.

²Based on 300 gallons of dilute spray per acre.

Application Rates for Fire Blight Infections of Shoots (Shoot Blight) for Susceptible Apple Varieties

Application Timing	Apogee plant growth regulator rate per 100 gallons of Dilute Spray ¹ (oz)	Apogee Rate per acre ² (oz)	Restrictions
To reduce fire blight infections of shoot by decreasing vegetative growth Apply at 1-3 inches of new shoot growth. Make a second application if new shoot growth occurs.	6 to 12	18 to 36	DO NOT apply more than 48 oz./A (3 lbs.) of Apogee within any 21-day interval. DO NOT apply more than 99 oz./A (6.2 lbs.) of Apogee per year.

¹Refer to the **Application Instructions** section for rate calculations on the label.

²Based on 300 gallons of dilute spray per acre.

Selected Apple Varieties and Their 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	On spur type, begin first application 2 weeks after bloom, followed by an application 2 weeks later, and then 2 weeks after for medium-size trees.
phytotoxic	Empire, Winesap	Do not use.

Kudos is a generic formulation of prohexidione calcium, the active ingredient in Apogee.

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, 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 40.

Insect populations 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. 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, you also need to make border sprays or at least one or two cover sprays. Controlling codling moth by mating disruption does 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 and about 1 1/2 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. Annual cicadas ordinarily 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 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 1/2 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 grapevines 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 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 do not provide complete control. Using both methods probably does 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 effective only against insects the sprays contact at the time of application. These sprays provide no residual control. Many questions about their efficacy 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 more effective for aphid and (especially) mite control than M-Pede. Data from Michigan indicate that adding M-Pede at 2 percent by volume to full-rate sprays of Vendex, Kelthane, and presumably other miticides, greatly enhances the control they provide.

Phytotoxicity, leaf drop, and fruit blemishes should be major concerns when deciding 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 russetting, 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 are 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.

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.

Fungicide Resistance Management

Many of our most effective fungicides have a high risk for evolving fungicide resistance in the fungi they control. These include Topsin-M, Scala, Vanguard, the sterol-inhibiting fungicides (Rally, Rhyme, Rubigan, Indar, Inspire Super, and Procure); the strobilurin fungicides (Sovran, Pristine, and Flint); and the succinase dehydrogenase inhibiting fungicides (Aprovia, Fontelis, Luna Sensation, Luna Tranquility, and Merivon). Because they all have 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.

To delay resistance development, never use these fungicides alone in a season-long program and use them as little as possible. Most of the newer fungicides limit 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 should be made without alternating with another fungicide with a different mode of action. The sterol-inhibiting fungicides, strobilurin fungicides, and succinase dehydrogenase inhibiting fungicides have 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 pre-mix. For example, if you use Pageant (a pre-mix of a strobilurin and SDHI fungicide; FRAC11+7), avoid using Sovran or Flint (FRAC11), the Luna series (FRAC 7+11; FRAC 7+3; FRAC 7+9), or Merivon (FRAC 7+11), all of which contain either a strobilurin (FRAC 11) or an SDHI (FRAC 7). Do not rotate with Fontelis and Aprovia, which are SDHI fungicides (FRAC 7).

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 pit 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:

- Apply lime to raise the soil pH to around 6.5 to make calcium more available for tree uptake.
- 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.
- 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.

- Adjust fruit density by chemically thinning fruit in heavy cropping years to avoid a light crop and calcium disorders the following year.
- 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 cultivars most susceptible 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 1.5-2 pounds of calcium chloride dissolved in 400 gallons or more of water per acre. Begin applying calcium in the first cover spray. Apply this spray to runoff.

Special Notes for Growth Regulator Use in Apples

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.
4. Cause premature fruit drop, particularly on spur-type 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 does 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 aminothoxy-vinylglycine (AVG), 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 (11.7 oz.) or two pouches per acre. 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 in the morning or evening. Thorough wetting and coverage are essential for optimum effectiveness. Although ReTain seems to be compatible with other materials, it should be applied alone. Do not apply if rain is expected within eight hours of application.

Additives. Including a 100% organosilicone surfactant (e.g., Widespread Max) for peaches is absolutely critical for good results.

For Increasing Fruit Set

ReTain is labeled to increase fruit set on apples, European pears, peaches, and cherries. Make a single application from pink to bloom on apple, from white bud to full 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, use it only on high-value, productive blocks with good fruit quality. Store treated fruit separately.

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 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, because excess moisture can induce russet. Direct 85 percent of the spray volume to the upper two-thirds of the tree.

Stayman Cracking

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-methyl-carbamate), 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.

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 do 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" results in better fruit size at harvest than the same amount of fruit thinning obtained by the full dosage of NAA alone.

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

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 is 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.

There are two options on mature trees with a heavy set:

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 best results under slow drying conditions and is often applied in the evening.

Thorough spraying and uniform coverage are necessary for satisfactory results. However, to reduce the degree of thinning or avoid 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 is 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 effectively defruits 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.

Recommended Chemical Thinners for Apple¹

Cultivars	NAD ^{2,3,4} (PPM)	NAA ^{2,4} (PPM)	NAA2 + 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	7 1/2-12	3-5	1/4-1/2	E	
Jonathan	35-50	7 1/2-12	3-5	1/4-1/2	E	
Spartan		10-15	5-7 1/2	1/2-1	?	
Cortland	35-50	7 1/2-12	3-5	1/4	E	
Grimes Golden	35-50	5-10	5-7 1/2		?	NAD 25-50 + Sevin 1/2-1
Red Delicious/non-spur		5-10	3-5	1/2-1	E	
Red Delicious/spur		5-10	5-7 1/2	1/2-1	M	
Honeycrisp		3-5		1/4-1/2	?	N.R.
Empire		10-15	5-7 1/2	1/2-1	E	
Golden Delicious		10-20	5-10	1/2-1	M	NAA 5-10 + Sevin 1/2-1
Blushing Golden				1/4-1/2	?	
Firmgold				1/4-1/2	?	
Idared				1/2-1	E	
Winesap	35-50	7 1/2-10	3-5	1/2-1	E	
Stayman and Turley	35-50	7 1/2-10	3-5	1/2-1	M	
Braeburn		7 1/2	7 1/2			NAA 7 1/2 + Sevin 1
Rome	50-60	15-20	7 1/2-10	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.

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 (page 37) 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.).

NAA Formulations

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

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.

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	E	E	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	—	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	E	G
Omega ³	E-G	—	F4	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	—	F4	F	E
Sovran ²	E	G	E	G	G	E
Sulfur	F	G	O	F	—	P
Syllit ²	E	O	P	P	-	P
Topguard	E	E	E	—	—	—
Topsin-M ²	P	G	O	G	E-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	3A	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	—

(continued)

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

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
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	—	—	—	—
Versys Inscalis	9D	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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	—
Envior	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.

²See list of generic products on page 152.

Sprout and Sucker Control on Apple and Pear

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. 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 treats 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.

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 pesticides: 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. However, never combine copper sulfate alone with dormant oil.

Pear Late Dormant

Apply 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.	
	Esteem 35WP	5 oz.	Single treatment during delayed dormant to pink stage.
	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	2%	
	Sivanto Prime	10.5-14 fl. oz.	
	Surround WP	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.	Check label as generic products may vary. Use either the Pre-bloom (6 lbs.) or Extended Application (3 lbs.) schedule. See Restrictions on EBDC Products, page 24. Generic product include Roper, Koverall, Penncozeb 75 DF.
	Merivon	4-5.5 fl. oz.	Do not apply with EC or oil-based products.
	Pristine	14.5-18.5 oz.	Also controls powdery mildew. Refer to label for rates.
	Procure 480SC	8-16 oz.	Also controls powdery mildew. Refer to label for rates.
	Scala SSC	7-10 fl. oz.	77-day PHI.
	Sovran 50WG	2-2.5 oz.	Also controls powdery mildew. Refer to label for rates.
	Syllit FL PLUS	1.5-3 pts.	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.
	Mancozeb 75DF	2.25 lbs.	
	Topguard	13 fl. oz.	
	Topsin-M WSB	1 lb.	
	Vanguard 75WG	5 oz.	
	Ziram 76DF	6 lbs.	
powdery mildew	Torino	6.8 oz.	Only effective for powdery mildew
pear psylla (hatching eggs)	Esteem 35WP	4-5 oz.	
	Dimilin 25W	2.5-3 lbs.	
	Dimilin 2L	40-48 fl. oz.	
	Portal XLO	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 WP	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 43. 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.	Generic products include AgriStrep, Strep, AgriMycin, Firewall Start fire blight sprays at first sign of open blossoms. Repeat sprays at 4- to 5-day intervals through bloom and petal fall on highly susceptible varieties. A minimum of two applications are necessary to provide control. If warm, wet weather occurs during bloom, use maximum rate of streptomycin of 100 ppm (0.5 lb./100 gals.).
	Streptomycin 17W PLUS	1 lb.	
	Regulaid	1 pt.	

(continued)

Pear Bloom (continued)

fire blight (continued)	Labeled but not recommended These products are registered for fire blight control, but are only needed in orchards with a history of streptomycin resistance.		
	Mycoshield 17WP	16 oz./200 ppm.	Any OTC (OxyTetracycline Calcium) 200 ppm (1 lb./ 100 gals. water).
	FireLine	16 oz./200 ppm.	
	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 43.		
fire blight	Same as for Pear Bloom, pages 43-44. Continue sprays for fire blight until the last petals have fallen.		
plum curculio, tarnished plant bug, stink bugs	Imidan 70W	2.13-5.75 lbs.	Plum curculio only.
	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	2-2.4 fl. oz.	Maximum rate for tarnished plant bug is 2.4 fl. oz.; plum cuculio rate is 2.4–2.8 fl. oz.
	Mustang Maxx 0.8EC	1.28-4 fl. oz.	
pear psylla (nymphs)	Esteem 35WP	4-5 oz.	
	Epi-Mek 0.15EC	10-20 fl. oz.	Apply with 1% oil. Control is 3-4 weeks at 10 oz. rate. Control is season-long at 20 oz. rate.
	Agri-Mek SC	2.25-4.25 fl. oz.	Must be mixed with an adjuvant.
	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 fl. oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Sivanto Prime	10.5-14 fl. oz.	
	Surround WP	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 43. 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.		
	Epi-Mek 0.15EC	10-20 fl. oz.	
	Nexter 75WP	6.6-10.7 fl. oz.	Also suppresses pear psylla.
	Nexter SC	11-17 fl. oz.	
	Envidor 2SC	16-18 fl. oz.	
	Portal XLO	2 pts.	
	Movento 2SC	6-9 fl. oz.	
codling moth, plum curculio	Same as for plum curculio at Pear Petal Fall, page 44. 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 32). 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.	For codling moth only.
	Exirel 0.83 SE	8.5-20.5 fl. oz.	
pear psylla	Same as at Pear Petal Fall, page 44. 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 43. 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	Imidan 70W	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 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 44 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 SC	2.25-4.25 fl. oz.	Must use with an adjuvant.
	Epi-Mek 0.15EC	10-20 fl. oz.	
	Acramite 50WS	0.75-1 lb.	
	Portal XLO	2 pts.	
	Kanemite 15SC	21-31 fl. oz.	
	Envirdor 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 XLO	2 pts.	
	Movento 2SC	6-9 fl. oz.	
	Centaur 70WDG	34.5-46 oz.	
Stink bugs	Baythroid XL 1EC	2-2.4 fl. oz.	
	Belay 2.13SC	4-6 fl. oz.	
	Brigade 2EC	2.6-12.8 fl. oz.	
	Mustang Maxx 0.83EC	1.28-4 fl. oz.	
	Proaxis 0.5EC	2.56-5.12 fl. oz.	
	Warrior II 2.08CS	1.28-2.56 fl. 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		
	Aframe plus	14 fl. oz.	A pre-mix of azoxystrobin (FRAC 11) and propiconazole (FRAC 3). Be careful with subsequent rotations; avoid back-to-back applications of stobis (FRAC11) products.
	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 XBF	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan. Maximum of 3 applications per season.
	Tilt	4 fl. oz.	Do not exceed 8 applications or 48 fl. oz. per acre per season for Orbit. Do not exceed 20 fl. oz./ year for Tilt. *Generics names include various Propiconazole trade names.
	Pristine	10.5-14.5 oz.	Do not exceed 2 sequential applications before alternating to a non-FRAC Group 11 fungicide with a different mode of action.
	Procure 480SC	8-16 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, Suncrisp, Zestar! These fungicides are labeled for use only on stone fruit, but drift or improper sprayer cleaning could damage apple fruit.
	Quash	2.5-4 oz.	Do not apply more than 12 oz. per acre per year.

(continued)

Cherry Early Bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight) (continued)	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 labeled for use only on stone fruit, but drift or improper sprayer cleaning 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 apply 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.	Many sulfur compounds are registered. See label for appropriate rate. Can be used between petal and harvest. Must be reapplied frequently in wet seasons.
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Start application at 1-5% bloom followed by an application at 50-100% bloom. This product includes 2 active ingredients — FRAC groups 3 and 11.
	Topsin M70 WSB	1- 1.5 lbs.	Not available in IA, KS; other generic formulations may be available for purchase in these states.
	Ziram	5-6 lbs.	Two different formulations (76DF and XCEL), same rate, read and follow the labels.

Cherry Full Bloom

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight)	Same as for Cherry Early Bloom, page 47.		
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, page 47. 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 47-48) may be used for both brown rot and leaf spot. Do not apply Bravo after shuck fall.		
Tart cherry is more susceptible to leaf spot than is sweet cherry. See Cherry Leaf Spot Management, page 54.			
leaf spot	Aframe	12-15 oz.	Contains azoxystrobin, a fungicide known to cause phytotoxicity on these apple cultivars: Braeburn, Cortland, Gala, GoldRush, Hampshire, Jonamac, Macintosh, Silken, Spigold, Suncrisp, and Zestar! These fungicides are labeled for use only on stone fruit, but drift or improper spray tank cleaning could damage apple fruit.
	Aframe Plus	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-FRAC Group 11 fungicide with a different mode of action.

(continued)

Cherry Petal Fall (continued)

Pest/Problem	Material	Rate/Acre	Comments
leaf spot (continued)	Fontelis	14-20 fl. oz.	Do not exceed 61 fl. oz. per acre per year.
	Gem 500SC/Flint Extra	1.9-3.8 oz.	Gem* is being replaced by Flint Extra.
	Indar 2F	6 fl. oz.	
	Luna Experience	6-10 oz.	
	Luna Sensation	5-7 fl. oz.	
	Merivon XBF	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan. Maximum of 3 application per season.
	Pristine	10.5-14.5 oz.	Do not make more than 2 sequential application of Pristine or other FRAC Group 7 or 11 fungicides.
	wettable sulfur	See label	Can be used between petal and harvest. Must be reapplied frequently in wet seasons.
	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.	Do not exceed 61 fl. oz. per acre per year.
	Gem, Flint Extra	1.9-3.8 oz.	Gem is being replaced by Flint Extra.
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-10 oz.	
	Luna Sensation	5-5.6 fl. oz.	
	Pristine	10.5-14.5 oz.	
	Procure 480SC	10-16 oz.	
	Quash	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 70W	2.13-2.5 lbs.	Do not use on sweet cherries.
	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. Tart cherry is more susceptible to leaf spot than sweet cherry. See Cherry Leaf Spot Management, pages 54.

Pest/Problem	Material	Rate/Acre	Comments
leaf spot	Abound Aframe	12-15 oz.	Azoxystrobin only. Contains azoxystrobin, a fungicide known to cause phytotoxicity on these apple cultivars: Braeburn, Cortland, Gala, GoldRush, Hampshire, Jonamac, Macintosh, Silken, Spigold, Suncrisp, and Zestar! These fungicides are labeled for use only on stone fruit, but drift or improper sprayer cleaning could damage apple fruit.
	Aframe Plus	14 fl. oz.	
	Bravo Weather Stik and other chlorothalonil products	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.
	Flint Extra	2.5-3.8 fl. oz.	
	Fontelis	14-20 fl. oz.	
	Gem, Flint Extra	1.9-3.8 oz.	Gem is being replaced by Flint Extra.
	Indar 2F	6 fl. oz.	
	Inspire Super	16-20 fl. oz.	
	Luna Experience	6-10 oz.	
	Luna Sensation	5-7.6 fl. oz.	
	Merivon XFB	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, Suncrisp, and Zestar! These fungicides are labeled for use only on stone fruit, but drift, or improper sprayer cleaning could damage apple fruit.
	Rally 40WSP	2.5-6 oz.	
	Topguard EQ	6-8 fl. oz.	
	Topsin-M 70 WSB PLUS	1.5 lbs.	Other formulations are available, such as 4L and 50WP. See Use of Captan Fungicide on Tree Fruit-Restricted Entry Intervals (REI), page 33.
	Captan 80WDG	2.5 lbs.	

Cherry First Cover Spray

10 days after shuck fall. The timing of the first cover spray after shuck fall is critical in tart cherry orchards.

Pest/Problem	Material	Rate/Acre	Comments
powdery mildew	Same as for Cherry Petal Fall, page 49.		
plum curculio	Same as for Cherry Petal Fall, page 49.		
leaf spot	Same as for Cherry Shuck Fall except not Bravo, page 50. See Cherry Leaf Spot Management, page 54.		
powdery mildew, leaf spot	Same as for Cherry Petal Fall or a copper fungicide, page 49.		
plum curculio, cherry fruit fly	Imidan 70W	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 at lower rate for plum curculio and at 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 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 50. Do not apply Bravo after shuck fall. See Cherry Leaf Spot Management, page 54.		
powdery mildew	Same as for Cherry Petal Fall, page 49.		
plum curculio, cherry fruit fly	Same as for Cherry First Cover, page 51.		

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, page 47. Do not apply Rovral after petal fall.		
leaf spot	Same as for Cherry Shuck Fall except not Bravo, page 50. Do not apply Bravo after shuck fall. See Cherry Leaf Spot Management, page 54.		
powdery mildew	Same as for Cherry Petal Fall, page 49.		
cherry fruit fly	Imidan 70W	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 2SC	4-8 fl. oz.	
	Altacor 35WDG	3-4.5 oz.	
borer control	See Borers of Peach, Cherry, and Plum Trees, page 76.		

Cherry Pre-harvest Sprays

Beginning 3-4 weeks before harvest.

Pest/Problem	Material	Rate/Acre	Comments
brown rot	Aframe Plus	14 fl. oz.	0-day PHI.
	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 Pre-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 labeled for use only on stone fruit, but drift, or improper sprayer cleaning could damage apple fruit. Check PHI restrictions very carefully.
	Quash	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 labeled for use only on stone fruit, but drift, or improper sprayer cleaning could damage apple fruit. 0-day PHI.
	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 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 70W	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, page 54.		
	Adament 50WG	4-8 oz.	
	Bravo Weather Stik	3-4 pts.	Can be applied on trees after harvest, and would be the fungicide of choice for fungicide resistance management. 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*, Tilt	4 fl. oz.	Do not exceed 8 applications or 48 fl. oz. per acre per season for Orbit. Do not exceed 20 fl. oz./ year for Tilt. *Generics names include various Propiconazole trade names.
	Rally 40WSP	2.5-6 oz.	

(continued)

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.	Do not exceed 61 fl. oz. per acre per year.
	Indar 2F	6 fl. oz.	
	Luna Sensation	5-5.6 fl. oz.	
	Merivon XBF	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Pristine	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 russetting but have negligible effects on photosynthesis and do not noticeably affect yield or fruit quality. Adding lime to COCS (copper oxychloride) is recommended on the label to prevent plant injury.</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>
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.

Special Comments on Cherry Schedule

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 fl. 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.

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.

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			14
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	1
Entrust	5	ST	MT		P	G		G	4	7
Exirel	28	ST	HT		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
bacterial spot	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. As season progresses, reduce the rate of copper applied to reduce the risk of phytotoxicity. Copper applied using tank with a pH of less than 6.5 may result in phytotoxicity issues.
	copper oxychloride (C-O-C-S WDG)	12-15.6 lbs.	
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 75.
mites, San Jose scale	superior oil		Check labels for temperature restrictions.
San Jose scale	Esteem 35WP	4-5 oz.	
	Centaur 70WDG	34.5 oz.	
	Lorsban Advanced 4E	1-4 pt.	
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.	Not labeled for stink bug control.
	Beleaf 50SG	2-2.8 oz.	Not labeled for stink bug control.
	Assail 30SG	5.3-8 oz.	

Peach Pink

Pest/Problem	Material	Rate/Acre	Comments
bacterial spot	copper hydroxide (Kocide 3000) Cuprofix Ultra 40 disperss	1.7 lbs./100 gals. 1.25 lbs./100 gals.	As season progresses, reduce the rate of copper applied, to reduce the risk of phytotoxicity. Copper applied to tanks with a pH of less than 6.5 may result in phytotoxicity issues.
brown rot (blossom blight)	Abound	12-15 fl. oz.	Begin applications at early bloom and continue through petal fall.
	Aframe		
	Aframe Plus	14 oz.	Generic version of Quilt Xcel containing azoxystrobin and propiconazole.
	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 33.
	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 Flint Extra	2.5-3.8 fl. oz.	Replaced Gem 500.
	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.	
	Luna Sensation	5-7.6 fl. oz.	
	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.
	Tilt/Bumper	4 fl. oz.	Apply in a minimum of 50 gals. of water per acre.
	Pristine	10.5-14.5 oz.	
	Rhyme	7 oz.	
	Topguard EQ	6-8 oz.	This is a pre-mix of azoxystrobin and flutriafol. Start applications at 1-5% bloom followed by an application at 50-100% bloom.
	Topguard Specialty Crop	14 oz.	Does not contain azoxystrobin.
	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	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.
	Rhyme	7 oz.	Start applications at 1-5% bloom followed by an application at 50-100% bloom
	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.

(continued)

Peach Pink (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight) (continued)	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° 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 33.
	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.
oriental fruit moth (monitoring)	Put pheromone traps to monitor oriental fruit moth in place now to determine the need for sprays at petal fall (page 60).		
oriental fruit moth (mating disruption)	Isomate-M 100 Isomate M Rosso Isomate OFM TT	100-200 dispensers (depending on product)	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 75.
	CheckMate OFM	108-150 dispensers	
	CheckMate OFM-F Sprayable pheromone	1.32-2.93 fl. oz.	
	Cidetrak OFM-L	100-200 dispensers	

Peach Full Bloom

Pest/Problem	Material	Rate/Acre	Comments
brown rot (blossom blight)	Abound Aframe	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 Plus	14 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 33.
	Elevate 50WDG	1-1.5 lbs.	
	Elite 45WSP	6 oz.	
	Fontelis	14-20 fl. oz.	
	Gem 500SC Flint Extra	1.9-3.8 oz.	Replaced Gem 500SC.
	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.	1-day PHI.
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Orbit, Tilt	4 fl. oz.	Apply in a minimum of 50 gals. water per acre. Other generics available.
	Pristine	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	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.
	Rhyme	7 oz.	For brown rot blossom blight start applications at 5-10% bloom followed by an application at 50-100% bloom. Rhyme and Topguard specialty crop contain the same active ingredient, with Rhyme having a higher rate.
	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.
	Topguard Specialty Crop	14 oz.	7-day PHI. Does not contain azoxystrobin.
	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 33.
	Vangard 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, page 57. 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.	
	copper hydroxide (Kocide 3000)	0.25-0.5 lb./100 gals. 1.5 pint/100 gals.	Note reduced rate of copper applied, to reduce the risk of phytotoxicity. Copper applied to tanks with a pH of less than 6.5 may result in phytotoxicity issues. When using coppers post-bloom, drying conditions should be excellent. Do not apply during extended dews or foggy conditions. Do not apply after shuck split.
	Badge SC Cuprofix Ultra 40 disperss	0.75 lb/100 gals.	
peach scab	Abound Aframe	12.0-15.5 fl. oz.	Begin applications at petal fall and continue at 7- to 14-day intervals in rotation with other products. For peaches, do not exceed 15.5 fl. oz. for scab control.
	Aframe Plus	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 33.
	Flint Extra	2.5-3.8 fl. oz.	Effective against scab. Suppresses brown rot.
	Indar 2F	6 fl. oz.	

(continued)

Peach Petal Fall (continued)

Pest/Problem	Material	Rate/Acre	Comments
peach scab (continued)	Luna Experience	8-10 oz.	35-day PHI.
	Luna Sensation	5-7.6 fl. oz.	1-day PHI.
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Pristine	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.
	Topguard EQ	6-8 oz.	This is a pre-mix 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 Dormant, page 56. OR		
	Exirel 0.83SE	10-20.5 fl. oz.	Not labeled for tarnished plant bug or stink bug. User lower rate for oriental fruit moth; use higher rate for plum curculio.
	Belay 2.13 EC	6 fl. oz.	Not labelled for oriental fruit moth.
	Avaunt 30WDG	5-6 oz.	For plum curculio.
	Apta 1.31EC	21-27 fl. oz.	For plum curculio.
	Imidan 70W	2.13-4.25 lbs.	Not for tarnished plant bug or stink bug.
oriental fruit moth	Any of the products listed above for four species combined OR		
	Entrust 2SC	4-8 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
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.	Oxytetracycline is most effective when applied during extended periods of leaf wetness. Apply within 24 hours of wetting events and allow time for the spray to dry before rain.
	copper hydroxide (Kocide 3000)	0.25-0.5 lbs per 100 gals.	As season progresses, reduce the rate of copper applied to reduce the risk of phytotoxicity. Copper applied to tanks with a pH of less than 6.5 may result in phytotoxicity issues. When using coppers post-bloom, drying conditions should be excellent. Do not apply during extended dews or foggy conditions.
	Badge SE	8 oz./100 gals.	
	Cuprofix Ultra 40 disperss	0.75 lb./100 gals.	
			Do not apply Cuprofix after shuck split.

Peach Shuck Split (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot, scab	Abound	9-15.5 fl. oz.	Begin applications at petal fall and continue at 7-14 day intervals in rotation with other products.
	Aframe		
	Aframe plus	14 oz.	
	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 33. 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.
brown rot, scab (continued)	Fontelis	14-20 fl. oz.	
	Inspire Super	16-20 fl. oz.	
	Luna Experience	8-10 oz.	35-day PHI.
	Luna Sensation	5-7.6 fl. oz.	1-day PHI.
	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	10.5-14.5 oz.	
	Quash	3.5-4 oz.	
	Rhyme	7 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 33.
	Topguard	14 fl. oz.	
	Topguard Specialty Crop	14 oz.	7-day PHI. Does not contain azoxystrobin.
	Topguard EQ	6-8 oz.	Also controls powdery mildew. Higher rate of flutriafol (Topguard) plus azoxystrobin.
	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 33.
	Flint Extra	2.5-3.8 fl. oz.	Effective against powdery mildew and scab. Suppresses brown rot.
	Fontelis	14-20 fl. 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.	1-day PHI.
	Merivon	4-6.7 fl. oz.	Do not apply EC or oil-based products. Do not apply with Bravo or captan.
	Pristine	10.5-14.5 oz.	
	Quash	3.5-4 oz.	Do not apply more than 12 oz. product per acre per year when the maximum rate per application is 4.0 oz. product per acre.
	Quintec 2.08F	7 fl. oz.	
	Rally 40WSP	2.5-6 oz.	
	Rhyme	7 oz.	
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Also controls powdery mildew and scab.
	Topguard Specialty Crop	14 oz.	7-day PHI. Does not contain azoxystrobin.

(continued)

Peach Shuck Split *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
plum curculio, stink bugs, tarnished plant bug	Same as for Peach Petal Fall, page 60.		
plum curculio	Any of the products listed at Peach Petal Fall for the three species combined, page 60. OR		
oriental fruit moth	Same for Peach Petal Fall, page 60.		
green peach aphid	Admire Pro 4.6F	1.4-2.8 fl. oz.	
	Sivanto Prime	7-14 fl. oz.	
	Closer SC	1.5-2.75 fl. oz.	
	Beleaf 50SG	2-2.8 oz.	
	Movento 2SC	6-9 fl. oz.	
	Versys Inscalis 0.83SC	1.5 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.	
	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.	
	Epi-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
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.	Oxytetracycline is most effective when applied during extended periods of leaf wetness. Apply within 24 hours of wetting events and allow time for the spray to dry before rain.
	Badge SC copper hydroxide (Kocide 3000)	8 fl. oz. /100 gals. 0.13 lb. per 100 gals.	As season progresses, reduce the rate of copper applied to reduce the risk of phytotoxicity. Copper applied to tanks with a pH of less than 6.5 may result in phytotoxicity issues.
brown rot, scab	Abound Aframe	12.0-15.5 fl. oz.	Begin applications at petal fall and continue at 7-14 day intervals in rotation with other products.
	Aframe plus	14 oz.	For brown rot on fruit, apply as needed, a maximum of 2 sprays of Aframe Plus, during the preharvest period up to the day of harvest. Make the 2 applications no closer than 10 days apart.
	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 33. Do not exceed 30 lbs. of captan per season.
	Flint Extra Gem 500SC	2.5-3.8 fl. oz.	Effective against powdery mildew and scab. Suppresses brown rot.
	Fontelis	14-20 fl. oz.	
	Indar 2F	6 fl. oz.	

(continued)

Peach First Cover (continued)

Pest/Problem	Material	Rate/Acre	Comments
brown rot, scab (continued)	Inspire Super	16-20 fl. oz.	
	Luna Experience	8-10 oz.	Do not exceed 34 oz. per acre per year.
	Luna Sensation	5-7.6 fl. oz.	1-day PHI.
	Merivon	4-6.7 fl. oz.	Do not apply with an EC or oil-based products. Do not apply with Bravo or captan.
	Pristine	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	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 be use where drift might affect apples.
	Rhyme	7 oz.	
	wettable sulfur 90%	10-30 lbs.	
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Also controls powdery mildew and scab.
	Topguard Specialty Crop	14 oz.	7-day PHI. Does not contain azoxystrobin.
	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 33.
	Ziram 76DF	4.5-8 lbs.	
powdery mildew	Abound	12-15.5 oz.	Begin application at the onset of disease as a protectant fungicide and continue on a 7- to 14-day schedule.
	Aframe		
	Flint Extra	2.5-3.8 fl. oz.	Effective against powdery mildew and scab. Suppresses brown rot.
	Fontelis	14-20 fl. 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.	1-day PHI.
	Merivon	4-6.7 fl. oz.	Do not apply an EC or oil-based products. Do not apply with Bravo or captan.
	Pristine	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	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.	7-day PHI.
	Topguard EQ	6-8 oz.	7-day PHI.
	Topguard Specialty Crop	14 oz.	7-day PHI. Does not contain azoxystrobin.
	wettable sulfur 90%	10-30 lbs.	

(continued)

Peach First Cover (continued)

Pest/Problem	Material	Rate/Acre	Comments
bacterial spot	FireLine	12 oz.	
	Kocide 2000/3000	0.13-0.5 lbs.	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.
plum curculio, oriental fruit moth, stink bugs, tarnished plant bug	Same as for Peach Petal Fall, page 60.		
oriental fruit moth	Same as for Peach Petal Fall, page 60.		
European red mite	Same as for Peach Shuck Split, page 62.		
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 76.		

Peach Second Cover

10 days after first cover.

Pest/Problem	Material	Rate/Acre	Comments
brown rot, scab	Same as for Peach First Cover, page 62. Luna Experience has a 35-day PHI.		
bacterial spot	FireLine	0.75 lbs.	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.
	Kocide 2000/3000	0.13-0.5 lbs.	Only recommended if bacterial spot is a recurring issue. Post-bloom application applied at first and second cover sprays. Sprays are critical from late May to through June to prevent large fruit lesions. Under wet conditions, bacterial spot infections may continue through harvest. Small bacterial spot lesions increase susceptibility to brown rot, and failure to control can result in significantly more brown rot. Spotting of leaves and defoliation may occur from use in cover sprays.
	Mycoshield 17WP	0.75 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 63.		
plum curculio, oriental fruit moth, catfacing insects	Same as for Peach Petal Fall, page 60.		
mites	Same as for Peach Shuck Split, page 62.		
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.	

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 62. Scab requires control until fruit is within 40 days of harvest.		
powdery mildew	Same as for Peach First Cover, page 63.		
oriental fruit moth	Same as for Peach Petal Fall, page 60.		
mites	Same as for Peach Shuck Split, page 62.		
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 76.		

Peach Pre-harvest

Apply according to label directions beginning 3 weeks before harvest.

Pest/Problem	Material	Rate/Acre	Comments
brown rot	Abound Aframe	12-15.5 oz.	0-day PHI. Do not apply more than 92.3 fl. oz. of product/A/season.
	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 33. Do not exceed 30 lbs. of captan per season.
	Flint Extra	2.5-3.8 fl. oz.	Suppresses brown rot. 1-day PHI.
	Fontelis	14-20 fl. oz.	
	Indar 2F	6 oz.	
brown rot	Inspire Super	16-20 fl. oz.	
	Luna Sensation	5-7.6 oz.	1-day PHI.
	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	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	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.
	Rhyme	7 oz.	Apply 1 to 2 weeks prior to harvest; Do not apply within 7 day of harvest.
	Topguard	14 oz.	7-day PHI.
	Topguard EQ	6-8 oz.	7-day PHI.
	Topguard Specialty Crop	14 oz.	7-day PHI. Does not contain azoxystrobin.
	Topsin-M 70WSB PLUS	1.5 lbs.	Pre-harvest use, restrictions, and limitations vary by product; refer to label for details.
	Captan 80WDG	2.5 lbs.	
	Ziram 76DF	4.5-8 lbs.	Do not apply within 14 days of harvest.

(continued)

Peach Pre-harvest (continued)

Pest/Problem	Material	Rate/Acre	Comments
oriental fruit moth, Japanese beetle, green June beetle	Sevin XLR Plus (4L)	2-3 qts.	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.	
	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Warrior II	1.28-2.56 fl. oz.	
	Exirel 0.83SE	10-20.5 fl. oz.	Use higher rate for Japanese beetle.
spotted wing Drosophila	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Delegate 25WG	4.5-7 oz.	
	Mustang Maxx	4 fl. oz.	
	Entrust 2SC	4-8 fl. 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

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)
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
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	1
Entrust	5	ST	MT			P	F					G	4	1
Exirel	28		ST			G	E		G			G	12	3
Movento	23		MT		G						G		24	7
Versys Inscalis	9D												12	7
Miticides														
Acramite	un	ST	MT	F									12	3
Agri-Mek, Epi-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 spot	copper hydroxide (Kocide 3000, Champ)	3.5-5 lbs.	Plum is on most, but not all, copper labels. Check label before use.
	Copper oxychloride (C-O-C-S WDG)	4.5-5 lbs.	Using copper at the dormant stage may also reduce the overwintering inoculum of the bacteria that cause bacterial canker and bacterial spot. As season progresses, reduce the rate of copper applied to reduce the risk of phytotoxicity. Copper applied to tanks with a pH of less than 6.5 may result in phytotoxicity issues.
black knot	copper pesticides	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. Plum is on most, but not all, copper labels. Check label before use.
	Bordeaux mixture	See label	Not as effective as Bravo, but using copper at dormant stage will protect against black knot and 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.	Most effective fungicide for black knot control. Other formulations and generics available.
Plum pockets/Leaf Curl	Bravo Weather Stik	3-4 pts.	Note: Ferbam is NOT labeled for plums.
	Copper hydroxide (Kocide 3000, Champ)	3.5-5 lbs.	
	Cuprofix Ultra 40 Disperss	3-3.75 lbs.	
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
bacterial spot	Copper hydroxide (Kocide 3000, Champ)	1.67 lb./100 gals.	Copper rates are tied to crop development, with rates reduced as the season progresses to minimize the risk of phytotoxicity.
	Cuprofix Ultra 40 Disperss	1.25 lb. /100 gals.	When using coppers post-bloom, drying conditions should be excellent. Do not apply during extended dews or foggy conditions.
black knot	See Plum Dormant		
	Bravo Weather Stik	3-4 pts.	
	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 33.

(continued)

Plum Pre-bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
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.
	Aframe		
	Aframe Plus	14 oz.	Applications of Aframe Plus during bloom to Stanley plums have occasionally caused fruit to be less oval in shape and smaller in size at harvest. To avoid this, do not apply Aframe Plus to Stanley plums earlier than 21 days prior to harvest.
	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 33. 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.	Also controls fruit rot and powdery mildew. Fluopyram + tebuconazole. FRAC 7+3
	Luna Sensation	5-7.6 fl. oz.	Also controls fruit rot and powdery mildew. fluopyram + trifloxystrobin. FRAC 7+11
	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/Tilt/Bumper	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	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 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	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 33.
	Topguard	14 fl. oz.	
	Topguard EQ	6-8 oz.	Start applications at 1-5% bloom, and then at 50-100%.
	Topguard Specialty Crop	14 fl. oz.	Does not contain azoxystrobin.
	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, page 68.		
brown rot (blossom blight)	Same as at Plum Pre-bloom, page 69.		
insects, mites	SAVE THE BEES! Do not apply insecticides during bloom.		

Plum Petal Fall

Pest/Problem	Material	Rate/Acre	Comments
bacterial spot	Copper hydroxide (Kocide 3000, Champ)	0.25-0.5 lb./100 gals.	Copper rates are tied to crop development, with rates reduced as the season progresses to minimize the risk of phytotoxicity.
	Cuprofix Ultra 40 Disperss	0.75 lb./100 gals.	
	Badge SC	1.5 pt./100 gals.	
brown rot (blossom blight), black knot	Same as at Plum Pre-bloom, page 69.		
brown rot (blossom blight)	Same as at Plum Pre-bloom, page 69. 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 70W	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.	
	Apta 1.31 EC	21-27 fl. oz.	Plum curculio only.
	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 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
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.	Oxytetracycline is most effective when applied during extended periods of leaf wetness. Apply within 24 hours of wetting events and allow time for the spray to dry before rain.
	copper hydroxide (Kocide 3000)	0.25-0.5 lbs. per 100 gals.	As season progresses, reduce the rate of copper applied to reduce the risk of phytotoxicity. Copper applied to tanks with a pH of less than 6.5 may result in phytotoxicity issues. When using coppers post-bloom, drying conditions should be excellent. Do not apply during extended dews or foggy conditions.
	Badge SC	8 oz./100 gals.	
	Cuprofix Ultra 40 disperss	0.75 lb./100 gals.	
		Do not apply Cuprofix after shuck split.	
brown rot, black knot	Same as at Plum Pre-bloom except Roval, pages 68-69. 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 33.
	Luna Experience	6-10 oz.	35-day PHI.
	Luna Sensation	5-7.6 fl. oz.	Also controls fruit rot and powdery mildew.
	Merivon	4-6.7 oz.	
	Orbit/Tilt/Bumper	4 oz.	
	Pristine	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.
	Quash	2.5-3.5 lb.	Do not make more than 2 sequential applications after petal fall.
	Rhyme	7 oz.	
	Topguard Specialty Crop	14 fl. oz.	Does not contain azoxystrobin.
	Topguard EQ	6-8 oz.	Start applications at 1-5% bloom, and then at 50-100%.
brown rot	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 33.
plum curculio, oriental fruit moth	Same as at Plum Petal Fall, page 70.		
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 2SC	16-18 fl. oz.	
	Epi-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
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.	Oxytetracycline is most effective when applied during extended periods of leaf wetness. Apply within 24 hours of wetting events and allow time for the spray to dry before rain.
	copper hydroxide (Kocide 3000)	0.13-0.5 lb./100 gals.	As season progresses, reduce the rate of copper applied to reduce the risk of phytotoxicity. Copper applied to tanks with a pH of less than 6.5 may result in phytotoxicity issues. When using coppers post-bloom, drying conditions should be excellent. Do not apply during extended dews or foggy conditions. Do not apply Cuprofix after shuck split.
	Badge SC	8 oz./100 gals.	
	Cuprofix Ultra 40 disperss	0.75 lb./100 gals.	
brown rot, black knot	Same as Shuck Split EXCEPT Rovral and Bravo can no longer be applied, page 71. 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 70.		
peachtree borers	See Borers of Peach, Cherry, and Plum Trees, page 76.		

Plum Second and Additional Cover Sprays

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

Pest/Problem	Material	Rate/Acre	Comments
bacterial spot			Same as First Cover, as needed.
brown rot	Same as Plum Shuck Split, page 71, EXCEPT Rovral and Bravo can no longer be applied. 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 70.		
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.	
	Danitol 2.4EC	10.7-21.3 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	Abound Aframe	12-15.5 oz.	Do not use with silicone-based surfactants (e.g., Silwe L-77t, Sur-Plus, Sylgard 309 etc.).
	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 33.
	Elevate	1-1.5 lb.	
	Flint Extra	2.5-3.8 fl. oz.	Suppressive against brown rot. 1-day PHI.
	Fontelis	14-20 fl. oz.	
	Indar 2F	6 oz.	
	Inspire Super	16-20 fl. oz.	2-day PHI.
	Luna Privilege	4-6.84 fl. oz.	This is fluopyram, the SDHI component of Luna Sensation.
	Luna Sensation	5-7.6 fl. oz.	Also controls fruit rot and powdery mildew. 1-day PHI.
	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. 1-day PHI.
	Pristine	10.5-14.5 fl. oz.	1-day PHI.
	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. 0-day PHI.
	Rhyme	7 oz.	Apply 1 week prior to harvest.
	Topguard Specialty Crop	14 fl. oz.	
	Topguard EQ	6-8 oz.	
spotted wing Drosophila	Topsin-M 70WSB PLUS Captan 80WDG	1.5 lbs.	Pre-harvest use, restrictions, and limitations are variable according to product; refer to label for details.
		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 33.
	Danitol 2.4EC	10.7-21.3 fl. oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Delegate 25WG	4.5-7 oz.	
	Mustang Maxx	4 fl. oz.	
	Entrust 2SC	4-8 fl. 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
Apta	21A		HT		G					12	14
Avaunt	22	MT	HT		G	F	F	G		12	14
Delegate	5	MT	HT		P	E			E	4	1
Entrust	5	ST	MT		P	F			G	4	1
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

Special Problems and Pests of 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, 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 resistant to bacterial spot provides the best control. In the past, various control programs have tried using 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, 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 3-4 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. The rate of copper decreases over the growing season. On peaches, copper can cause injury to leaves and appears as reddish spots and shot-holes with some very mild defoliation when using an effective rate of copper. Because of risk for foliar injury, most copper

materials are not registered for use post-bloom or in more than two applications post-bloom, and then only at low rates (always read and follow label instructions).

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?fwd=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 SL provides 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. (Subsequent rain or irrigation moves material into the soil.)

Ridomil Gold SL is also registered for use on cherries (sweet and tart), nectarines, plums, and prunes. See label for further information and use rates. See page 27 for additional information on phosphorous acid, phosphonates and phosphites.

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 of at least 1-2 acres, 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 77.

Periodical Cicadas

See *Periodical Cicadas*, page 31.

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.	Not labeled for plum.
	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 75.
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	3 qts.	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.	
	Mustang Maxx	1.4-4.3 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 75.
	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 75.
peachtree borer (preplant dip)	Lorsban 75WG	2-4 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.	
shothole borer	Insecticide sprays are not effective. Maintain tree health and vigor, prune dead and dying limbs, and remove dead trees to prevent beetle problems.		

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	—
Inder 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.

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 to 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 91.

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	Sulfurix	1-2 gals.	This delayed dormant application is aimed at reducing overwintering inoculum on canes. See anthracnose, page 89.
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 70W	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.
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 improves 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 Fungicide Resistance Management, page 90, 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 91.		
	Captan 80 WDG	1.25-2.5 lbs.	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.
	Mettle 125ME	3-5 fl. oz.	Consult label: The REI varies for different vineyard activities.
	potassium salts	See comments	For powdery and downy mildew only.
	Procure 480SC Trionic	4-8 oz.	
	Quintec	4-6.6 fl. oz.	For powdery mildew only.
	Rally 40WSP	3-5 oz.	
	sulfur	See label	Use sulfur with caution.
	TebuSTAR 45WSP	4 oz.	Several generic fungicides contain the active ingredient tebuconazole — see Generic Fungicides, page 152.
	OR ONE OF THE PRODUCTS BELOW BY ITSELF:		
	Abound	10.0-15.5 fl. oz.	Active ingredient is azoxystrobin. Other labeled products include Satori, Trevio, AFrame, Azoxystar, Azteroid and Acadia 2Sc. Labeled rates are the same as Abound.
	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 fl. 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.	

(continued)

Grape Bud Break to Pre-bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
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: The powdery mildew fungus is especially prone to fungicide resistance. Avoid back-to-back applications of any one systemic fungicide class.		
	Abound	10.0-15.5 fl. oz.	Active ingredient is azoxystrobin. Other labeled products include Satori, Trevo, AFrame, Azoxystar, Azteroid and Acadia 2Sc. Labeled rates are the same as Abound.
	Endura 70WG	4.5-8.0 oz.	
	Flint 50WG	1.5-4.0 oz.	
	Intuity	6.0 fl. oz.	Suppression only. Do not use on <i>V. labrusca</i> , <i>V. labrusca</i> hybrids and other non-vinifera hybrids where crop sensitivity is not known.
	JMS Stylet Oil	1.0-2.0% conc.	Not registered in all states.
	Kenja 400SC	20.0-22.0 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	3.0-5.0 fl. oz.	
	potassium salts	See comments.	
	Procure 480SC	4.0-8.0 oz.	
	Trionic 4SC		
	Quintec 2.08F	3.0-4.0 fl. oz.	
	Rally 40WSP	3.0-5.0 oz	
	Sovran 50WG	3.2-6.4 oz.	
	sulfur	See label	Use sulfur with caution.
	TebuStar 45 WSP	4.0 oz.	See note for Tebuzol in black rot, etc., above.
	Torino	3.4 oz.	
	Vivando 2.5F	10.3-15.4 fl. oz.	
flea beetle, climbing cutworm	Same as for Grape Delayed Dormant through Bud Swell, page 79.		
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 pests 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 79. 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 W	1.3-2.1 lbs.	Do not exceed 6.5 lbs. per acre per year.
	Sevin XLR Plus (4F)	1-2 qts.	Other formulations may be available.
redbanded leafroller	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, 21-day PHI. More than 12 fl. oz., 30-day PHI.
	Sevin XLR Plus (4F)	2 qts.	Other formulations may be available.

(continued)

Grape 4- to 10-inch Shoots (continued)

Pest/Problem	Material	Rate/Acre	Comments
European red mite	Acramite 50WS	0.75-1 lb.	Do not exceed 1 application per year with any of these products.
	Apollo 1SC	4-8 fl. oz.	
	Envior 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 XLO	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 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. Fungicide protection against powdery and downy mildews therefore 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, page 80. 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 81. *Pheromone traps for grape berry moth and redbanded leafroller 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. Because 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. 60-day PHI.
	Scorpion 35SL	2-5 fl.oz.; 9-10.5 fl. oz.	Use low rate for foliar application (1-day PHI). Use high rate for soil application (28-day PHI). 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, page 80. 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.		
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: The downy mildew pathogen is especially prone to fungicide resistance. Avoid back-to-back applications of any one systemic fungicide class.		
	Abound	10.0-15.5 fl. oz.	
	Captan 80WDG	1.25-2.5 lbs.	Do not apply sulfur or Captan within two weeks of an oil application, and do not apply stylet oil within two weeks of a sulfur or Captan application.
	fixed copper	See comments.	See Fixed Copper Fungicides, page 13.
	Forum	6.0 oz.	
	Mancozeb 75DF	3-4 lbs.	66-day PHI.
	phosphorous acid	See label	Phosphorous acid products include but are not limited to ProPhyt, Phostrol, Fosphite, Fungi-fite, Confine Extra, K-phite, and Rampart.
	Pristine 38WG	8-12.5 oz.	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.	42-day PHI.
	Ridomil Gold MZ WG	2.5 lbs.	66-day PHI.
	Sovran 50WG	3.2-6.4 oz.	
	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 81.		
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 89.		
	Elevate 50WDG	1.0 lb.	
	Intuity	6.0 fl. oz.	
	Kenja 400SC	20.0-22.0 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	1.0-2.0 pts.	
	Scala SC	18.0 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	11.0-14.0 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	1.0-1.5 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	10.0 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, page 80. Note PHI on products that contain mancozeb. OR		
	Kenja 400SC	20.0-22.0 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 83. 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, page 154, 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.
	Imidan 70W	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: 21-day PHI. More than 12 fl. oz.: 30-day PHI.
	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. 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.
	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 70W	1.3-2.1 lbs.	
	Mustang Maxx 0.8EC	4 fl. oz.	
	Platinum 2SC	8-17 fl. oz.	Soil-applied for systemic control. 60-day PHI.
	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 70W	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.
leafhoppers (including sharpshooters)	Examining the undersides of grape leaves indicates if leafhoppers are present.		
	Actara 25WG	1.5-3.5 oz.	Do not exceed 7 oz. per acre per year.
	Admire Pro (4.6F)	1-1.4 fl. oz.; 7-14 fl. oz.	Use low rate for foliar application (0-day PHI). Use high rate for soil application (30-day PHI).
	Epi-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 70W	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 XLO	1-2 pts.	Do not exceed 2 applications per year.
	Platinum 2SC	8-17 fl. oz.	Soil-applied for systemic control. 60-day PHI.
	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.
	Sevin XLR Plus (4F)	1-2 qts.	Other formulations may be available. 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 (0-day PHI). Use high rate for soil application (30-day PHI).
	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 (1-day PHI). Use high rate for soil applications (28-day PHI).

(continued)

Grape Shatter (continued)

Pest/Problem	Material	Rate/Acre	Comments
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)	1-1.4 fl. oz.; 7-14 fl. oz.	Use low rate for foliar application (0-day PHI). Use high rate for soil application (30-day PHI).
	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 70W	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. 60-day PHI.
	Portal XLO	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 (1-day PHI). Use high rate for soil applications (28-day PHI).
mites	Acramite 50WS	0.75-1.0 lb.	Do not exceed 1 application per year.
	Epil-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.
	Envirdor 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 XLO	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, page 83. 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, page 84. 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 89. Same as for Grape Bloom, page 83. OR		
	OSO 5% SC	3.75-13.0 fl. oz.	
ripe rot	Abound	10.5-15.5 fl. oz.	
	Flint 50WG	1.5-4.0 oz.	Do not apply to Concord or other American type grapes, as injury may occur.
	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.	
	Sovran 50WG	3.2-6.4 oz.	
sour rot complex	Oxidate 2.0	32 fl. oz. per 100 gals.	Mix Oxidate 2.0 in a 1:400 dilution and apply at 30 to 100 gals. per acre. Include an insecticide for Drosophila control. See discussion on page xx.
	Blight Ban 506	5.3 oz.	Include an insecticide for Drosophila control. See discussion on page xx.
powdery mildew, downy mildew	Same as for Grape Bloom, page 83.		
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 84. 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. 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 85 (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. 30-day PHI. 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. 1-day PHI.
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. 3-day PHI.
	Danitol 2.4EC	10.7-21.3 fl. oz.	21-day PHI.
	Delegate 25WG	3-5 oz.	As recommended on 2(ee) label. 7-day PHI.
	Entrust 2SC	4-8 fl. oz.	As recommended on 2(ee) label. 7-day PHI.
	Imidan 70WP	1.3-2.1 lbs.	PHI is 7 or 14 days depending on activity.
	Malathion	See label	See Spotted Wing Drosophila, page 88. Malathion formulations and rates vary by state. Check labels for specific information. 3-day PHI.
	Mustang Maxx 0.8EC	4 fl. oz.	As recommended on 2(ee) label. 1-day PHI.
multicolored Asian lady beetle	See Multicolored Asian Lady Beetle, page 88. Scout vineyards several days before harvest to determine the abundance of multicolored Asian lady beetle. Additional insecticides (including Baythroid and Mustang Maxx) have short pre-harvest intervals, and although not labeled specifically for this pest, have been effective in trials and vineyard use.		
	Belay 2.13SC	2-4 fl. oz.	0-day PHI.
	Mustang Maxx 0.8EC	2-4 fl. oz.	1-day PHI.
	Scorpion 35SL	2-5 fl. oz.	1-day PHI.
	Venom 70SG	1-3 oz.	1-day PHI.
grape root borer	See Grape Root Borer, page 86.		
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. 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 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).

SWD is different from other fruit flies; 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. Soft-skinned fruit generally become vulnerable to attack as they begin to soften and turn color during ripening, usually in the final 7 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, 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 them at the winery. When stressed, MALB secretes a defense chemical that 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 not labeled specifically against MALB, have been effective in trials and vineyard use.

Grape Root Borer

Evaluating grape root borer damage is generally difficult. 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 effectively attracts grape root borer males. Set out traps in early June. We advise treatment if you detect moths.

If you believe 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 problems, as well as solve them.

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. Label directions 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. They are pests more because they sting than because they damage much fruit. Unfortunately, little help is available for controlling wasps.

Wasps are generally attracted to the juice and soft fruit. Sanitation is key to preventing or at least reducing problems with wasps. Pick all ripe fruit and fruit debris regularly and thoroughly. Also 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 Sulfurix

Apply Sulfurix 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 probably do not provide satisfactory anthracnose control unless you use them in conjunction with a delayed-dormant Sulfurix application. See Effectiveness of Fungicides for Control of Grape Diseases on page 91 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 may be bitter rot.

The systemic FRAC 3 fungicides (Rally, Bayleton, TebSTAR, Mettle, and Procure) are not effective against bitter rot (see Effectiveness of Fungicides for Control of Grape Diseases, page 91). If bitter rot is a problem, pre-harvest applications of captan may be beneficial. Observe all pre-harvest restrictions.

Grape Ripe Rot

Ripe rot attacks mature berries, resulting in shriveled berries with a vinegar odor or bitter taste. Infected berries become covered in blister-like lesions (acervuli) covered in salmon-colored spore masses. Minnesota varieties Frontenac and Marquette are extremely susceptible to ripe rot.

The systemic FRAC 11 fungicides (Abound, Sovran, Flint, and products that contain a FRAC 11 fungicide such as Pristine and Quadris Top) are effective against ripe rot. Captan may also be effective. 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 three to five years. Vanguard and Elevate are also at risk for fungicide resistance development. We therefore recommend limiting Rovral, Elevate, and Vanguard applications to three per year to reduce the probability of developing strains of Botrytis resistant to these materials. In addition, consider alternating applications of Rovral, Elevate, and Vanguard 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 Botrytis-caused losses.

Grape Sour Rot

Sour rot occurs late in the season near harvest on berries damaged from bird pecks, rain cracking, and insects. The most obvious sour rot symptom is a pre-harvest decay accompanied by a vinegar smell; that is, acetic acid, or what winemakers 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.

A combination of yeasts and bacteria in a step-wise process cause sour rot. 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 do 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. Fruit flies of the genus *Drosophila* also 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 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).

Fungicide Resistance Management

A spray program should be thoughtfully developed to prevent and slow the evolution of fungicide-resistant pathogens in the berry patch. Fungicides that have a site-specific mode of action are classified as medium to high risk for fungicide resistance development. Fungicides with Fungicide Resistance Action Committee (FRAC) codes or numbers 1, 2, 3, 4, 7, 9, 11, and 49, are medium to high-risk fungicides. **No more than two sequential applications** of a high-risk fungicide should be applied before alternating to a fungicide with a different mode of action. Do not overuse fungicides — high-risk fungicides have restrictions on how often they can be applied — and apply only at the recommended manufacturer rates. It is unlawful to apply fungicides in a manner inconsistent with the product label.

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 in 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 125-126) identify the various insecticide mode of action groups. Rotating to insecticides with a different IRAC code should help avoid development of insecticide resistance.

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 season-long 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.

Effectiveness of Fungicides for Control of Grape Diseases¹

These ratings, intended to provide readers with an idea of relative effectiveness, 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.

Trade Name	Common Name	FRAC Code ³	Phomopsis cane and leaf spot	black rot	downy mildew	Powdery mildew	Botrytis rot	bitter rot	anthracnose	Grape Pre-harvest Intervals (PHI) and Limitations (maximum amount per acre per season) ²	REI ⁴ (hours)
Abound	azoxystrobin	11	F	E	E ^R	E ^R	G	1	E	14 (92.3 fl. oz.)	4
Aprovia	benzovindiflupyr	7	0	G-E	0	G-E	0	0	0	21 (31.5 fl. oz.)	12
Aliette	fosetyl-AL	33	0	0	G-E	0	0	0	0	15	12
basic copper sulfate	copper sulfate	M	F	F	F	F	F	F	1	0	48
Captan 80WDG	captan	M	E	F	E	0	F	G	G	0 (15 lbs. a.i.)	48
Dithane M-45, others	mancozeb	M	E	E	E	0	0	G	E	66 (24 lbs.)	24
Elevate 50 WDG	fenhexamid	17	0	0	0	0	E	0	1	0* (3 lbs.)	12
Endura	boscalid	7	0	0	0	E	G	0	E	14 (24 oz.)	12
Flint	trifloxystrobin	11	F	E	F ^R	E ^R	G	1	E	14 (24 oz.)	12
Forum	dimethomorph	40	0	0	E	0	0	0	0	14 (24 oz.)	12
Fracture	Banda de Lupinus albus doce (BLAD)	M	0	0	0	E	E	0	0	1*	4
Inspire Super	difenoconazole + cyprinil	3+9	0	E	0	E	E	1	E	14 (80 fl. oz.)	12
Intuity	mandestrobin	11	0	0	0	G	G-E	0	0	10 (18 fl. oz.)	12

(continued)

Effectiveness of Fungicides for Control of Grape Diseases¹ (continued)

Trade Name	Common Name	FRAC Code ³	Phomopsis cane and leaf spot	black rot	downy mildew	Powdery mildew	Botrytis rot	bitter rot	anthracnose	Grape Pre-harvest Intervals (PHI) and Limitations (maximum amount per acre per season) ²	REI ⁴ (hours)
JMS Stylet Oil	oil	-	0	0	0	E	0	0	0	0	12
Kenja 400SC	isofetamid	7	0	G-E	0	F	F	0	0	16 (66 fl. oz.)	12
Luna Experience	fluopyram + tebuconazole	7+3	G	G	G	E	E	G	0	14 (34 fl. oz.)	12 / 5 days ⁵
Merivon Xemium	fluxapyroxad + pyraclostrobin	7+11	0	0	0	E	0	0	0	14 (33 fl. Oz)	12
Mettle 125ME	tetraconazole	3	0	E	0	E ^R	0	0	E	14 (10 oz.)	12 / 7 days ⁶
Pristine	pyraclostrobin + boscalid	11+7	F	E	E ^R	E	G	1	E	14 (69 oz.)	12 hr / 5 days ⁵
Procure 480SC	triflumizole	3	0	G	0	E ^R	0	1	1	7 (32 fl. oz.)	24
Prophyt, Phostrol, Agri-Fos, Legion, Rampart	phosphorous acid	33	0	0	E	0	0	0	0	0	4
Quadris Top	difenoconazole + azoxystrobin	3+11	F	E	E	E	G	1	E	14 (56 fl. oz.)	12
Quintec	quinoxifen	13	0	0	0	E	0	0	0	21 (33 fl. oz.)	12
Rally 40WSP	myclobutanil	3	0	E	0	E ^R	0	1	E	14 (1.5 lbs.)	24
Ranman 400SC	cyazofamid	21	0	0	E	0	0	0	0	30 (16.5 fl. oz.)	12
Reason 500SC	fenamidone	11	G	G	E	E	1	1	1	30 (8.1 fl. oz.)	12
Revus	mandipropamid	40	0	0	E	0	0	0	0	14 (32 fl. oz.)	4
Revus Top	difenoconazole + mandipropamid	3+40	0	E	E	E	1	1	E	14* (28 fl. oz.)	12
Ridomil Gold MZ WG	mefenoxam + mancozeb	4+M	F	G	E	0	0	G	G	66 (10 lbs.)	48
Ridomil Gold SL	mefenoxam	4	F	F	E	G	F	F	0	60*	48
Ridomil Gold Copper	mefenoxam + copper	4+M	F	F	E	G	F	F	0	42 (8 lbs.)	48
Rovral 4 Flowable	iprodione	2	0	0	0	0	G	0	1	7*	48
Scala SC	pyrimethanil	9	0	0	0	0	G	0	1	7 (36 fl. oz.)	12
Sovran	kresoxim-methyl	11	F	E	G ^R	E ^R	G	1	E	14* (25.6 oz.)	12
Sulforix	calcium polysulfide	M	G	0	0	0	0	0	E	0*	48
Sulfur (wetable)	sulfur	M	F	0	0	E	0	0	1	0	24
Switch 62.5 WG	cyprodinil + fludioxonil	9+12	0	0	0	0	G	1	0	7 (56 oz.)	12
Tanos	famoxadone + cymoxanil	11+27	0	0	E	0	0	0	0	30 (72 oz.)	12
TebuStar 45 WSP	tebuconazole	3	0	E	0	E ^R	0	1	E	14 (2 lbs.)	12
Topsin M WSB	thiophanate	1	G	F	0	E	G	G	E	7 (6 lbs.)	2 days
Torino	cyflufenamid	U6	0	0	0	E	0	0	0	3 (6.8 oz.)	4
Vanguard WG	cyprodinil	9	0	0	0	0	E	0	1	7* (30 oz.)	12
Vintage SC	Fenarimol	3	0	E	0	E ^R	0	1	E	21 (21 fl. oz.)	24
Vivando	metrafenone	U8	0	0	0	E	0	0	0	14 (42.6 fl. oz.)	12
Zampro	ametoctradin + dimethomorph	45 + 40	0	0	E	0	0	0	0	14 (56 fl. oz.)	12
Ziram 76DF	ziram	M	G	E	G	0	0	1	G	21 (28 lbs.)	48

¹ E = Excellent. G = Good. F = Fair. F = Fair. 0 = not effective. 1 = effectiveness unknown or not established. R = Fungicide resistance possible.

² Amounts shown in parenthesis are the maximum amounts of the fungicide permitted per season. * = limited number of applications allowed, or other restrictions apply. Refer to label directions.

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. The REI is 12 hours for all other activities in wine grapes.

⁶ The REI is 7 days for treated table grape activities of cane tying, turning, or girdling. The REI is 12 hours for all other activities in table 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

^a 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 ¹											
	black rot	downy mildew	powdery mildew	Botrytis	Phomopsis	Eutypa	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	+++	++	?
Chardonnay	++	+++	+++	+++	+++	++	+++	+++	No	+	++	+++
Concord	+++	+	++	+	+++	+++	+	+	Yes	+	+++	++
Corot noir	+	+++	+	+	++	+	+	+	No	?	++	+++
Cynthiana/Norton	+	++	+	+	+	?	+	+	Yes	?	+++	+++
DeChaunac	+	++	++	+	+++	+++	++	++	Yes	+	+	++
Delaware	++	+++ ⁵	++	+	+++	+	+	++	No	+	+++	?
Edelweiss	?	?	?	?	?	?	?	?	?	?	++	?
Faith	+	+	+	+	+	+	+	+	?	?	+	?
Foch	++	+	++	+	+	+++	+	++	Yes	++	+++	+++
Fredonia	++	+++	++	+	+++	?	+	+++	No	?	++	++
Frontenac	+++	+	++	++	+	?	?	+++	No	++	+	+++
Frontenac Gris	++	+	++	++	+	?	?	++	No	++	+	+
Geneva Red	+	++	++	++	+	+	+	+	No	?	+	+++
Gewürztraminer	+++	+++	+++	+++	?	?	+++	+++	No	+	?	?
Gratitude	+	+	+	+	+	+	+++	+	?	?	+	?
Hope	+	+	+	+	+	+	+	+	?	?	+	?
Joy	+	+	+	+	+	+	+	+	?	?	+	?
Jupiter	++	+++	+++	+	+	?	?	+	?	?	+	++
LaCrescent	++	+++	++	+	+++	+	+	+	No	?	+++	+++
LaCrosse	+++	++	++	+++	++	?	?	+	No	++	+++	+++
Lemberger	+++	+++	+++	+	?	+++	+++	?	No	?	++	?
Leon Millot	+	++	+++	+	+	+	?	+	Yes	++	+	?
Marquette	++	+	+	+++	+++	?	+	+++	No	++	+++	+
Marquis	+	+++	+	+	+++	?	?	+++	?	?	+	?
Mars	+	+	+	+	+	?	+	++	?	?	+	+
Merlot	++	+++	+++	++	+	+++	+++	++	No	++	?	?
Moore's Diamond	+++	+	+++	++	?	++	?	?	No	?	?	?

(continued)

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

Cultivar	Susceptible or Sensitive to ¹											
	black rot	downy mildew	powdery mildew	Botrytis	Phomopsis	Eutypa	crown gall	anthracnose	sulfur ²	copper ³	2,4-D ⁴	dicamba ⁴
Niagara	+++	+++	++	+	+++	+	++	++	No	+	+++	++
Noiret	+++	++	++	+	+	?	++	+	No	?	++	+++
Petite Pearl	+++	+	+	+	+	?	+	+	?	?	+	?
Pinot gris	+++	+++	+++	++	?	+++	+++	?	No	?	?	?
Pinot noir	+++	+++	+++	+++	?	?	+++	?	No	+	?	?
Reliance	+++	+++	++	+	++	?	?	+++	No	+	+	?
Riesling	+++	+++	+++	+++	++	++	+++	?	No	+	+	++
St. Croix	?	++	++	++	+++	?	?	+	No	++	++	?
Seyval	++	++	+++	+++	++	+	++	+	No	+	++	+++
Steuben	++	+	+	+	+	?	+	+++	No	?	+	++
Sunbelt	+	++	++	+	+	?	?	+	?	?	+++	++
Thompcord	+	+++	+	+	+	?	+	+	?	?	+	+
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.
	Sulfurix	1-2 gals.	Dilute in 100 to 150 gallons water. Additional applications can be applied during the growing season at 2 quarts per acre. Refer to label for application rates.
Phytophthora root rot	Aliette WDG	0.5 lbs.	
	phosphorous acid	See Phytophthora Root Rot, page 100. The phosphorus acid spray solution must have a pH greater than 5.5 to limit phytotoxicity. Carefully monitor fertility, because phosphorous acid applications can cause nutrient deficiencies.	
	Ridomil Gold SL	Do not exceed 1 soil application per season at 3.6 pts./A.	

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	Abound	6-15.5 fl. oz.	
	Aframe	6-15.5 fl. oz.	
	Quilt Xcel	14-21 fl. oz.	Generics include Aframe Plus and Cover XL.
	Captan 80WDG	1.25-3 lbs.	Also available as Captec 4L (0.75-1 qts./100 gals.). Do not tank mix captan with diazinon.
	CaptEstate 68WDG	4.7 lbs.	For management of mummy berry and anthracnose.
	Inder 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.
	Tilt	6 fl. oz.	For mummy berry management. Tilt is a propiconazole. Generics include Bumper, Protocol, Topaz, and more.
	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.	Generic azoxystrobin products include Acadia, Aframe, AzoxyStar, and more.
	Aframe Plus/Quilt Xcel	14-21 fl. oz.	Generics include Aframe Plus and Cover XL.
	Captan 80WDG	1.25-3 lbs.	Provides protective control of stem canker and stem blight, anthracnose, and Phomopsis canker.
	CaptEstate 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.
	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/Bumper/Topaz	6 fl. oz.	For mummy berry management.
	Ziram 76DF	3 lbs.	
Botrytis blight	CaptEstate 68WDG	3.5-4.7 lbs.	
	Elevate 50 WDG	1.5 lbs.	
	Kenja 400SC	13.5-15.5 fl. oz.	For <i>Botrytis</i> control. Tank mix with another fungicide with a different mode of action. 12-hour reentry. 7-day PHI.
	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 97.		
Botrytis blight	Same as for Blueberry Pink Bud Stage and 25% Bloom, page 97.		
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.	
	Exirel 0.83SE	10-13.5 fl. oz.	
	Imidan 70W	1.33 lbs.	
	Intrepid 2F	10-16 fl. oz.	
	Knack 0.83EC	16 fl. oz.	
	Lannate LV	24-48 fl. oz.	
	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.
	CaptEstate 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, above. 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 70W	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 124-125) and Insecticide and Miticide PHIs and REIs tables (pages 125-126).

Pest/Problem	Material	Rate/Acre	Comments
anthracnose, Phomopsis stem canker and stem blight	Same as Blueberry First and Second Cover, page 98. 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 70W	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 Prime	12-14 fl. oz.	
brown marmorated stink bug	Danitol 2.4EC	10.67-16 fl. oz.	
	Lannate LV	24-48 fl. oz.	
	Lannate SP	8-16 oz.	
	Brigade 2EC	6.4 fl. oz.	
Japanese beetle	See Insecticide and Miticide PHIs and REIs tables (pages 125-126) 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 70W	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.
Drosophila (fruit flies, vinegar flies), including spotted wing Drosophila	Danitol 2.4EC	10.67-16 fl. oz.	
	Delegate 25WG	3-6 oz.	
	Entrust 2SC	4-6 fl. oz.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Imidan 70W	1.33 lbs.	
	Lannate LV	24-48 fl. oz.	
	Lannate SP	8-16 oz.	
	Malathion	See label	Formulations and rates vary by state and special local need (SLN). 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- to 6-week intervals until leaf drop in the fall.

Special Comments on Blueberry Schedule

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, Alude, Agri-Fos, ProPhyt, Phostrol, and Rampart. 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
CaptEate 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

(continued)

Effectiveness of Pesticides for Blueberry Diseases¹ (continued)

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
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

(continued)

Efficacy of Selected Pesticides for Control of Blueberry Insects¹ (continued)

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)
Others												
Altacor	chlorantraniliprole	28	ST		G	G					1	4
Avaunt	indoxacarb	22	MT	G	F				F		7	12
Aza-direct	azadirachtin						F				0	4
Delegate	spinetoram	5	MT		G				F	E	3	4
Dipel	B. thuringiensis	11	ST		F						0	4
Entrust	spinosad	5	ST	F	G					G	1/3*	4
Exirel	cyantraniliprole	28		G	G				F	G	3	12
Neemix	Azadirachtin						F				0	4
Sivanto Prime	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.

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	CaptEate 68WDG	3.5-5.25 lbs.	Labeled for raspberries only.
	copper hydroxide 50WP	4.0 lbs.	Copper products are available in various formulations. Read labels carefully.
	Sulfurix	3.0 gals./100 gals. water	Use with minimum 50 gals. carrier per acre.
Phytophthora root rot	phosphorous acid	4.5 pts.	Phosphorous acid products include ProPhyt, Phostrol, Fosphite, Fungi-fite, Confine Extra, K-phite, and Rampart.
	Ridomil Gold SL	3.6 pts.	Ridomil Gold SL has replaced Ridomil Gold EC. See Phytophthora Root Rot (page 108) for application information.
	Ridomil Gold GR	5.0 lbs./1000 ft. row	At time of planting. Topdressing with this product is not recommended.
	Orondis Gold 200	4.8-9.6 fl. oz.	Apply as a banded, soil-directed spray in a minimum of 20 gals./A of water. Direct the spray along each side of the crop row, and direct the application to the soil near and under the lower leaves.
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 107) 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 108.		
	Abound	6.0-15.5 fl. oz.	Active ingredient is azoxystrobin. Other labeled products include Satori, Trevo, AFrame, Azoxystar, Azteroid and Acadia 2Sc. Labeled rates are the same as Abound.
	Cabrio EG	14 oz.	
	Captan 80WDG	2.5 lbs.	
	Captan 4L	0.75-1 qt.	
	CaptEate 68WDG	3.0-5.0 lbs.	Labeled for anthracnose and spur blight in raspberries.
	Pristine 38WG	18.5-23 oz.	
	Quilt Xcel Cover XL	14.0-21.0 fl. oz.	Not labeled for spur blight. 30-day PHI.
	Tanos	8.0-10.0 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 108.		
	Abound	6.0-15.5 fl. oz.	Use 10-15.5 fl. oz. rate for blackberry rust.
	Cabrio EG	14.0 oz.	
	Pristine	18.5-23 oz.	Suppresses rust diseases.
	Prolivo 300SC	4.0-5.0 fl. oz.	Powdery mildew only.
	Quilt Xcel Cover XL	14.0-21.0 fl. oz.	30-day PHI.
	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 Orange Rust, page 108.
	Tilt	6.0 fl. oz.	Active ingredient is propiconazole. Other labeled products include Topaz, Bumper ES, Bumper 41.8 EC, Propiconazole 3.6 EC, Propiconazole 41.8% EC and Propi-Star EC. See labels for application rates.

(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.	
	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 qts.	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 (page 154) 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.	
	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.	
	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 108. Same as for Raspberry and Blackberry Pre-bloom, page 103. Note: Quilt Xcel and Cover XL have a 30-day PHI.		
rosette (double blossom)	See Rosette or Double Blossom, page 108.		
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. Follow with a third as petals begin to fall.		
	Abound	6.0-15.5 fl. oz.	Active ingredient is azoxystrobin. Other labeled products include Satori, Trevo, AFrame, Azoxystar, Azteroid and Acadia 2Sc. Labeled rates are the same as Abound.
	Cabrio	14.0 oz.	Suppression only.
	Captan 80WDG	2.5 lbs.	Use 45-100 gals. of carrier per acre.
	Captec 4L	0.75-1qt.	
	CaptEstate 68WDG	3.5 lbs.	
	Elevate 50WDG	1.5 lbs.	
	Luna Tranquility	16.0-27.0 fl. oz.	
	Pristine	18.5-23.0 oz.	
	Rovral 4F	1-2 pts.	Use a minimum of 100 gals. of carrier per acre. See Fungicide Resistance Management, page 108.
	Switch 62.5WG	11.0-14.0 oz.	
	OSO 5%SC 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 108. Same as for Raspberry and Blackberry Pre-bloom, page 103. Note: Quilt Xcel and Cover XL have a 30-day PHI.		
Botrytis fruit rot (only)	Same as for Raspberry and Blackberry First Bloom through Petal Fall, page 105.		
rust diseases (orange rust and late leaf rust), powdery mildew	Abound	6.0-15.5 fl. oz.	Active ingredient is azoxystrobin. Other labeled products include Satori, Trevo, AFrame, Azoxystar, Azteroid and Acadia 2Sc. Labeled rates are the same as Abound.
	Cabrio 20EG	14 oz.	Suppresses rust diseases.
	Luna Tranquility	13.6-27.0 fl. oz.	Powdery mildew only.
	Pristine	18.5-23 oz.	
	Prolivo 300SC	4.0-5.0 fl. oz.	Powdery mildew only.
	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 Orange Rust, page 108.
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 107.
	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.

(continued)

Raspberry and Blackberry Post-bloom through Harvest *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
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 daily. 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.	
Japanese beetle, green June beetle	See Insecticide and Miticide PHIs and REIs (pages 125-126).		
	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 2SC	4-6 fl. 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./100 gals. 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.	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. See Broad Mite, page 108.
Drosophila (also known as fruit flies and vinegar flies), including spotted wing Drosophila	See Spotted Wing Drosophila, page 86.		
	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.	
	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 103.		
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.	
	Diazinon AG600	51 fl. oz.	Minimum of 100 gals. as a drench in spring before buds break.
	Hero 1.24EC	10.3 fl. oz.	Minimum of 200 gals. of water as a drench.

Special Comments on Raspberry and Blackberry Schedule

Spotted Wing Drosophila

See page 86 (under Grapes).

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 and in litter under plants. Eggs are oval and spotted (0.08 mm long). Broad mites are oval and vary from small white immatures to amber adults (0.2mm) with white hourglass mark on back of females.

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. 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 Disperss wettable sulfur (10 pounds per acre), 2% JMS Stylet-Oil, and 1% M-Pede. 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.

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. It 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 gallons of water per acre. Do not apply pre-bloom or during bloom or when bees are actively foraging.

Phytophthora Root Rot

Ridomil Gold SL, Ridomil Gold GR, Ridomil/Copper, Orondis Gold B, and Orondis Gold 200 are all labeled for control of *Phytophthora* root rot on brambles. See the labels for more detailed information on application rates and timing.

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

Many phosphorous acid fungicides are registered for *Phytophthora* root rot control on blackberry and raspberry, and they all 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. Recommendations for use vary among products. See labels for use recommendations and restrictions.

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

Blackberry 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. Products containing azoxystrobin (e.g., Abound, Satori, Acadia 2SC, ect.), Quilt Xcel, and Cover XL are labeled for control on blackberry; however, 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. Although this sacrifices one year of production, the practice may provide short-term control.

Varieties vary in susceptibility. 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 become infected over time.

Blackberry Downy Mildew

Blackberry downy mildew is caused by the fungus-like (oomycete) *Peronospora sparsa*. It was first reported in Ohio, in 2018. The pathogen spreads systemically and

infects both the leaves and fruit. Stunting can occur in infected plants even when foliar symptoms are not visible. The disease is most severe during wet weather with cool to warm temperatures. The cultivated varieties Chester, Arapahoe, Apache, and Navaho have been reported to be moderately resistant. Purchase plants from a reputable nursery and inspect them for signs or symptoms of downy mildew before planting. Early symptoms include light green to yellow leaves with brown to red spots, stunting, and red streaking on the stems and petioles. Fungicides containing mefenoxam or potassium phosphite provide the best level of control. Applications of potassium phosphite can result in phosphorous deficiencies; a balanced nutritional program therefore should be followed and monitored.

Orange Rust

All cultivars of black and purple raspberries and most erect and trailing blackberries are very susceptible to orange rust. Unlike all other fungi infecting brambles, this fungus grows systemically throughout the roots, crowns, and shoots of infected plants and is perennial in belowground plant parts. 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. Alternate Rally with Abound (or another axozystrobin product), Cabrio, or Pristine in the spray program to prevent fungicide resistance development.

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).

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.

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
Hero	3A	zeta-cypermethrin	HT		E	E	E	E					E	E	E	E			3	12
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	pyriproxifen	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	abamectin	HT	E															7	12
JMS Stylet-Oil (OMRI)	oil		ST	E															0	4
Kanemite	20B	acequinocyl	MT															G	1	12
Microthiol Disperss (OMRI)	UN	Sulfur		E															0	24
M-Pede (OMRI)	insecticidal soap	potassium salts of fatty acids	ST	E															0	12
Savey	10A	hexythiazox	ST															E	3	12
Zeal	10B	etoxazole	MT															E	12	0

¹P = 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	Anthraxnose	Cane blight/spur blight	Raspberry leaf spot/Septoria 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	U	0 (92.3 fl. oz.)	4
Aliette WDG	fosetyl-AL	33	U	U	U	U	U	U	E	60 (4 app.)	12
Badge SC	copper sulfate + oxychloride*	M	G	G	G	U	U	F	U	0 (35.2 pts.)	48
basic copper sulfate	copper sulfate*	M	G	G	G	U	U	F	U	0**	12
Cabrio EG	pyraclostrobin	11	G	G	G	G	G		U	0**	12
Captan 50WP	captan*	M	G	G	G	G	U	U	U	3 (10 lbs.)	48
CaptEstate 68WDG	captan + fenhexamid	M 17	G	G	G	E	G	U	U	30 (21 lbs.)	48
Elevate 50WDG	fenhexamid	17	U	U	U	E	U	U	U	0 (6 lbs.)	12
Kocide 2000	copper hydroxide*	M	U	U	U	U	U	U	U	0 (28.6 lbs.)	48
Luna Tranquility	fluopyram + pyrimethanil	7 + 9	U	U	U	U			U	0 (54.7 fl. oz.)	12
Nordox	cuprous oxide*	M	U	U	U	U			U	0 (24 lbs.)	24
Orondis Gold 200	oxathiapiprolin	U15	U	U	U	U			U	1 (19.2 fl. oz.)	4
OSO 5% SC, PH-D WDG	polyoxin D	19	U	U	U	U			U	0 (4.2 oz.)	4
Pristine	pyraclostrobin + boscalid	11 + 7	E	E	E	E	E	E	U	0 (92 oz.)	12
Prolivo 300 SC	pyriofenone	U8	U	U	U	U	U	U	U	0 (16 fl. oz.)	4
Phostrol	phosphorous acid*	33	U	U	U	U	U	U	E	0**	4
Quilt Xcel/Cover XL	azoxystrobin + propiconazole	11 + 3	G	G	G	G	G	G	U	30 (63 fl. oz.)	12
Rally 40WSP	myclobutanil	3	U	U	G	U	E	E	U	0 (10 oz.)	24
Ridomil Gold SL	mefenoxam*	4	U	U	U	U	U	U	E	45 (2 app.)	48
Ridomil Gold/Copper	mefenoxam + copper hydroxide	4 + M	U	U	U	U	U	U	E	0 (2 app.)	48
Rovral 4 Flowable	iprodione*	2	U	U	U	E	U	U	U	0 (8 pts.)	24
Sulfurix	calcium polysulfide	M	E	G	G	U	U	U	U	0**	48
sulfur	sulfur*	M	G	U	U	U	U	U	U	0**	24
Switch 62.5 WG	cyprodinil + fludioxonil	9 12	U	U	U	E	U	U	U	0 (56 oz.)	12
Tanos	famoxadone + cymoxanil	11 27	G	G	G	U	U	U	U	0 (72 oz.)	12
Tilt	propiconazole*	3	U	U	U	U	E	E	U	30 (30 fl. oz.)	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.

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 may 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 may 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 may stunt plants.
	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	6.0-15.5 fl. oz.	Registered for control of leaf spot, powdery mildew, and anthracnose. Registered for control of leaf spot, powdery mildew, and anthracnose. Generic azoxystrobin products include Acadia, Aframe, AzoxyStar, and more.
	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. Suppresses Botrytis.
	Flint Extra	2.5-3.0 fl. oz.	Controls powdery mildew and Phomopsis. Suppresses anthracnose. Flint Extra is a replacement for Gem.
	Fontelis	16-24 oz.	For powdery mildew only. Do not use on Clancy, Jewel and L'amour varieties.
	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.	Does 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.	Generics include Aframe Plus and Cover XL.
	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. Does not control anthracnose.
	Switch	11.0-14 oz.	Not labeled for leaf spots, scorch, or blight.
	Tilt	4 fl. oz.	Tilt is a propiconazole. Generics include Bumper, Protocol, Topaz, and more.
	Topguard EQ	5-8 oz.	Do not use with silicone surfactants.
	Torino	3.4 fl. oz.	Controls powdery mildew only and must be used in a protectant program.
red stele	See Leather Rot and Red Stele, page 117.		

(continued)

Strawberry Early Spring (Pre-bloom) *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
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.
	Radiant 1SC	6-10 fl. oz.	
	Sivanto Prime	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.
spider mites	Sevin XLR Plus (4F)	1.5-2 qts.	Other formulations may be available.
	Acramite 50WS	0.75-1.0 lb.	
	Agri-Mek SC	3.5 fl. oz.	Must use an adjuvant.
	Danitol 2.4EC	16-21.33 fl. oz.	
	Kanemite 15SC	21-31 fl. oz.	
	Nealta 1.67SC	13.7 fl. oz.	
	Nexter 75WP	4.4-10.67 oz.	
	Oberon 2SC	12-16 fl. oz.	
	Portal XLO	2 pts.	
	Savey 50DF	6 oz.	Kills eggs and young nymphs, not adults.
cyclamen mite	Zeal 72WP	2-3 oz.	Zeal is primarily an ovicide/larvicide and, if needed, should be used early in the season.
	Portal XLO	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.
Botrytis blossom blight and fruit rot	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.
	Intuity	6 fl. oz.	Controls Botrytis. Suppresses powdery mildew.
	Kenja 400SC	13.5-15.5 fl. oz.	For powdery mildew and anthracnose.
	Luna Sensation	6-7.6 fl. oz.	Higher rate controls Botrytis, powdery mildew, leaf spot, anthracnose, and Phomopsis leaf blight.
	Luna Tranquility	16-27 fl. oz.	Controls Botrytis, powdery mildew. Suppresses leaf spot and Phomopsis blight.
	Merivon	8-11 fl. oz.	
	Rovral 4F	2.0 pts.	For control of anthracnose leaf spot, Phomopsis rot, and grey mold. This is the best timing for the application of this fungicide. Do not exceed 1 application per season. Use rate of 1.0 pts. in tank mix. Use 100 gal/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 season long Botrytis control because of the potential for pathogen strains to develop resistance.
	OR ANY OF THE ABOVE PLUS ONE OF THE FOLLOWING:		
	Captan 80WDG	1.9 to 3.75 lb.	
	Thiram 65WP	4 lbs.	
	OR ONE OF THE FOLLOWING ALONE:		
	Captan 80WDG	1.9 to 3.75 lb.	
	Captec 4L	1.5-3.0 qts./100 gals. water.	
	CaptEstate 68WG	3.5-5.25 lbs.	A combination of Captan plus Elevate. At the high rate of CaptEstate, 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.	Generic propiconazole products include Bumper, Propicure, Propimax, and more.
	Thiram 24/7	2-6 qts.	

(continued)

Strawberry Early Bloom through Bloom *(continued)*

Pest/Problem	Material	Rate/Acre	Comments
powdery mildew, leaf spot, leaf blight, leaf scorch	Abound	6.0-15.5 fl. oz.	Registered for control of powdery mildew and anthracnose. Generic azoxystrobin products include Acadia, Aframe, AzoxyStar, and more.
	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.
	Luna Sensation	4-7.6 fl. oz.	
	Luna Tranquility	16-27 fl. oz.	
	Merivon	4-8 fl. oz.	
	Mettle	3-5 fl. oz.	Does 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. Generic propiconazole products include Bumper, Propicure, Propimax, and more.
	Quadris Top	12-14 fl. oz.	
	Quilt Xcel	14 fl. oz.	Generics include Aframe Plus and Cover XL.
	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.	Tilt is a propiconazole. Generics include Bumper, Protocol, Topaz, and more.
	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.	Generic azoxystrobin products include Acadia, Aframe, AzoxyStar, and more.
	Aftershock	2.0-5.7 fl. oz.	
	Cabrio 20EG	12-14 oz.	
	Captan 50WP	3-6 lbs.	
	CaptEvate	5.25 lbs.	
	Evito	2.0-5.7 fl. oz.	
	Flint Extra	2.5-3 fl. oz.	0-day PHI.
	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.
	Pristine 38WG	18.5-23 oz.	
	Protocol	1.33 pts.	Generic propiconazole products include Bumper, Propicure, Propimax, and more.
	Quadris Top	12-14 fl. oz.	
	Quilt Xcel	14 fl. oz.	
	Switch 62.5WG	11-14 oz.	
	Tilt	4 fl. oz.	Tilt is a propiconazole. Generics include Bumper, Protocol, Topaz, and more.
	Topguard EQ	5-8 oz.	21-day PHI. For anthracnose fruit rot, powdery mildew, and leather rot. Suppresses Botrytis on foliage.
	Topsin M WSB	0.75-1.0 lb.	
	OR ANY OF THE ABOVE PLUS:		
	Captan 80WDG	1.9 to 3.75 lb.	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 125-126) and Insecticide and Miticide PHIs and REIs tables (pages 125-126).

Pest/Problem	Material	Rate/Acre	Comments
Botrytis fruit rot	Same as for Strawberry Early Bloom through Bloom, page 113. A good layer of straw mulch reduces berry contact with soil and lessens 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 CaptElate close to harvest may result in visible fungicide residues on the fruit. Elevate, Merivon, Pristine, Switch, or Topsin M alone result in little or no visible residues.		
anthracnose fruit rot	Same as for Strawberry Early Bloom through Bloom, page 114. See note about visible fungicide residue on fruit. See Anthracnose Fruit Rot page 117.		
leather rot	Abound	6.0-15.5 fl. oz.	Generic azoxystrobin products include Acadia, Aframe, AzoxyStar, and more.
	Cabrio 20EG	12-14 oz.	
	phosphorous acid products	See label	See Leather Rot and Red Stele (page 117) 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, page 114.		
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 (page 154) 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.	
	Danitol 2.4 EC	10.67-21.33 fl. oz.	
	Entrust 2SC	4-6 fl. 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.	
	Danitol 2.4EC	16-21.33 fl. oz.	2-day PHI.
	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.	
	Exirel 0.83SE	13.5-20.5 fl. oz.	
	Radiant 1SC	6-10 fl. oz.	
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)	25 lbs.	
	Sluggo	20-44 lbs.	
crickets	Sevin 5 Bait	40 lbs.	7-day PHI.
strawberry rootworm (adult beetles)	Insecticides used for control of other strawberry pests are likely to control this pest as well. It 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: Controlling Botrytis during bloom greatly reduces or eliminates the need for additional fungicide applications during harvest. 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.	0-day PHI.
	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.
	Luna Sensation	6-7.6 fl. oz.	Can be used up to day of harvest.
	Luna Tranquility	16-27 fl. oz.	1-day PHI.
	Merivon	8-11 fl. oz.	0-day PHI.
	Pristine	18.5-23 oz.	
	Scala SC	18 fl. oz.	
	Switch 62.5WG	11-14 oz.	0-day PHI.
	Topsin M WSB	0.75-1 lbs.	1-day PHI.
	OR ANY OF THE ABOVE PLUS:		
	Captan 80WDG	1.9 to 3.75 lb	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 117. See note on visible fungicide residue on fruit.		
leather rot	See Leather Rot and Red Stele, page 117.		

Strawberry Post-harvest and New Plantings

Apply every 10-14 days as needed.

Pest/Problem	Material	Rate/Acre	Comments
anthracnose crown rot	If weather is warm and wet during planting or establishment, apply Abound, Cabrio, or Pristine as protectants. These fungicides may also be used to protect plugs prior to planting. Scout for anthracnose crown rot during autumn and spring when weather is conducive to disease. See section on annual plasticulture production on page 117.		
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 80WDG	1.9 to 3.75 lbs.	
	Thiram 24/7	2-6 qts.	
	Topsin M WSB	0.75-1 lb.	
powdery mildew, leaf blight, leaf spot, leaf scorch	Same as for Strawberry Early Bloom through Bloom, page 114.		
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 117.		
leather rot, red stele	See Leather Rot and Red Stele, page 117.		

Special Comments on the Strawberry Schedule

Annual Plasticulture Strawberry

Timely planting of healthy plugs is key to establishing a successful planting. Planting date influences runner and branch crown formation. Too early is better than too late. If planted too early, energy is directed toward runner formation; if planted too late, the 4-5 branch crowns that are desired at flowering may not develop in time. Research in Ohio and central Kentucky has identified early to mid-September as best for plugs in most years. Growers further north or at higher elevations in the Appalachian Mountains may be able to plant in late August, while growers further south or west may be able to plant slightly later. On-farm research over a number of years gives growers the best planting window for their particular location. Weed management in the row is usually accomplished by applying a pre-emergent herbicide beneath the plastic prior to laying the plastic to control winter annuals. Growers use different strategies to manage weeds between rows. Many have had success by simply planting a cover crop of annual ryegrass or cereal rye to suppress weeds and then killing it with a graminicide in the spring. Insect management is usually not a significant issue. All growers should plant disease-free plugs; however, it's also a good idea to make a fungicide application for anthracnose crown rot to the plug trays or to the plants in the field after planting, especially since infections may be present but symptoms can be delayed or go unnoticed until they become more serious.

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, and Rampart.

These materials are highly systemic as foliar sprays for leather rot control or as root dip for red stele control. 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 temperatures accompanied by rainfall before and during harvest. If anthracnose was a problem last year, or 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.

The risk for fungicide resistance is high in the fungi that cause powdery mildew and anthracnose. To prevent or delay fungicide resistance, follow label recommendations on rotations and maximum numbers of applications per season. 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 standard for anthracnose control but is not as effective as Abound, Cabrio, or Pristine. However, little to no risk of fungicide resistance is associated with it. 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 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. The weevils lack mobility, so 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
June Bearing				
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
CaptElate	G	G	0	E	F	G
Elevate	0	0	0	E	0	0
Fontelis	?	?	E	E	0	0
Luna Sensation		G	E	E	E	E
Luna Tranquility			E	E		
Merivon		E	F	E		E
Mettle	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
CaptEstate	captan + fenhexamid	M	0 (21 lbs.)	24
17	0	24	0*	12
Evito	fluoxystrobin	11	1	12
Fontelis	penthiopyrad	7	0	12
JMS Stylet Oil	oil	-	0	4
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, 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	29												E		0	12
Brigade	bifenthrin	3A	E		E	G	E				E	F	E	E		0	12
Coragen	chlorantraniliprole	28					E									1	4
Courier	buprofezin	16				F										3	12
Danitol	fenpropathrin	3A	E		E	G	E				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
Exirel	Cyantraniliprole	28										G				1	12
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
Nexter	pyridaben	21										G				1	12
Oberon	spiromesifen	23										G				3	12
Platinum	thiamethoxam	4A	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.

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 them.

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 control. No single material or technique is effective for complete control of voles. We therefore suggest you vary both the materials and methods of control during the season.

You can construct tree guards from “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 tends to discourage meadow voles from attacking crowns of trees, but does not discourage other mouse species.

Voles need abundant cover to proliferate. Maintaining a clean area 1 to 2 feet around the base of each tree discourages surface feeding and also regulates vole populations long term. Chemical weed control in early spring significantly reduces the amount of labor involved in keeping the area around the tree clean.

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. The three common species are 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 either as 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 available as a weather-resistant, pellet-style bait. It is highly accepted by rodents but does not kill them for several days. For effective control, 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 results 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 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. Some voles survive the pre-harvest control and enter fruit boxes on the ground that are carried into cold storage.
2. The pre-harvest poison application reduces the population of voles in the orchard, which greatly reduces competition among survivors, making food and cover ample. Under these favorable conditions, survivors breed, with as many as eight young per litter. In a very short time, populations may recover to original levels, and are 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.

Before harvest

- Poison rats and mice in storage one month before picking. Keep storage area baited and free of debris.
- Clean up outside debris one week before picking. Pay special attention near loading areas.
- Use rodent-proof storage. Seal all holes and cracks. Mice can fit through a hole the size of a dime.

During harvest

- Move filled boxes into storage quickly. Any box left overnight may have mice.
- 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. Squares of heavy roofing shingles (or other weather-resistant materials) placed out of traffic areas between trees can serve as bait stations to protect the bait and hiding of rodents.

Some growers have constructed bait stations that require less refilling by building inverted T-shaped stations from PVC tubing and fittings that provide bait storage and a protected feeding area. Place bait stations in the field 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. Apply this product only 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 (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.

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		
Abound, AFrame	azoxystrobin	—	—	0	0	0	11	4
Aframe Plus?	azoxystrobin+propiconazole	—	—	0	0	0	11+3	12
Aliette, Legion	fosetyl-AL	14*	14*	—	—	—	33	12
Agri-Fos, Phostrol, ProPhyt, Rampart	phosphorous acid	0	0	0	0	0	33	4
Agri-strep	streptomycin	50	30	—	—	—	25	12
Aprovia	benzovindiflupyr	30	30	—	—	—	7	12
Bayleton	triadimefon	0	0	—	—	—	3	12
Bravo and many generics	chlorothalonil	—	—	*SS	SS*	SS*	M	48
Captan	captan	0	—	0	0	0	M	4
CaptEstate	captan + fenhexamid	—	—	—	0	—	M+17	24
Carbamate	ferbam	7	7	21	4	7	M	24
Elevate	fenhexamid	—	0	0	0	0	17	12
Flint	trifloxystrobin	14*	14*	—	—	—	11	12
Flint Extra	Trifloxystrobin(higher rate)	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*	—	3+9	12
Luna Experience	fluopyram + tebuconazole	—	—	0	0	0	7+3	12
Luna Sensation	fluopyram + trifloxystrobin	14	14	1	1	1	7+11	12
Luna Tranquility	fluopyram + pyrimethanil	72	—	—	—	—	7+9	12
Mancozeb: Penncozeb, Dithane M-45, 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
OSO, Ph-d	Polyoxin D	0	0	0	0	0	19	4
Polyram	metiram	77*	—	—	—	—	M	24
Pristine	pyraclostrobin + boscalid	0*	0*	0*	0*	0*	11+7	12
Procure/Trionic	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	—	0	0	0	3	24
Rhyme	flutriofol	14	14	7	7	7	3	12
Ridomil Gold SL	mefenoxam	*	*	*	*	*	4	48
Rovral	iprodione	—	—	*	*	*	2	24
Scala	pyrimethanil	72	72	2*	—	2*	9	12
Sovran	kresoxim-methyl	30*	30*	—	—	—	11	12
Sulfur	sulfur	0	0	0	0	0	M	24

(continued)

Fungicide Pre-harvest Intervals and Restricted Entry Intervals for Tree Fruit¹ (continued)

Trade Names	Common Names	Pre-harvest Interval (days)					FRAC Code ²	REI ³ (hours)
		Apple	Pear	Peach	Cherry	Plum		
Syllit	dodine	7*	7*	15*	7	—	U12	48
Topguard/Topguard Specialty Crop	flutriafol	14*	14*	7*	7*	7*	3	12
Topguard EQ	Azoxystrobin+ flutriafol	--	--	7	7	7	3+11	12
Topsin-M	thiophanate-methyl	0	1*	1	1	1	1	12
Torino	cyflufenamid	14	14	—	—	—	U6	4
Vanguard	cyprodinil	0	0	2	2	2	9	12
Vintage	fenarimol	30	30	—	0	—	3	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. SS= shucks-split

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 33.

Insecticide and Miticide PHIs and REIs

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

See Generic Insecticides, pages 153-154. Consult product labels for complete restrictions and limitations.

Trade Name	Common Name	Pre-harvest Interval (days)					IRAC ²	REI ³ (hours)	Repirator required
		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	Yes
Asana (RUP)	esfenvalerate	21*	28*	14*	14*	14*	3A	12	
Assail	acetamiprid	7	7	7	7	7	4A	12	Yes*
Avaunt	indoxacarb	14	28	14	14	14	22	12	
Baythroid XL (RUP)	beta-cyfluthrin	7	7	7	7	7	3A	12	No*
BeetleGONE!	B. thuringiensis galleriae	0	0	0	0	0	11A	4	Yes
Belay	clothianidin	7	7	21	—	—	4A	12	
Beleaf 50 SG	flonicamid	21	21	14	14	14	29	12	
Brigade (RUP)	bifenthrin	—	14	—	—	—	3A	12	
Centaur	buprofezin	14	14	14	14	14	16	12	
Closer	sulfoxaflor	7	7	7	7	7	4c	4	
Confirm	tebufenozide	14	14	—	—	—	18	4	
Cyd-X (OMRI)	codling moth granulovirus	0	0	—	—	—	—	4	Yes
Danitol (RUP)	fenpropathrin	14	14	3	3	3	3A	24	
Delegate	spinetoram	7	7	1	7	1	5	4	

(continued)

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

Trade Name	Common Name	Pre-harvest Interval (days)					IRAC ²	REI ³ (hours)	Repirator required
		Apple	Pear	Peach	Cherry	Plum			
Delta Gold (RUP)	deltamethrin	21	21	—	—	—	3A	12	
Dimethoate	dimethoate	—	28	—	—	—	1B	48	Yes
Dimilin* (RUP)	diflubenzuron	—	14	UPF	UPF	UPF	15	12	No*
Diazinon (RUP)	diazinon	21	21	21	21	21	1B	5 days	Yes
Dicofol	dicofol	7	7	—	—	—	—	35 days	Yes
Dipel (OMRI)	Bacillus thuringiensis	0	0	0	0	0	11A	4-12	Yes
Entrust (OMRI)	spinosad	7	7	1	7	1	5	4	Yes
Envior	spiroticlofen	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	Yes
Intrepid	methoxyfenozide	14	14	7	7	7	18	4	
Kanemite	acequinocyl	14	14	—	—	—	20B	12	
Lannate (RUP)	methomyl	14	7	4	—	—	1A	*	Yes
Lorsban (RUP, EC only)	chlorpyrifos	UPF*	*	14*	21	14	1B	4 days	Yes
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	25	7/10	7/10	7/10	7/10	21A	12	Yes
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	No*
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	Yes
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	Yes
Surround (OMRI)	kaolin	0	0	0	0	0	—	4	Yes
Vendex (RUP)	fenbutatin-oxide	14	14	14	14	14	12B	48	Yes
Venom, Scorpion	dinotefuran	—	—	3/21	—	—	4A	12	
Vydate (RUP)	oxamyl	14	14	—	—	—	1A	48	Yes
Versys Inscalis	afidopyropen	7	7	7	7	7	9D	12	
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.

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 in 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.

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

See Generic Fungicides, page 152. 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, 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*(20 lb)	60(*)	12 hr.(30 lb)	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 80WDG (formulations and times may vary)	captan	0 (15 lbs.)	0 (43.75 lbs.)	3(12.5 lb)	1(30 lb)	M	48
CaptEstate	captan + fenhexamid	—	0 (21 lbs.)	0 (21 lbs.)	3(21 lbs)	M + 17	24 strawberry 48 blueberry and raspberry ⁵
Dithane, others	mancozeb	66*	—	—	—	M	24
Elevate	fenhexamid	0*(3lb.)	0 (6lbs.)	0(6 lbs.)	0*(6 lbs.)	17	12
Endura	boscalid	14(24 oz.)	—	—	—	7	12
Evito	fluoxystrobin	—	—	—	1	11	12
Flint	trifloxystrobin	14(24 oz.)	—	—	1(19.2 oz.)	11	12
Fontelis	penthiopyrad	—	0(72 fl. oz.)	—	0(72 fl. oz.)	7	12
Forum	dimethomorph	28(30 fl. oz.)	—	—	—	40	12
Indar	fenbuconazole	—	30(24 fl. oz.)	—	—	3	12
Inspire Super	difenoconazole + cyprodinil	14*(80 fl. oz.)	7 (80 fl. oz.)	—	0(80 fl. oz.)	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 Sensation	fluopyram + trifloxystrobin	—	0(27.1 fl. oz.)	—	0 (27.1 oz.)	7 + 11	12
Luna Tranquility	fluopyram + pyrimethanil	—	1 (54.7 fl. oz.)	0 (54.7 fl. oz.)	1 (54.7 oz.)	7 + 9	12
Merivon	fluxapyroxad + pyraclostrobin	14(33 oz)	—	—	0 (33 fl. oz.)	7 + 11	12
Mettle	tetraconazole	14	—	—	0	3	12
Omega	fluazinam	—	30 (7.5 pts.)	—	—	29	12
OSO, PHD	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*(23 oz)	0*(23 oz)	0*(92 oz)	0*(23 oz)	11 + 7	12 ⁶
Procure, Trionic	triflumizole	7 (32 oz.)	—	—	1	3	12
ProPhyt, Phostrol, Agri-Fos, Legion, Rampart	phosphorous acid	0	0	0*	0	33	4

(continued)

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

Trade Name	Common Name	Pre-harvest Intervals (days) (Maximum amount/acre/season) ²				FRAC ³ Code	REI ⁴ (hours)
		Grape	Blueberry	Brambles	Strawberry		
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(56 fl. oz.)*	7(56 fl. oz.)	—	1(56 fl. oz.)	3 + 11	12
Quash	metconazole	—	—	7 (7.5 oz.)	—	3	12
Quilt Xcel	azoxystrobin + propiconazole	--	30 (82 fl. oz.)	30 (105 fl. oz.)	0 (56 fl. oz.)	11+ 3	12
Quintec	quinoxifen	14*(33 fl. oz.)	—	—	1*(24 fl. oz.)	13	12
Rally	myclobutanil	14 (1.5 lbs.)	—	1 (10 oz.)	1 (10 oz.)	3	24
Ranman	cyazofamid	30*(16.5 fl. oz.)	—	—	—	21	12
Reason	fenamidone	30 (8.1 fl. oz.)	—	—	—	11	12
Revus	mandipropamid	14(32 fl. oz.)	—	—	—	40	12
Revus Top	difenoconazole + mandipropamid	14*(28 fl. oz.)	—	—	—	3 + 40	12
Ridomil Gold SL	mefenoxam	—	*	45(0.9 gal.)	0(1.5 qt.)	4	48
Ridomil Gold MZ	mefenoxam + mancozeb	66(10 lb)*	—	—	—	4 + M	48
Rovral	iprodione	7*(8 pts.)	0*(8 pts.)	0*(8 pts.)	0*(2 pts.)	2	24 (fruit)/48 (grape) ⁷
Scala	pyrimethanil	7(36 fl. oz.)	—	—	1(54 fl. oz.)	9	12 ⁸
Sovran	kresoxim-methyl	14*(25.6 oz.)	—	—	—	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(72 oz.)	—	0(72 oz.)	—	11 + 27	12
PhD, 5%OSO, Affirm	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
Tebuzaol	tebuconazole	14(2 lb.)	—	—	—	3	12
Thiram	thiram	—	—	—	3	M	24
Tilt, Bumper,	propiconazole	—	30(30 fl. oz.)	30(30 fl. o.z)	0(16 fl. oz.)	3	12
Topsin M	thiophanate	14 (4 lb.)	—	—	1(4 lb.)	1	24 (strawberry)/48 (grape) ⁹
Torino	cyflufenamid	3*(6.8 fl. oz.)	—	—	0(6.8 fl. oz.)	U6	4
Vanguard	cyprodinil	7*(30 oz.)	—	—	—	9	12
Vivando	metrafenone	14 (42.6 fl. oz.)	—	—	—	U8	12
Zampro	ametoctradin + dimethomorph	14 (56 fl. oz.)	—	—	—	45 + 40	12
Ziram	ziram	21*(28 oz)	*	—	—	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. CaptEvate has different REIs for each crop. Refer to label.

⁶ REI for Pristine is 12 hr EXCEPT for grapes when conducting cane tying, cane turning, or cane girdling, which is then 5 days.

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 evolve resistance to fungicides after repeated exposure. To manage fungicide resistance, avoid successive applications of fungicides in the same group or type of chemistry.

Several tables in this guide list Fungicide Resistance Action Committee (FRAC) codes, including grape (page 91), blueberry (page 100), brambles (page 110), strawberry (page 120), tree fruit (page 124), and small fruit (page 127). 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, Bumper, Quilt Xcel, Tilt).

These fungicides are also at-risk for resistance development: thiophanate-methyl (Topsin M, T-methyl), fenhexamide (Elevate), SDHI [Aprovia, Endura, Kenja, and pre-mix partners boscalid (Pristine), fluopyram (Luna series), and fluxapyroxad (Merivon)], 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.

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

See Generic Insecticides, pages 153-154. *Consult product labels for complete restrictions and limitations.*

Trade Name	Common Name	Pre-harvest Intervals (days)				IRAC ² Code	REI ³ (hours)	Respirator required
		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	Yes
Avaunt	indoxacarb	7	7	—	—	22	12	
Baythroid (RUP)	cyfluthrin	3	—	—	—	3	12	Yes
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	

(continued)

Insecticide and Miticide Pre-harvest Intervals and Restricted Entry Intervals on Small Fruit¹ *(continued)*

Trade Name	Common Name	Pre-harvest Intervals (days)				IRAC ² Code	REI ³ (hours)	Respirator required
		Grape	Blueberry	Brambles	Strawberry			
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	—	5	—	5*	1B	120	Yes
Dibrom (RUP)	naled	10	—	—	1	1B	48/72	Yes
Dicofol	dicofol	7	—	—	2/3	UN	31/39 days	Yes
DiPel ⁴ (OMRI)	B. thuringiensis	0	0	0	0	11A	4	Yes
Entrust (OMRI)	spinosad	7	1	1	1	5	4	Yes
Envior	spirodiclofen	14	—	—	—	23	12	
Esteem	pyriproxyfen	—	7	—	—	7C	12	
Exirel	cyantraniliprole	—	3	—	1	28	12	
Imidan	phosmet	7/14	3	—	—	1B	24 hr/14 days	Yes
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*	Yes
Lorsban (some RUP)	chlorpyrifos	35*	—	—	21*	1B	24	Yes
Malathion	malathion	3*	1*	1	3	1B	12/24	
Movento	spirotetramat	7	—	—	—	23	24	
Mustang Maxx (RUP)	zeta-cypermethrin	1	1	1	—	3A	12	
Mycotrol	Beauveria	0	0	0	0	—	4	Yes
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	3A	12	Yes
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	Yes
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	Yes
Vendex (RUP)	fenbutatin-oxide (hexakis)	28*	—	—	1*	12B	48	Yes
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 in the same group or type of chemistry. The Insecticide Resistance Action Committee (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.

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, Kudos	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-vide	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 greatly improves 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

For herbicides to be effective, you must properly select them 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, the given herbicide rates 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, 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 is 4/10 of the broadcast rate per acre.

Herbicides can injure fruit plants if used improperly. 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, deposits herbicide uniformly.

Consider using one of the recently introduced low-drift nozzles such as the Turbo TeeJet Nozzle or TurboDrop Nozzle. They have been designed to provide similar performance to traditional flat fan nozzles while reducing the number of very small droplets that are highly subject to drift.

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 it 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 to avoid building up herbicide-resistant weed biotypes. We recommend 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 important for best results.

Growers often 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 controls any weeds that have emerged since the first application and puts the pre-emergence in place at the right time so it lasts through the main period of weed emergence.

Spot treatments with suitable post-emergence herbicides keeps 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 the table on pages 155-157 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. 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 the herbicides can be used on, as well as the timing and rates for which these materials are registered. Use only registered materials at the recommended rates for the crops listed. 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. Spray only in 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

For generic herbicides, see page 155.

Weed Problem	Material and 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. 14-day PHI.
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. 60-day PHI.
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.	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.	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 per 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 burns 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 improves 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. 7-day PHI.
annual grasses and broadleaves	Princep 4L (simazine 4 lbs. a.i./gal.) at 2-4 qts. in minimum of 40 gals. of water.	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. 150-day PHI 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.	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. 60-day PHI. Non-bearing: (young, newly planted) Apple: Apply at 0.5-1 lb. Make the first application after a significant rainfall or irrigation event that allows the ground to settle around the base of the trees. Make 1-2 applications per season. Do not exceed 1 lb. per year. Do not use on soils with <1% organic matter.

(continued)

Herbicide Recommendations for Apple and Pear *(continued)*

Weed Problem	Material and Rate per Acre	Notes and Comments
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. 60-day PHI.
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water.	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. per 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. per year. Minimum 14 days between applications. 3-day PHI. 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.	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 per year. Maximum 75 days between applications. 14-day PHI.
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. 60-day PHI.
annual broadleaves	Goal 2XL (oxyfluorfen 2lbs.a.i./gal.) at 2-8 pts in minimum 40 gals. water	See Pre-emergence section (page 134) 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.	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 per year. 28-day PHI. Restricted use pesticide.
annual grasses and broadleaves	Karmex DF (diuron 80% a.i.) at 4 lbs. in 25-40 gals. of water.	See Pre-emergence section (page 134) 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. per application or 7.5 pts. per season. 14-day PHI.
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	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 246 fl. oz. per acre in a 12-month period. Do not make spot or directed spray applications to tree trunks or to apple suckers, as tree injury may occur. 14-day PHI.

(continued)

Herbicide Recommendations for Apple and Pear *(continued)*

Weed Problem	Material and Rate per Acre	Notes and Comments
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	Rate depends on weed species and stage of growth. See label for details. Do not exceed 7 qts. per acre per 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. 1-day PHI.
broadleaves and nutsedge	Sandea (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. per 12-month period. May not control ALS-resistant weeds. Make a single application using a minimum of 0.75 oz. per 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.
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 in 10 gals. or more of total spray volume per acre	Apple only: 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. Do not exceed a total of 2/3 pt. per acre per crop year. 30-day PHI.
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. per acre per cropping season. Trunk shields should be used until trees have been established for 2-3 years. For optimum burndown, use with methylated seed oil (MSO), ammonium sulfate (AMS), or urea ammonium nitrate (UAN) adjuvant. Do not use an NIS as a substitute for MSO. Apply only when wind is 10 mph or less and blowing away from nontarget areas. Rainfast in 1 hour. Do not use in tree nurseries. 0-day PHI.
annual and perennial broadleaves	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. per acre per 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 and 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. 14-day PHI.
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 gals. 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. per season or exceed 2 applications per growing season. Minimum 30 days between applications. 60-day PHI.

(continued)

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

Weed Problem	Material and 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	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. per year.
annual grasses and broadleaves	Karmex DF diuron (80% a.i.) at 2-5 lbs. in 25-40 gals. of water	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 per year. 20-day PHI for IL and MO. 3-month PHI for other states.
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 burns 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 improves 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. 14-day PHI.
annual grasses and broadleaves	Princep 4L (simazine 4 lbs. a.i./gal.) at 1.6-4 qts. in minimum of 40 gals. of water	Apply under trees established at least 1 year. Apply in spring before weeds emerge avoiding contact with fruit, foliage, or stems. Peach Only: Use only in AR, MO, and states east of the Mississippi River. Plum, 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	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. 60-day PHI. 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 allows the ground to settle around the base of the trees. Make 1-2 applications per season. Do not exceed 1 lb. per year. Do not use on soils with <1% OM.
annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (noraflurazon 78.6% a.i.) at 3.75-5 lbs. in minimum of 20 gals. of water	Apply a directed spray 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. 60-day PHI.
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water	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. per 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	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.

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

Weed Problem	Material and Rate per Acre	Notes and Comments
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. per year. Minimum 14 days between applications. 3-day PHI. 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	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 per year. Minimum 75 days between applications. 40-day PHI on bearing trees.
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. per acre per season. 14-day PHI.
annual broadleaves	Goal 2XL (oxyfluorfen 2 lbs. a.i./gal.) at 5-8 pts. in minimum of 40 gals. of water	See Pre-emergence section (page 137) 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	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 per year. 14-day PHI for peach. 28-day PHI for nectarine, plum, cherry. Restricted use pesticide.
annual grasses and broadleaves	Karmex DF diuron (80% a.i.) at 2-5 lbs. in 25-40 gals. of water	See Pre-emergence section (page 137) 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. per application or 5 pts. per season. Peach, plum, and nectarine are very tolerant to Poast and may be applied over the top of small non-bearing trees. 25-day PHI.
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	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. per acre in a 12-month period. Do not make spot or directed spray applications to tree trunks or to suckers as tree injury may occur. Applications must be a minimum of 28 days apart. 14-day PHI.
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)	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. 17-day PHI.
annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lbs. 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	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. 14-day PHI.
most annual and perennial grasses	Stinger (clopyralid 3 lbs. a.i./gal.) at 1/3-2/3 pts. in 10 gals. or more of total spray volume per acre	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. Do not exceed 2/3 pt. per acre per crop year. 30-day PHI.

Herbicide Recommendations for Non-bearing Fruit Trees Only

Weed Problem	Material and 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. per application or exceed 4 pts. per season. 1-year PHI.
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. per acre per season.
most broadleaves	Gallery 75DF (isoxaben 75% a.i.) at 0.66-1.33 lb in minimum of 10 gals. 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 (1/2 inch) is needed within 21 days of application. Not effective on germinated weeds. Minimum 60 days between applications. Maximum rate is 4 lbs. 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.
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 1/2 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. per 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. per 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. 12-month PHI on non-bearing trees.

Herbicide Recommendations for Grape

Weed Problem	Material and 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 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. per season. Minimum 30 days between applications. Also has post-emergence activity. 60-day PHI. 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	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. per acre per crop cycle. 70-day PHI.
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	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. per 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	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 per 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.
annual grasses and broadleaves	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 1/2 inch of rainfall or sprinkler irrigation occurs within 2 weeks after application. Age Restriction: Do not apply to vines established less than one year. 14-day PHI.
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. 75-day PHI.
annual grasses and broadleaves	Princep 4L (simazine 4 lbs. a.i./gal) at 2-4 qts. in 25-40 gals. of water	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 per 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	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.

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Herbicide Recommendations for Grape (continued)

Weed Problem	Material and 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. 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. per 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. 60-day PHI.
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water	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. Minimum 1/2 inch of rainfall or irrigation is required for activation. Minimum of 2.5 months between applications. Do not exceed 12 qts. per year.
annual grasses and broadleaves	Treflan HFP 4EC (trifluralin 4 lbs. a.i./gal.) at 1-4 pts. in 5-40 gals. of water	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. 60-day PHI.
annual and perennial broadleaves	Trellis (isoxaben 75% a.i.) at 0.67-1.33 lbs. in minimum of 10 gals. of water	Non-bearing: Apply any time before target weeds germinate or immediately after cultivation. 1-year PHI. Bearing: Apply before target weeds germinate or immediately after cultivation. Do not exceed 2 applications per crop year or exceed 1.33 lbs. (1.0 lb. isoxaben) per acre per crop year. 165-day PHI.
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. 3-day PHI. 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. 3-day PHI. 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 lba. 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. per year. Minimum 14 days between applications. 3-day PHI. 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. per application per acre or exceed 72 fl. oz. per acre per year. Minimum 14 days between applications. 50-day PHI.
annual broadleaves	Goal 2XL (oxyfluorfen 2 lbs. a.i./gal/) at 5-8 pts. in minimum of 10 gals. of water	See Pre-emergence section (page 140) for details.

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Herbicide Recommendations for Grape (continued)

Weed Problem	Material and Rate per Acre	Notes and Comments
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	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 per 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.
annual and perennial grasses and broadleaves	Mission (flazasulfuron 25% a.i.) at 2.14-2.85 oz. in 15-50 gal. of water	See Pre-emergence section (page 140) 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. per application or exceed 5 pts. per season. 50-day PHI.
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. 1-year PHI.
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	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. per acre per year. For spot application, mix 1.7 fl. oz./gal. 14-day PHI.
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	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. 14-day PHI.
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.	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. per year.
annual broadleaves	Venue (pyraflufen ethyl 0.177 lb. a.i./gal.) at 2.0-4.0 fl. oz.	Use as a directed spray from dormancy, prior to bloom. Repeat if needed. Keep off green stems and foliage. The addition of COC at 1-2% is recommended Do not exceed 6.8 fl. oz. per acre or 3 applications per growing season.

Herbicide Recommendations for Blueberry

Weed Problem	Material and 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 per year or exceed 6 fl. oz. per 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 and 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. per acre per application. Do not make a sequential application within 30 days of the first application. Do not exceed 12 oz. per acre per 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. 7-day PHI.
annual grasses and broadleaves	Devrinol 2-XT (napropamide 2 lbs. a.i./gal.) at 2 gals./acre (see Generic Herbicides, page 155)	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. per acre per crop cycle.
most broadleaves	Gallery 75DF (isoxaben 75% a.i.) at 0.66-1.33 lbs. in minimum of 10 gals. of water	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 1/2 inch is needed within 21 days of application. Not effective on germinated weeds. Minimum of 60 days between applications. Do not exceed 4 lbs. per acre per 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 newly transplanted blueberries until roots are well established. Restricted use pesticide.
annual and perennial grasses and broadleaves	Princep 4L (simazine 4 lbs. a.i./gal.) at 2-4 qts. in minimum of 40 gals. of water	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	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 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. per acre per year. 14-day PHI. 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.
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, 1/2 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. per 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 1/2 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. 60-day PHI.
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water	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 1/2 inch of rainfall or irrigation is required for activation. Minimum 2.5 months between applications. Do not exceed 12 qts. per year.

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Herbicide Recommendations for Blueberry (continued)

Weed Problem	Material and Rate per Acre	Notes and Comments
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. 90-day PHI. 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. 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. 3-day PHI. 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. per 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. 3-day PHI. 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. 1-day PHI.
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	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 48 fl. oz. in a maximum of two 24 oz. applications per year. Minimum 14 days between applications. 1-day PHI.
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	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 per 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. per application or exceed 5 pts. per season. 30-day PHI.
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. 1-year PHI.
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	Apply as a directed spray to actively growing weeds. Do not apply on desirable foliage or drift on foliage, green, or uncultured bark. Coverage of all foliage is necessary for optimum control. Do not exceed 164 fl. oz. per acre per year. 14-day PHI.
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	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) to minimize the potential for overspray or drift 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 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. 14-day PHI.
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.	Apply as a directed spray to actively growing grasses before tillering. Do not use COC. Minimum 14 days between applications. 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 64 fl. oz. per year. 14-day PHI.

Herbicide Recommendations for Brambles

Weed Problem	Material and 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.
annual broadleaves and suppression of grasses	Chateau SW (flumioxazin 51% a.i.) at 6 oz./acre in a minimum of 15 gals. of spray solution per acre	Supplemental label. Apply as a uniform band directed at the base of the canes. Preferred application timing is in the fall. Do not exceed 6 oz. per acre per application. Do not apply over the top of the crop or allow spray to come in contact with the crop as a result of application or drift. Do not apply within 300 yards of non-dormant pome or stone fruit. 7-day PHI.
annual grasses and broadleaves	Devrinol 2-XT (napropamide 2 lbs. a.i./gal.) at 2 gals./acre	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. per acre per crop cycle.
most broadleaves	Gallery 75DF (isoxaben 75% a.i.) at 0.66-1.33 lb. in minimum of 10 gals. of water	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 1/2 inch is needed within 21 days of application. Not effective on germinated weeds. Minimum 60 days between applications. Do not exceed 4 lbs. per acre per 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 per 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	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 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. 70-day PHI.
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, 1/2 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. per 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 1/2 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. 60-day PHI.
annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lbs. a.i./gal.) at 2-6 qts. in 20-40 gals. of water	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 1/2 inch is required for activation. Minimum 2.5 months between applications. Do not exceed 12 qts. per 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. 3-day PHI. 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.) per 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. 3-day PHI. Age Restriction: Apply to crops that have been growing for at least 3 years and are in good condition.

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Herbicide Recommendations for Brambles (continued)

Weed Problem	Material and Rate per Acre	Notes and Comments
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. per year. Minimum 14 days between applications. 15-day PHI. Primocane Control: Apply when primocanes are 6 inches at 6.4 fl. oz. in minimum of 20 gals. of water at intervals of 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	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 48 fl. oz. in a minimum of two 24 oz. applications per year. Minimum 14 days between applications. 1-day PHI.
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	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 per year. Restricted use pesticide.
annual grasses and broadleaves	Karmex DF (diuron 80%ai) at 3 lbs in 25-40 gals. of water. Select states only.	See Pre-emergence (page 145) 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. per season. May be used as a spot treatment at 1-1.5% solution. 45-day PHI.
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. 1-year PHI.
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	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) to minimize the potential for overspray or drift 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 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. 14-day PHI.
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.	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. 7-day PHI.

Herbicide Recommendations for Strawberry

Weed Problem	Material and 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.

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Herbicide Recommendations for Strawberry (continued)

Weed Problem	Material and Rate per Acre	Notes and Comments
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 cultivator 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.
annual grasses and certain broadleaves	Devrinol 2-XT (napropamide 2 lbs. a.i./gal.) at 2 gals./acre	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. 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. per acre per crop cycle. 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. per acre per crop cycle. Do not apply from bloom through harvest. 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. per acre per crop cycle. Do not apply from bloom through harvest.
annual broadleaves, especially winter annuals	Goal 2XL (oxyfluorfen 2 lbs. a.i./gal.) at 1-2 pts. in minimum of 40 gals. of water	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.
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.	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 provides the most benefit. Do not exceed 3 pts. per application or exceed 6 pts. per season. 35-day PHI.
annual grasses and broadleaves	Sinbar 80WP (terbacil 80% a.i.) at 2-8 oz. in minimum of 20 gals. of water	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, 1/2 to 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. 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. per season. 110-day PHI. 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.
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. Do not exceed 8 fl. oz. per acre per 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. 70-day PHI.
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. 0-day PHI.
annual and some perennial broadleaves	2,4-D amine (4 lbs. a.i./gal.) at 2-3 pts. in 25-50 gals. of water	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	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 16 fl. oz. per year. Do not exceed 1 application per year. 14-day PHI.

(continued)

Herbicide Recommendations for Strawberry (continued)

Weed Problem	Material and Rate per Acre	Notes and Comments
annual broadleaves	Goal 2XL (oxyfluorfen 2lb ai/gal) at 1-2 pts in minimum of 40 gals. of water	See Pre-emergence section (page 147) 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	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 per year. 21-day PHI. 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. per application or exceed 2.5 pts. per season. Caution: Application of Poast up to six weeks after Sinbar application can occasionally cause strawberry leaf injury. 7-day PHI.
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	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. 14-day PHI.
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	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. 4-day PHI.
annual and perennial broadleaves	Spur (clopypalid 3 lbs. a.i./gal) at 2/3 pts	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. per acre per 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. per acre per 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. 60-day PHI. 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. 120-day PHI.

Herbicides Registered for Weed Control in Small Fruit

Trade Name	Common Name	HRAC/WSSA ¹	Crop Use and PHI (days)	Risk of Resistance	Signal Word	REI (hours)
Pre-emergence control of grasses and/or broadleaf weeds						
Alion	indaziflam	L/21	grape (14)	medium	caution	12
Callisto	mesotrione	F2/27	Blueberry (prebloom)	medium	caution	12
Casoron, Norosac	dichlobenil	L/20	blueberry, brambles, grape	medium	caution	12
Chateau	flumioxazin	E/14	blueberry (7), brambles (7), grape (60), strawberry ²	medium	caution	12
Dachtal	DCPA	K1/3	strawberry ²	low	caution	12
Devrinol	napropamide	K3/15	blueberry ² , brambles ² , grape (70), strawberry (not from bloom to harvest)	low	caution	24
Gallery, Trellis	isoxaben	L/21	nonbearing blueberry, brambles, grape	medium	caution	12
Goal	oxyfluorfen	E/14	grape ² , strawberry ²	medium	warning	24
Karmex	diuron	C2/7	blueberry ² , brambles ² , grape ²	medium	caution	12
Kerb (RUP)	pronamide	K1/3	blueberry, grape (fall or early winter after harvest prior to soil freeze up)	low	caution	24
Matrix	rimsulfuron	B/2	grape (14)	medium	caution	4
Mission	flazasulfuron	B/2	grape (75)	medium	caution	12
Princep	simazine	C1/5	blueberry ² , brambles ² , grape ²	medium	caution	12
Prowl H ₂ O	pendimethalin	K1/3	grape (90), strawberry (35)	low	caution	12
Sandea	halosulfuron	B/2	blueberry (14)	low	caution	12
Sinbar	terbacil	C1/5	blueberry ² , brambles (70), strawberry (110)	medium	caution	12
Snapshot	isoxaben + trifluralin	L/21 + K1/3	nonbearing grape, blueberry, brambles	medium	caution	12
Solicam	norflurazon	F1/12	blueberry (60), brambles (60), grape (60)	medium	caution	12
Surflan	oryzalin	K1/3	blueberry, brambles, grape	low	caution	24
Treflan	trifluralin	K1/3	grape (60)	low	caution	12
Velpar	hexazinone	C1/5	blueberry (90)	medium	danger	48
Zeus XC, Spartan	sulfentrazone	E/14	grape (3), blueberry ² , brambles ² , strawberry ²	medium	caution	12
Zeus Prime XC	carfentrazone-ethyl + sulfentrazone	E/14	grape (3), blueberry (3), brambles (3)	medium	caution	12
Post-emergence control of grasses						
Fusilade	fluazifop	A/1	blueberry (1), brambles (1), grape (50) strawberry (14)	high	caution	12
Poast	sethoxydim	A/1	blueberry (30), brambles (45), grape (50), strawberry (7)	high	warning	12
Scythe	pelargonic acid	Z/17	blueberry (24), brambles (24), grape (24), strawberry (24)	low	warning	12
Select Max	clethodim	A/1	strawberry (4), brambles (7), blueberry (14)	high	warning	12
Post-emergence control of broadleaf weeds						
Aim	carfentrazone	E/14	grape (3), blueberry (0), brambles (15), strawberry (0)	medium	caution	12
Amine 4	2,4-D amine	O/4	strawberry ²	low	danger	48
Goal	oxyfluorfen	E/14	grape ² , strawberry ²	medium	warning	24
Spur	clopyralid	O/4	strawberry (1 application after harvest)	medium	caution	12
Venue	pyraflufen ethyl	E/14	grape (0)	medium	caution	12
Post-emergence control of grasses and broadleaf weeds						
Gramoxone (RUP)	paraquat	D/22	blueberry ² , brambles, ² grape ² , strawberry (21)	medium	poison	12
Roundup	glyphosate	G/9	blueberry (14), brambles (14), grape (14), strawberry (14)	low	caution	12
Reglone	diquat	D/22	nonbearing grape, blueberry, brambles (1 year)	medium	medium	24
Rely	glufosinate	H/10	grape (14), blueberry (14)	low	warning	12
Ultra Blazer	acifluorfen	E/14	Strawberry (60)	medium	danger	48

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	lambquarters	marestail	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	150 d apple only
	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.

²Check label

Generic Pesticides

A generic agricultural chemical is manufactured and sold by a company other than the original manufacturer and patent holder, usually after the patent has expired. The generic pesticide contains the same active ingredient(s) (AI) and tend to be **similar** in performance to receive an EPA registration.

Generic products are **not always identical**, so be sure to carefully read the label, with special attention to rates and percent active ingredient.

Generic Fungicides

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

Generic Insecticides

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Admire Pro (Bayer)	imidacloprid	Advise 2F (Winfield) Alias 2F (Adama) Couraze 1.6F, 75WP, 2F (FMC) Imidashot DF (Sulfur Mills) Macho 2FL, 2F (Albaugh) Malice 75WSP (Loveland) Midash 2SC, Forte 4F 4F (Sharda) Montana 2F,4F (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)
Agri-Mek 0.15EC (Syngenta)	abamectin	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)
Arcamite (Arysta)	Bifenazate	Bizate (Loveland) Vigilant 4SC (Arysta)
Asana XL 0.66EC (Dupont)	esfenvalerate	S-Fenvalostar 0.66EC (LG Life Sciences) Zyrate 0.66EC (Rotam)
Assail 30SG (United Phosphorous)	acetamiprid	Anarchy 30SG (Loveland), 70WP (Loveland) Arvida (Atticus) Intruder 70WP (United Phos.)
Baythroid XL 1EC (Bayer)	cyfluthrin	Tombstone 2E (Loveland) Tombstone Helios 2E (Loveland)
Brigade 2EC (FMC) Capture 2EC (FMC)	bifenthrin	BBi-Dash 2EC (Adama) Bifen 2AG Gold (Direct AG Source) Bifenture 2EC (United Phosphorous) Discipline 2EC (Amvac) Fanfare 2EC, EL, ES (Adama) Frenzy Veloz 2EC (Real Farm) Revere 2EC (Adama) Ruckus LFR (Helena) Sniper 2EC (Loveland) Tundra 2EC (Winfield) Xpedient 2FC (Amvac)
Cygon 4EC (FMC)	dimethoate	Dimate 4EC (Winfield) Dimethoate 400, 4EC (Drexel, Loveland, FMC)

(continued)

Generic Insecticides (continued)

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Dipel (Valent)	Bacillus thuringienensis	Agree (Certis) Biobit (Valent) CryMax (Certis) Deliver (Certis) Jackpot WP (Certis) Javelin (Certis) Xentari (Valent)
Esteem 35WP (Valent) Knack 0.83EC (Valent)	pyriproxyfen	Farewell 0.86 EC (Adama) Pitch (0.83EC (Adama)
Intrepid 2F (Dow AgroSciences)	methoxyfenozide	Invertid 2F (Loveland) Troubador 2F (Helena) Turnstyle 2F (United Phosphorus)
Lorsban 4E, 15G, 75WDG, Advanced 3.76E (Dow)	chlorpyrifos	Chlorpyrifos 4E (Drexel, Adama) 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)
Mustang Maxx (FMC)	zeta-cypermethrin	Respect 0.8EC (BASF)
Orthene 90SP (Amvac)	acephate	Bracket 90 (Winfield) Bracket 90 WSP (Winfield)
Pounce 3.2EC (FMC)	permethrin	Arctic 3.2EC (Winfield) Permethrin 3.2EC (Loveland, Helena, Direct Ag, Tenkoz) Perm-Up 3.2EC (United Phosphorus) Perm Star AG (LG Int'l)
Proaxis (Loveland)	gamma cyhalothrin	Declare (FMC) Proaxis 0.5EC (FMC)
Sevin XLR Plus, 4L (Tessenderlo Kerley)	carbaryl	Carbaryl 4L (Drexel, Loveland) Carbaryl 15% Bait (Drexel) Carbaryl Cutworm Bait (Drexel)
Warrior II 2.08CS (Syngenta)	lambda-cyhalothrin	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)
Zeal (Valent)	Etoxazole	Zara WSB (Atticus)

Generic Herbicides¹

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Amine4 2,4-D (Tenkoz)	2,4-D amine	2,4-D Amine 4 (WinField Solutions) 2,4-D Amine (Alligare) Amine 4 2,4-D Weed Killer (Loveland Industries) Amine 6 (Loveland Products) Clean Amine (Loveland Products) Defy Amine 4 (Makhteshim) Embed (Dow Agrosciences) Havoc Amine (Innvictis Crop Care) Opti-Amine (Helena) Orchard Master (PBI Gordon) Orchard Star (Allbaugh/Agri Star) Rugged (WinField United) Saber (Loveland Products) Shredder Amine 4 (WinField Solutions)
Callisto (Syngenta)	mesotrione	Argos (Helm Agro) Explorer (Syngenta) Incinerate (WinField United) Mesotrione 4SC (Allbaugh) Meso Star (Sharda USA) Motif (United Phosphorus) Quartz 4L (Sipcam Agro) Willowood Mesotrione 4SC (Willowood)
Chateau WDG (Valent USA)	flumioxazin	BroadStar (Valent USA) Tuscany and TuscanySC (Nufarm) Warfox (ADAMA)
Devrinol 10G (United Phosphorus)	napropamide	Devrinol 2 EC/2 XT/2 G/50 DF (United Phosphorus) Strawberry & Fruit Tree Weeder (Lawn & Garden Products)
Gallery 75 DF (Dow Agrosciences)	isoxaben	Trellis and Trellis SC (Dow Agrosciences)
Goal 2XL (Dow AgroSciences)	oxyfluorfen	Oxystar 2E (Albaugh/Agri Star) Collide (United Phosphorus) Oxyfluorfen 2E Herbicide (Solera Source Dynamics) Willowood Oxyflo 2EC/4SC (Willowood) Galigan 2E , Galigan H2O (ADAMA)
Gramoxone Inteon/Max/SL/SL 2.0 (Syngenta)	paraquat	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.)
Karmex DF (Makhteshim Agan of North America)	diuron	Alligare Diuron 80 DF (Alligare, LLC) Direx 4 L (ADAMA) Diuron 4L and 80 (Drexel) Diuron 4L (Makhteshim) Diuron 4L (WinField United) Diuron 4L and 80 WDG (Loveland) Parrot 4L (ADAMA)
Kerb 50 WP (Dow AgroSciences)	pronamide	Pronamide 50 WSP (Willowood USA)
Matrix FNV (Dupont)	rimsulfuron	Grapple (Nufarm) Hinge (Rotam) Pruvin (ADAMA) Solida (FMC)

(continued)

Generic Herbicides (continued)

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Poast (BASF)	sethoxydim	Segment (BASF) Sethoxydim SPC (Nufarm Americas)
Princep 4L (Syngenta)	simazine	Princep Caliber 90 (Syngenta) Sentry Simazine 4L/90DF (United Suppliers) Simazine 4L (several producer/suppliers) Simazine 90 DF (Monterey Ag Resources) Simazine 90 DF/WDG (WinField United) SIM-TROL 4L/90DF (Sipcam Agro USA)
Prowl 3.3EC (BASF)	pendimethalin	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)
Reglone (Syngenta)	diquat	Aceto Diquat 2L AG (Aceto Agricultural Chemicals) Dessicash Ag (Sharda-USA) Diquat 2LAG (Solera Source Dynamics) Diquash Ag (Sharda-USA) Nufarm Diquat 2 L (Nufarm Agricultural) Rowrunner AG (Rotam North America) Verdure-X-Herbicide (Helm Agro)
Rely 280 (Bayer CropScience)	glufosinate-ammonium	Forfeit 280 (Loveland Industries) Reckon 280 SL (Solera Source Dynamics) Cheetah (Nufarm Americas) Lifeline and Interline (United Phosphorus) Surmise (Albaugh/Agri Star) Refer 280 SL (Summit Agro) Total (WinField United) Willowood Glufosinate 280SL (Willowood)
Roundup WeatherMAX/PowerMAX (Monsanto)	glyphosate	Numerous products
Select 2 EC (Valent USA)	clethodim	Clethodim (Crop Smart) Clethodim 2E (Albaugh/Agri Star) Clethodim 2EC (Agromarketing) Arrow 2 EC (ADAMA) Avatar (Innvictis Crop Care) Cleanse 2 EC (WinField United) Envoy Plus (Valent USA) Intensity Intensity and Intensity One (Loveland Industries) Omni Clethodim 2 EC (Helena) Section 2EC (WinField United) Section Three (WinField United) Select Max (Valent USA) Shadow (Arysta Life Science) Vaquero (Wilbur Ellis) Volunteer (Tenkoz)
Stinger 3EC	clopyralid	Spur (Albaugh) Clean Slate (Nufarm) Clopyr AG (United Phosphorus) Garrison (Nufarm Americas)

(continued)

Generic Herbicides *(continued)*

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Surflan AS	oryzalin	Fugitive (ADAMA) Harrier 4L (United Phosphorus) Oryzalin 4 (Quali-Pro) Oryzalin 4 (Alligare) Oryzalin 4 AS (Makhteshim) Surflan XL 2G (United Phosphorus) XL 2G (Helena)
Treflan HFP (Dow AgroSciences)	trifluralin	Dintec Treflan 4D (Gowan) Treflan 4 EC (Helena) Trifluralin HFP (Helena) Trifluralin 10G (several producers/suppliers) TrlAP 10G or 4HF (Independent Agribusiness Professionals) Aceto Trifluralin 4 EC (Aceto Agricultural Chemicals) Cornbelt Trifluralin EC (Van Diest Supply) Preen Garden Weed Preventer (Lebanon Seaboard) Trust (WinField United)
Ultra Blazer (United Phosphorus)	acifluorfen	Acifin 2L (Summit Agro) Acifluorfen 2E (Tacoma Ag) Avalanche Ultra (WinField United)
Velpar DF CU/L CU (DuPont)	hexazinone	Velossa (Helena) Tide Hexazinone 2 SL (Tide Int'l)
Zeus (FMC) strawberry, grape	sulfentrazone	Spartan 4F (FMC) strawberry only Sulfentrazone 4F (Helm) Sulfentrazone 4SC (Willowood)

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

Suggested recordkeeping form for restricted-use pesticides.

Farm name and address: _____

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

Suggested recordkeeping form for restricted-use pesticides.

Farm name and address: _____

Date and State of Growth	Crop	Chemical Applied (trade name, formulation and EPA registration number)	Rate per Acre	Total Applied	Location and Size of Block	Target Pest(s)	Name of Applicator and 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* free of charge at fff.hort.purdue.edu. This fruit grower newsletter is issued to Indiana growers at frequent intervals during the fruit season. You can subscribe to the online version for free, or receive a printout 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.

For a hard copy, send your name, address, and current 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 <https://hortnews.extension.iastate.edu/>. Subscribe to Horticulture & Home Pest News to receive email alerts when we post new information. Go to the News tab. Small Farm Sustainability website, <https://www.extension.iastate.edu/smallfarms>.

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 (jonestammy@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 Maria Smith at smith.127203@osu.edu.

The 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 along with information and observations about the problem. 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 162-163).

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 has 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 early in the week so they 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 bags. Pack firmly in a crush-proof container so that fruit is not 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 70 percent rubbing (Isopropyl) alcohol or hand sanitizer. In Kansas, submit in vinegar. 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 162-163).

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
clinic <https://www.uaex.edu/yard-garden/plant-health-clinic/>
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 is 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

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

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:

Joy Pierzynski, pierzynski.4@osu.edu or
ppdc@cfaes.osu.edu
Fruit and Vegetable Pathology Laboratories
The Ohio State University-Wooster Campus
1680 Madison Ave.
Wooster, OH 44691
330-263-3838

Contact:

Fruit Samples: Melanie Lewis Ivey, ivey.14@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. https://extension2.missouri.edu/find-your-interest/agriculture-and-environment/natural-resources-and-environment/integrated-pest-management/pesticide-safety](http://www.https://extension2.missouri.edu/find-your-interest/agriculture-and-environment/natural-resources-and-environment/integrated-pest-management/pesticide-safety)

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 automatically connects 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](http://www.cardinalglennon.com/Pages/Poison%20Center.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 are 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 and 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

Midwest Fruit Pest Management Guide 2019-2020

The *Midwest Fruit Pest Management Guide* 2019-2020 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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