Midwest Fruit Pest Management Guide

2026-2027

GRAPE

Arkansas
University of Arkansas Cooperative Extension Service
AG1304

Illinois
University of Illinois Extension
ICSG-18

Indiana
Purdue Extension
ID-465

Iowa
Iowa State University Extension and Outreach
HORT 3035

Kansas
Kansas State Research and Extension
MF3278

Kentucky
University of Kentucky Cooperative Extension Service
ID-232

Ohio
Ohio State University Extension
Bulletin 506

Wisconsin
University of Wisconsin-Extension
A4104

Midwest Fruit Pest Management Guide 2026-2027

Citation

Long, E., Leach, A., Athey, K., Wimmer, M., Arnoldussen, B., Yadav, R., Meyer, S., Purcell, M., Santiago, J., Holland, L., Joshi, N., Whale, E., Babadoost, M., Vos, R., Slack, S., Cloyd, R., Bessin, R., Ivey, M., Wright, S., Beckerman, J., Leonberger, K., Gauthier, N. 2025. Midwest Fruit Pest Management Guide 2026-2027. Available online at: https://ag.purdue.edu/department/hla/extension/_docs/id-465.pdf

Contributors

University of Arkansas
Entomology: Neelendra Joshi

University of Illinois
Entomology: Kacie Athey*
Horticulture: Elizabeth Wahle*, James Santiago*
Plant Pathology: Mohammed Babadoost*

Iowa State University
Horticulture: Randall Vos*, Suzanne Slack

Kansas State University
Entomology: Raymond Cloyd

University of Kentucky
Entomology: Ric Bessin*
Horticulture: Shawn Wright*, Brent Arnoldussen*, Elayna Stirn
Plant Pathology: Nicole Gauthier*, Kim Leonberger*

University of Minnesota
Horticulture: Madeline Wimmer*

Ohio State University
Entomology: Ashley Leach*
Horticulture: Ram Yadav*
Plant Pathology: Melanie Ivey*

Purdue University
Entomology: Elizabeth Long*
Horticulture: Stephen Meyer, Miranda Purcell

University of Wisconsin
Plant Pathology: Leslie Holland*

*Section Editor

Acknowledgements

Authors would like to thank Janna Beckerman for her years of hard work on this guide.

Contents

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. Growers who use these 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 growers with up-to-date information about pesticides and their applicability to problems. We suggest that growers use this information to set up individualized spray programs. Always keep accurate records of materials used, application dates, areas treated, growth stages, and weather conditions. A sample record sheet is on page 285. 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 read and follow all label instructions, as well as any websites directed by the label.
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 all personal protective equipment as required by the label. If a respirator is rquired, a medical exam and fit test is needed for some types of respirators.
7. Have a "buddy" around when using acutely toxic organophosphates, just in case.
8. If working with cholinesterase inhibitor insecticides, 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 pesticides in their 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.
16. Never allow someone under the age of 18 to handle or use pesticides.
17. Train workers according to worker protection standards (WPS). This is required for all workers who will enter areas treated with a pesticide within 30 days after the last application.
18. Suspend applications while people are within the Application Exclusion Zone (AEZ). Application may be resumed when they exit the AEZ.

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. Check labels for posting and notification requirements to protect workers. Re-entry times and the required protective clothing for early entry are listed on product.
9. Inform all workers of re-entry restrictions and information on safe pesticide use and/or training to meet WPS requirements.
10. Comply with the Right-To-Know law. Have complete product labels readily available for workers to see. Have the Safety Data Sheet (SDS) 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). Training content must comply with WPS requirements.
12. Provide necessary PPE for your workers and regularly inspect and maintain PPE 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" are mandatory statements, 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 prohibited. 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 (PPE).

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, 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, most states 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 to 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. 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 may be the foliage, flowers, fruit, woody surfaces, or entire plants. The equipment and methods used for such a diverse spray program must be versatile, and the equipment must be properly calibrated for each type of application.

Dilute Spraying

The objective of spraying is to distribute the spray material uniformly over plants or plant parts. Pesticide recommendations are based on the amount of dilute spray needed to wet plants thoroughly, to the point just "prior to runoff." For example, 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.

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

The table on page 6 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

[1]Maximum 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.
[2]Minimum 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.

Growers 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 6x.

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 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 wind drift.

When making low-volume pesticide applications:

1. Use extreme care in calibrating the sprayer and maintaining a constant sprayer speed. As gallonage decreases, errors become much more critical.
2. Choose calm winds with 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 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, growers 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, growers 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.

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

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.

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

= 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

Spraying Small Volumes

In some cases growers 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, when preparing sprayers 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 typically sprayed, 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 lb.	15 tbsp.	9 tbsp.	3 tbsp.
	4 lb.	13 tbsp.	8 tbsp.	8 tsp.
	3 lb.	10 tbsp.	6 tbsp	2 tbsp.
	2 lb.	8 tbsp.	4 tbsp.	4 tsp.
	1 lb.	3 tbsp.	6 tsp.	2 tsp.
	1/2 lb. (8 oz.)	5 tsp.	1 tbsp.	1 tsp.
Emulsifiable Concentrate, Liquid	5 gal.	1 qt.	1 1/4 pt.	13 tbsp.
	4 gal.	1 1/2 pt.	1 pt.	10 tbsp.
	3 gal.	1 1/4 pt.	3/4 pt.	8 tbsp.
	2 gal.	3/4 pt.	1/2 pt.	5 tbsp.
	1 gal.	1/2 pt.	8 tbsp.	3 tbsp.
	1 qt.	3 tbsp.	2 tbsp.	2 tsp.
	1 pt.	5 tsp.	1 tbsp.	1 tsp.

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, https://www.uky.edu/Ag/Horticulture/masabni/Publications/HO-83.pdf).

Step 1. Check tractor/sprayer speed.
Attach the sprayer to the tractor and make test runs to determine the tractor speeds (mph) in different gears. Run the tractor at the PTO speed used 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 (sod, not pavement or gravel)

Formula

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

Your tractor sprayer speed

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

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 (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

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

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

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

Your figures

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

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 your target, 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. Consistent spray patterns require that outputs from individual nozzles within 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. Applicators 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 applicators 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

To determine travel speed needed 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 is usually satisfactory, depending on the size and density of the canopy, and capacity of the sprayer.

Before sprayer calibration, applicators must determine the travel speed in miles per hour (mph). To determine 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 travel 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:

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

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

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

Determining Nozzle Flow Rate

To select the correct nozzle and whirlplate sizes, first 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. These variables will be used, to calculate the gpm. Note: This equation is for one side of the sprayer manifold only; double the calculated answer if using both sides of the sprayer. Use the same size nozzles and whirlplates on both sides of the sprayer.

Step 1. Calculate the total gpm required per side:

$$\text{GPM (per side)} = \frac{\text{GPA x MPH x W}}{1{,}000}$$

GPM = gallons per minute (per side)

GPA = gallons per acre

MPH = speed (in miles per hour)

W = spacing between rows (in feet)

Example: To apply 70 gpm while traveling 2 mph, with row spacing of 10 feet apart the gpm per side is:

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

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 gal The actual output was:

100 gal (start) - 75 gal (stop) = 25 gal per 5 min. = 5 gpm

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

When actual output differs from the calculated output, adjust 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, with row spacing of 10 feet and it took 35 gallons to refill the sprayer to the original level, the gpa is:

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

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. Most adjuvants (see definition in the next section) are multipurpose adjuvants, serving as spreaders, activators, etc. Read the labels of both the pesticide and adjuvant before use. Granulated food grade citric acid may be the most convenient and inexpensive acidifying material. Two ounces per 100 gallons has been shown to reduce the pH of tap water from 8.3 to 5.4. Convenient granulated food grade citric acid measures are:

per 100 gal	1/4 cup, slightly rounded
per 300 gal	3/4 cup, rounded
per 500 gal	1 1/3 cups

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

Spray Adjuvants

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

Activators increase a pesticide's efficacy by increasing the penetration of a spray solution through leaf hairs or 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 spray droplets, allowing them to spread out more evenly on the surface of leaves 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 adjuvants are mixed 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 once. 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 within the formulation. 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.

Making Tank Mixes

Adding the components of a mixture in the order the label specifies is critical; whether some pesticides are physically compatible or not depends on the order in which they are added to the tank. This is especially true for pesticides packaged in water-soluble packets. A mistake in mixing order could prevent the package from dissolving completely, thus preventing uniform distribution of the pesticide in the spray tank. Labels provides mixing instructions for all registered tank mixes. Unless the label states otherwise, never apply any pesticide in the mixture at a rate higher than the label allows for when the pesticide is used alone for the same purpose.

Some pesticide labels do not provide adequate mixing order directions. The usual method for tank mixing is as follows.

First, fill the tank one-quarter to one-half full with the carrier (water) and begin agitation. If a compatibility, buffering or defoaming agent is needed, these products should be added before the other products. If using a drift reduction additive, always consult the label; some are added in the mixing sequence.

Next, slowly add and thoroughly mix the pesticide products, one at a time, beginning with those hardest to mix (such as suspension-forming formulations). Generally, wettable powder (WP) and dry flowable or water-dispersible granule (DF, WDG) products should be added first, followed by flowable (F, FL) and microencapsulated (ME) products. Add emulsifiable concentrates (EC) next, followed by any solution (S) or soluble powder (SP) products. Other spray modifiers (penetrants and surfactants) should be added last. Dry formulations should be preslurried (mixed with a little water) before adding them to the spray tank; this is also a good idea (even with ECs) when using liquid fertilizers as the carrier. Finally, continue adding the carrier to the desired level.

To assure a uniform spray mixture at all times, keep the mixture agitated during the entire application and until the tank is empty. Avoid letting the mixture stand overnight, if possible, without agitation. If you do end up with a physically incompatible spray mix, call the manufacturer of each product to see if you can rejuvenate the mix. Adding a compatibility agent may return the mix to a sprayable form. If you cannot rejuvenate the mix, treat it as pesticide waste.

Tank Mixing Order

1. Fill tank 1/4 to 1/2 full with carrier (water)
2. Begin agitation
3. Utility agents (if needed)
4. Suspension products
   a. Dry (Pre-mix): WP, DF, WDG,
   b. Wet F, FL, ME
5. Emulsifiable products (EC)
6. Solution products (S, SP)
7. Spray modifiers (if needed)
8. Finish filling the tank with carrier

From: Illinois Pesticide Applicator Training Manual SP39: General Standards. University of Illinois Extension Pesticide Safety Education Program.

Summary

Pesticide recommendations are confusing because there are so many options for materials to use for certain diseases or insect pests. Additional references may be needed.

With fungicides in particular, a single material may control one or more diseases, but not all. So when several diseases threaten, growers may need to combine materials to achieve control. Insect pests also may appear at the same time, so a tank mix multiple fungicides and insecticides may be applied together. However, not all pesticides are compatible, so applicators should test for compatibility before tank mixing any products.

Certain fungicides and insecticides may be phytotoxic (cause foliar damage) to certain crops and/or cultivars. For example, many grape cultivars are sensitive to sulfur and/or copper. The **Relative Disease Susceptibility and Chemical Sensitivity among Grape Cultivars** table on page 163 lists cultivar sensitivity to these materials. Additionally, some grape cultivars are sensitive to certain strobilurin fungicides, and some strawberry cultivars are sensitive to Sinbar herbicide. Several apple cultivars 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 cultivar, disease or insect pressure, and other factors. Grower preference, experience with materials, and price often influence decisions as well. Pest management in fruit crops is relatively easy as long as growers 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.

6. GRAPE

Grape Insect Pests

The shaded/colored boxes represent the crop stages where common pests in the Midwest are active. Scouting and/or preventative sprays may be necessary or recommended.

Grape Growth Stage								
Delayed Dormant Through Bud Swell	Bud Break	4- To 10-inch Shoots	Pre-bloom Through Bloom	Bloom	Shatter	Shatter To Veraison	Veraison To Harvest	Postharvest
Grape Flea Beetle								
	Grape Phylloxera							
		Rose Chafer			Rose Chafer			
					Grape Berry Moth			
					Japanese Beetle			
							Spotted-Wing Drosophila	
							Multi-Colored Asian Lady Beetle	
							Green June Beetle	
							Grape Root Borer	
Climbing Cutworm								
Spider Mites		Spider Mites						
Grape Scale			Grape Scale					
Grape Mealy Bug					Grape Mealybug			
		Redbanded Leafroller			Red-Banded Leafroller			
			Eight-Spotted Forester					
			Grape Cane Girdler					
			Grape Cane Gallmaker					
					Grape Rootworm			
							Stink Bug	
					Spotted Lanternfly			

Grape Spray Schedule

How to read the spray schedule tables

Every grape growth stage has important notes on disease or insect management. In some cases, the reader will be directed to the special problems section at the end of the chapter. Please make sure to read thoroughly and contact your local Extension Specialist with questions.

Key to tables

E = excellent control
G = good control
F = fair control
[r] = Fungicide/Insecticide resistance possible
s = suppression only
i = ineffective
u = unknown efficacy
x = pest not on the label

[1] Efficacy data in this publication are based on trials conducted across various regions and does not necessarily reflect local efficacy differences or changes over time. Growers should contact their Extension Specialist for the most recent or for state-specific information. The information in this publication is only a guide; the authors and their institutions assume no liability for practices implemented based on this information. Always read and follow pesticide labels. The label is the law. Product registration may vary by state.

[2] F/I-RAC code represents the mode of action of the fungicide/insecticide.

[3] PHI refers to the pre-harvest interval, which is the number of days before harvest that the product may not be applied.

[4] All fungicides/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 as restrictions may prohibit the use of certain pesticides during harvest.

[5] Max amt refers to the product's maximum amount/acre/year. Applicators must abide by both maximum amount of product per season AND maximum number of applications.

[6] Max app refers to the product's maximum number of applications per year. Applicators must abide by both maximum amount of product per season AND maximum number of applications.

[7] For treated wine grapes, the REI is 5 days when conducting cane tying, turning, or girdling. The REI is 12 hours for all other activities in wine grapes.

[8] For table grapes, the REI for cane tying, turning, or girdling is 7 days.

RUP refers to restricted use pesticide.

Notes 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 blight. Several recommendations in this guide include tank mixes of different fungicides that are intended to provide a program to control all these diseases simultaneously.

Phototoxicity Alerts

It is extremely important to read fungicide labels carefully as many fungicides can cause crop injury when used alone or combined with insecticides or horticultural oils.

- All fungicides with difenoconazole labeled for grapes have the following precaution: "On V. labrusca, V. labrusca 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."
- Concord and other American-type grapes: Crop injury may occur if Flint Extra, Inspire Super, Flint Extra, Intuity, Luna Experience, Merivon, Pristine, Quadris Top, REGEV, or Revus Top are used on Concord grapes.
- Pristine should not be applied to Concord or Noiret grapes.
- Merivon should not be applied to Concord, Noiret, or NY73.0136.17
- Do not apply sulfur or captan at the same time as an oil or within two weeks of an oil application.
- Do not tank mix captan with the insecticide Sevin XLR.

Grape Delayed Dormant To Bud Swell – Diseases

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

Notes on disease management

- **Anthracnose, Black rot, Powdery mildew and Phomopsis:** A delayed dormant application of lime-sulfur or Sulforix (calcium polysulfide) is recommended to reduce overwintering inoculum of the fungi that cause these four diseases.

Table 6-1. Grape Diseases – Delayed Dormant Through Bud Swell[1]

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose	Phomopsis	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Sulforix	M	x	See Label	See Label	48h	16 gal.
calcium polysulfide		x	E	s(E)	NA	8
Lime Sulfur	M	x	15-20 gal.	4-10 gal.	48 h	46 gal.
calcium polysulfide		x	E	s	0 day	16

Footnotes: See How to read the spray schedule tables section at the beginning of the chapter.

Grape Delayed Dormant To Bud Swell – Insects

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

Notes on insect pest management

- **Flea beetle (adults) and climbing cutworms:** Scout at least weekly as bud swell occurs.

Table 6-2. Grape Insects – Delayed Dormant Through Bud Swell[1]

Product And Formulation Active Ingredient	IRAC Code[2]	Climbing Cutworm	Grape Flea Beetle	Mites: European Red, Spider Mite	Scale	REI[3] PHI[4]	Max Amt[5] Max App[6]
Admire Pro (4.6F)	4A	x	x	x	7-14 fl. oz. (soil)	12h	2.8/14 fl. oz.
imidacloprid		x	x	x	G	0/30d	NA
Agri-Mek SC (0.7SC) **(RUP)**	6	x	x	1.75-3.5 fl. oz.	x	12h/4d	7 fl. oz.
abamectin		x	x	G	x	28d	2
Altacor eVo (35WDG)	28	3-4.5 oz.	x	x	x	4h	4.6 oz.
chlorantraniliprole		G	x	x	x	1d	3
Apollo SC (1SC)	10A	x	x	4-8 oz.	x	12h/14d	NA
clofentezine		x	x	E	x	21d	1
Azera 0.21EC	3A	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	12h	NA
azadirachtin + pyrethrins		u	u	u	u	0d	10
Baythroid XL (1EC) **(RUP)**	3A	2.4-3.2 fl. oz.	2.4-3.2 fl. oz.	x	x	12h	12.8 fl. oz.
beta-cyfluthrin		E	G	x	x	3d	NA
Brigade 2EC **(RUP)**	3A	3.2-6.4 fl. oz.	x	6.4 fl. oz.	x	12h	7 fl. oz.
bifenthrin		G	x	u	x	30d	NA
Brigade WSB (10WP) **(RUP)**	3A	8-16 oz.	x	16 oz.	x	12h	16 oz.
bifenthrin		G	x	u	x	30d	NA
B.t. (Agree, Dipel, etc.)	11A	x	x	x	x	4h	NA
Bacillus thuringiensis		F	x	x	x	0d	NA
Danitol 2.4EC **(RUP)**	3A	10.6-21.3 fl. oz.	5.3-10.6 fl. oz.	10.6-21.3 fl. oz.	x	24h	42.6 fl. oz.
fenpropathrin		G	E	G	x	21d	NA
Delegate WG (25WG)	5	3-5 oz.	x	x	x	4h	19.5 oz.
spinetoram		G	x	x	x	3d	5
Entrust SC (2SC)	5	4-8 fl. oz.	x	x	x	4h	23 fl. oz.
spinosad		G	x	x	x	3d	5

(Continued)

Table 6-2. Grape Insects – Delayed Dormant Through Bud Swell[1] *(continued)*

Product And Formulation Active Ingredient	IRAC Code[2]	Climbing Cutworm	Grape Flea Beetle	Mites: European Red, Spider Mite	Scale	REI[3] PHI[4]	Max Amt[5] Max App[6]
Envidor 2SC	23	x	x	16-34 fl. oz.	x	12h	34 fl. oz.
spirodiclofen		x	x	E	x	14d	1
Imidan 70W	1B	x	1.3-2.1 lb.	x	x	14d	6.5 lb.
phosmet		x	F	x	x	7/14d	NA
Kanemite 15SC	20B	x	x	21-31 fl. oz.	x	12h	62 fl. oz.
acequinocyl		x	x	F	x	7d	2
Magister SC (1.7SC)	21A	x	x	32-36 fl. oz.	x	12h	36 fl. oz.
fenazaquin		x	x	u	x	7d	1
Malathion 5EC	1B	x	x	3 pt.	3 pt.	72h	NA
malathion		x	x	u	u	3d	2
Movento (2SC)	23	x	x	6-8 fl. oz.	6-8 fl. oz.	24h	12.5 fl. oz.
spirotetramat		x	x	s	s	7d	NA
Mustang Maxx (0.83EC) **(RUP)**	3A	2-4 fl. oz.	x	x	x	12h	24 fl. oz.
zeta-cypermethrin		E	x	x	x	1d	NA
Nealta (1.67SC)	25	x	x	13.7 fl. oz.	x	12h	28 fl. oz.
cyflumetofen		x	x	G	x	14d	2
Nexter SC (3.75SC)	21A	x	x	7.5-17 fl. oz.	x	12h	NA
pyridaben		x	x	G	x	7d	2
Onager (1EC)	10A	x	x	12-24 oz.	x	12h	24 oz.
hexythiazox		x	x	E	x	7d	1
Portal XLO (0.4EC)	21A	x	x	2 pt.	x	12h	2 pt.
fenpyroximate		x	x	E	x	14d	2
Pyganic 5%EC	3A	x	4.5-15.6 fl. oz.	4.5-15.6 fl. oz.	4.5-15.6 fl. oz.	12h	NA
pyrethrins		x	F	u	u	0d	10
Sevin XLR Plus (4F)	1A	2 qt.	1-2 qt.	x	1-2 qt.	2d/6d	10 qt.
carbaryl		E	E	x	u	7d	5
Vendex 50WP **(RUP)**	12B	x	x	1-2.5 lb.	x	48h	4 lb.
fenbutatin-oxide		x	x	F	x	28d	2
Verdepryn 100SL (0.83SL)	28	8.2-11 fl. oz.	x	x	x	4h	33 fl. oz.
cyclaniliprole		u	x	x	x	7d	3
Zeal (72WP)	10B	x	x	2-3 oz.	x	12h	3 oz.
etoxazole		x	x	E	x	14d	1

Footnotes: See how to read the spray schedule tables section at the beginning of the chapter.

Grape Bud Break to Prebloom – Diseases

Notes on disease management

- Begin fungicide applications at 1-3 inch new shoot growth; repeat at 7-10 day intervals or according to label instructions and environmental conditions.
- **Powdery mildew:** Primary infections of powdery mildew can occur during this period, and it is critical to protect all new shoot growth. Sulfur is sufficient to control powdery mildew during this period unless varieties are sulfur sensitive. For sulfur sensitive varieties alternate FRAC 3 (Cevya, Mettle, Procure, Rally, TebuStar), FRAC 7 (Aprovia, Luna Privilege, Endura) and FRAC U13 (Gatten) fungicides. Using these fungicides in the third or fourth spray during this time period will also improve control of black rot.

Fungicide resistance alert

- The downy and powdery mildew pathogens are especially prone to fungicide resistance. Avoid back-to-back applications of any one systemic fungicide class. See Fungicide Resistance Management, page 180, for information about fungicide resistance development in powdery and downy mildews. See generic fungicides table for product with the same active ingredient, page 251.
- Avoid using fungicides in FRAC 11 during this period.

Foundation program: This program contains products that are at a lower risk of resistance and serves as foundation for a grape disease management program.

Supplemental sprays: These fungicides provide greater activity against specific diseases and should be applied as a tank mix or in rotation with the foundation program when specific disease pressures are higher. As more green tissue develops, systemic fungicides have greater efficacy against specific pathogens.

Table 6-3. Grape Diseases - Bud Break Through Prebloom[1]

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Abound (SC)	11	x	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	4h	90 fl. oz.
azoxystrobin		x	E	E [r]	F	E [r]	14d	varies
Aliette WDG	P07 (33)	x	x	3-5 lb.	x	x	12h	NA
aluminum tris		x	x	E	x	x	15d	3
Aprovia (EC)	7	8.6-10.5 fl. oz.	8.6-10.5 fl. oz.	x	8.6-10.5 fl. oz.	8.6-10.5 fl. oz.	12h	32 fl. oz.
benzovindiflupyr		i	G-E	x	i	G-E	21d	3
Captan 80 WDG	M	1.25-2.5 lb.	1.25-2.5 lb.	1.25-2.5 lb.	1.2-2.5 lb.	1.2-2.5 lb.	48h	15 lb.
captan		s(G)	s(F)	G	E	i	0d	NA
Cevya	3	x	4 fl. oz.	x	3-4 fl. oz.	3-4 fl. oz.	12h	8 fl. oz.
mefentrifluconazole		x	E	x	G	G-E	14d	2
Cuprofix Ultra 40D	M	x	1.25-3 lb.	1.2-3 lb.	1.2-3 lb.	1.2-3 lb.	48 h	50 lb.
copper sulfate		x	F	F	F	F-i	NA	NA
Endura (70WG)	7	x	x	x	x	4.5 oz.	12h	24 oz.
boscalid		x	x	x	x	E	14d	varies
Fervent 475SC	3+7	x	8.5 fl. oz.	x	8.5 fl. oz.	8.5 fl. oz.	12h	26 fl. oz.
isofetamid+tebuconazole		x	u	x	u	E	14d	NA
Flint Extra	11	x	3.5-3.8 fl. oz.	3.8 fl. oz.	3.5-3.8 fl. oz.	3-3.5 fl. oz.	12h	23 fl. oz.
trifloxystrobin		x	E	s	F	E	14d	6
Forum	40	x	x	6 oz.	x	x	12h	24 oz.
dimethomorph		x	x	E	x	x	14d	4

(Continued)

Table 6-3. Grape Diseases - Bug Break Through Prebloom[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Fracture	M	x	x	x	x	20.5-24.4 fl. oz.	4h	NA
Banda de Lupinus albus doce (BLAD)		x	x	x	x	E	1d	5
Gatten	U13	x	x	x	x	6.4 fl. oz.	12h	1 lb.
flutianil		x	x	x	x	G-E	14d	4
Inspire Super (EW)	3+9	16-20 fl. oz.	16-20 fl. oz.	x	x	16-20 fl. oz.	12h	80 fl. oz.
difenoconazole + cyprodinil		E	E	x	x	G	14d	NA
Kenja 400SC	7	20-22 fl. oz.	x	x	x	20-22 fl. oz.	12h	66 fl. oz.
isofetamid		G	x	x	x	F	14d	NA
Lifegard WG	M	x	4.5 oz.	4.5 oz	4.5 oz.	4.5 oz.	4h	NA
Bacillus mycoides isolate J		x	x	F	x	F	0d	NA
Luna Experience (SC)	7+3	x	8-8.6 fl. oz.	x	8.6 fl. oz.	6-8.6 fl. oz.	12h/5d6	34 fl. oz.
fluopyram + tebuconazol		x	G	x	s	E	14d	NA
Luna Privilege (SC)	7	x	6-6.8 fl. oz.	x	x	3.2-6.8 fl. oz.	12h	14 fl. oz.
fluopyram		x	G	x	x	G	7d	2
Luna Sensation (SC)	7+11	x	5-7.6 fl. oz.	7.6 fl. oz.	5-7.6 fl. oz.	4-7.6 fl. oz.	12h	28 fl. oz.
fluopyram + trifloxystrobin		x	G	s	F-G	E	14d	6
Merivon (2.09SC)	7+11	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	12h	33 fl. oz.
fluxapyroxad + pyraclostrobin		E	G-E	s	G-E	E [r]	14d	6
Mettle 125ME	3	3-5 fl. oz.	3-5 fl. oz.	x	x	3-5 fl. oz.	12h/7d7	10 oz.
tetraconazole		E	E	x	x	E [r]	14d	varies
Microthiol Disperss	M	x	x	x	3-10 lb.	3-10 lb.	24h	NA
sulfur		x	x	x	F	E	0d	NA
Miravis Prime	7+12	9.2-13.4 fl. oz.	9.2-13.4 fl. oz.	x	9.2-13.4 fl. oz.	9.2-13.4 fl. oz.	12h	37 fl. oz.
pydiflumetofen+fludioxonil		u	E	x	F-G	G-E	14d	2
OSO 5% SC	19	x	x	x	x	6.5-13 fl. oz.	4h	5 oz.
polyoxin D		x	x	x	x	G	0d	6
Pristine	11+7	8-12.5 oz.	8-12.5 oz.	8-12.5 oz.	8-12.5 oz.	8-12.5 oz.	12h/5d6	69 oz.
pyraclostrobin + boscalid		E	E	E [r]	F	E	14d	varies
Procure 480SC	3	x	x	x	x	4-8 fl. oz.	24h	32 fl. oz.
triflumizole		x	x	x	x	E [r]	7d	4
ProPhyt	P07 (33)	x	x	2-4 pt.	2-4 pt.	x	4h	NA
potassium phosphite		x	x	G-E	G-E	x	0d	NA
Quadris Top (SC)	3+11	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12h	56 fl. oz.
difenoconazole + azoxystrobin		E	E	F	F	E	14d	NA
Quintec (2.08F)	13	x	x	x	x	4-6.6 fl. oz.	12h	33 fl. oz.
quinoxyfen		x	x	x	x	E	21d	5
Rally 40WSP	3	3-5 oz.	3-5 oz.	x	x	3-5 oz.	24h	2 lb.
myclobutanil		E	E	x	x	E [r]	14d	NA

(Continued)

Table 6-3. Grape Diseases - Bug Break Through Prebloom[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Ranman 400SC	21	x	x	E	x	x	12h	17 fl. oz.
cyazofamid		x	x	2.1-2.75 fl. oz.	x	x	30d	6
Reason 500SC	11	x	x	2.7 fl. oz.	x	x	12h	9 fl. oz.
fenamidone		x	x	G [r]	x	x	30d	NA
Revus	40	x	x	8 fl. oz.	x	x	4h	32 fl. oz.
mandipropamid		x	x	E	x	x	14d	NA
Revus Top	3+40	7 fl. oz.	7 fl. oz.	7 fl. oz.	7 fl. oz.	7 fl. oz.	12h	28 fl. oz.
difenoconazole + mandipropamid		E	E	E	E	E	14d	NA
Rhyme	3	x	4-5 fl. oz.	x	x	4-5 fl. oz.	14d	30 fl. oz.
flutriafol		x	E	x	x	E	12h	6
Ridomil Gold Copper	4+M	x	x	5 lb. (1 pack)	x	x	48h	8 lb.
mefenoxam + copper hydroxide		x	x	E	x	x	42d	4
Ridomil Gold MZ WG	4+M	x	x	2.5 lb.	x	x	48h	10 lb.
mefenoxam + mancozeb		x	x	E	x	x	66d	4
Roper DF	M	x	1.5-4	1.5-4	1.5-4	x	24h	24 lb.
mancozeb		x	E	E	E	x	66d	6
Sovran (50WG)	11	x	3.2-4.8 oz.	4-6.4 oz.	3.2-4.8 oz.	3.2-4.8 oz.	12h	26 oz.
kresoxim-methyl		x	E	F [r]	F	E [r]	14d	4
Sulforix	M	x	x	x	1-2 gal., 1 pt.	1-2 gal., 1 pt.	48h	NA
calcium polysulfide		x	x	x	G-E	i	NA	8
Tanos	11+27	x	x	8 oz.	x	x	12h	72 oz.
famoxadone + cymoxanil		x	x	G [r]	x	x	30d	9
Tebustar 45WSP	3	x	4 oz.	x	x	4 oz.	12h	2 lb.
tebuconazole		x	E	x	x	E [r]	0d	NA
Topguard EQ	3+11	x	5-6 fl. oz.	8 fl. oz.	8 fl. oz.	5-6 fl. oz.	12h	34 fl. oz.
azoxystrobin+flutriafol		x	u	u	u	E	14d	6
Topsin M WSB	1	x	0.75-1.5 lb.	x	0.75-1.5 lb.	0.75-1.5 lb.	2d	6 lb.
thiophanate-methyl		x	F	x	G	E	7d	NA
Torino (SC)	U6	x	x	x	x	3.4-6.8 oz.	4h	7 oz.
cyflufenamid		x	x	x	x	E	3d	1 or 2
Vangard WG	9	x	x	x	x	10 oz.	12h	30 oz.
cyprodinil		x	x	x	x	s	7d	NA
Vivando 2.5F	U8	x	x	x	x	10.3-15.4 fl. oz.	12h	43 fl. oz.
metrafenone		x	x	x	x	E	14d	3
Zampro	45+40	x	x	11-14 fl. oz.	x	x	12h	56 fl. oz.
ametoctradin + dimethomorph		x	x	E	x	x	14d	NA
Ziram 76DF	M3	x	3-4 lb.	3-4 lb.	3-4 lb.	x	48h	28 lb.
ziram		x	E	G	G	x	21d	NA

Footnotes: See how to read the spray schedule tables section at the beginning of the chapter.

Grape Bud Break to Bloom – Insects

Notes on insect pest management

- **Grape phylloxera:** Admire Pro is soil-applied for systemic control. Use if there is a history of leaf-galling. Apply from bud swell until the first expanded leaf to be sure the chemical is available as soon as the roots begin to take up water, as it takes several weeks for the chemical to get to the leaves.
- **Rose chafers:** May be present any time between 4- and 10-inch shoot growth and bloom.
- **Redbanded leafroller and grape berry moth:** Pheromone traps for grape berry moth and redbanded leafroller indicate if they are present and help determine the need for control.
- **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.
- While all grapes do not benefit from insect pollination, protection of bees and other pollinators harvesting pollen from grape flowers is important. Avoid spraying insecticides that are toxic to pollinators during bloom.
- Scorpion 35SL: Use low rate for foliar. Use high rate for soil application.
- Movento 2SC: See label regarding adjuvants. Allow 30 days between applications. Movento is applied to leaves but moves to the roots. It is most effective if applied at this early stage of grape growth.
- **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).
- Other insecticide formulations may be available. See generic insecticides table for product with the same active ingredient, pages 279-280.

Table 6-4. Grape Insects – Bud Break Through Bloom[1]

Product And Formulation Active Ingredient	IRAC Code[2]	Climbing Cutworm	Grape Cane Girdler/ Gallmaker	Grape Flea Beetle	Rose Chafer	REI[3] PHI[4]	Max Amt[5] Max App[6]
Altacor eVo(35WDG)	28	3-4.5 oz.	x	x	x	4h	4.6 oz.
chlorantraniliprole		G	x	x	x	1d	3
Assail 30SG	4A	x	2.5-5.3 oz.	x	2.5-5.3 oz.	12h	10.6 oz.
acetamiprid		x	u	x	E	3d	2
Azera 0.21EC	3A	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	12h	NA
azadirachtin + pyrethrins		u	u	u	u	0d	10
Baythroid XL (1EC) **(RUP)**	3A	2.4 -3.2 fl. oz.	2.4 -3.2 fl. oz.	2.4 -3.2 fl. oz.	x	12h	12.8 fl. oz.
beta-cyfluthrin		E	G	G	x	3d	NA
Brigade 2EC **(RUP)**	3A	3.2-6.4 fl. oz.	x	x	x	12h	7 fl. oz.
bifenthrin		G	x	x	x	30d	NA
Brigade WSB (10WP) **(RUP)**	3A	8-16 oz.	x	x	x	12h	16 oz.
bifenthrin		G	x	x	x	30d	NA
Danitol 2.4EC **(RUP)**	3A	10.6-21.3 fl. oz.	10.6-21.3 fl. oz.	5.3 to 10.6 fl. oz.	10.6-21.3 fl. oz.	24h	42.6 fl. oz.
fenpropathrin		G	u	E	E	21d	NA
Delegate WG (25WG)	5	3-5 oz.	x	x	x	4h	19.5 oz.
spinetoram		G	x	x	x	3d	5
Entrust SC (2SC)	5	4-8 fl. oz.	x	x	x	4h	23 fl. oz.

(Continued)

Table 6-4. Grape Insects – Bud Break Through Bloom[1] *(continued)*

Product And Formulation Active Ingredient	IRAC Code[2]	Climbing Cutworm	Grape Cane Girdler/ Gallmaker	Grape Flea Beetle	Rose Chafer	REI[3] PHI[4]	Max Amt[5] Max App[6]
spinosad		G	x	x	x	3d	5
Imidan 70W	1B	x	1.3-2.1 lb.	1.3-2.1 lb.	1.3-2.1 lb.	14d	6.5 lb.
phosmet		x	u	F	G	7/14d	NA
Mustang Maxx (0.83EC) **(RUP)**	3A	2-4 fl. oz.	x	x	x	12h	24 fl. oz.
zeta-cypermethrin		E	x	x	x	1d	NA
Pyganic 5%EC	3A	x	x	4.5-15.6 fl. oz.	x	12h	NA
pyrethrins		x	x	F	x	0d	10
Sevin XLR Plus (4F)	1A	2 qt.	x	1-2 qt.	1-2 qt.	2d/6d	10 qt.
carbaryl		E	x	E	E	7d	5
Surround WP (95WP)	UN	x	x	x	25-50 lb.	4h	NA
kaolin		x	x	x	F	0	NA
Verdepryn 100SL (0.83SL)	28	8.2-11 fl. oz.	x	x	x	4h	33 fl. oz.
cyclaniliprole		u	x	x	x	7d	3

Footnotes: See how to read the spray schedule tables section at the beginning of the chapter.

Grape Prebloom To Shatter – Diseases

Notes on disease management

Prebloom through bloom

- Begin prebloom applications when shoots are 10- to 12- inches through the bloom period.
- Critical period for disease control: The period from immediate prebloom through four or five weeks after bloom (when grapes reach pea-size) is critical to control fruit infections by the black rot, powdery mildew, and the downy mildew pathogens.
- Although fruit of the most commonly planted varieties become resistant to powdery and downy mildews as they mature, the rachises (cluster stems) and leaves remain susceptible. Fungicide protection against powdery and downy mildews is therefore required throughout the growing season.

Bloom

- Begin bloom applications when the flower caps start to drop.
- If wet weather persists during bloom, or if the interval between the pre-bloom and shatter spray is greater than 10 days, a fungicide application during bloom should be applied.
- **Downy mildew** is the most common disease 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.
- **Ripe rot** infections occur during this period, but symptoms don't appear until the grapes mature. FRAC 11 and 12 fungicides provide the best level of control. FRAC 7 fungicides can be used if disease pressure is low. A fungicide application at veraison may be required if disease pressure is high (wet and warm). See page 159 for additional information on ripe rot.
- **Botrytis bunch rot:** A fungicide application during this period is critical on tight-clustered varieties (especially French hybrids or Vinifera) or in vineyards where Botrytis bunch rot has been a problem in the past. See Botrytis Bunch Rot, page 160.

Postharvest Interval (PHI) Reminder

- Pay close attention to the PHI on products that contain mancozeb (66 days) or mefenoxam (60 days).

Fungicide Resistance Alert

- The downy and powdery mildew pathogens are especially prone to fungicide resistance. Avoid back-to-back applications of any one systemic fungicide class (i.e., FRAC 3, 7, or 11).
- See Fungicide Resistance Management, page 180, for information about fungicide resistance development in powdery and downy mildews. See generic fungicides table for product with the same active ingredient, page 251.

Table 6-5. Grape Diseases – Prebloom Through Shatter[1]

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Botrytis Bunch Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Abound (SC)	11	x	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	4h	90 fl. oz.
azoxystrobin		x	E	s	E [r]	F	E [r]	14d	varies
Aliette WDG	P07 (33)	x	x	x	3-5 lb.	x	x	12h	NA
aluminum tris		x	x	x	E	x	x	15d	3
Aprovia (EC)	7	8.6-10.5 fl. oz.	8.6-10.5 fl. oz.	x	x	8.6-10.5 fl. oz.	8.6-10.5 fl. oz.	12h	32 fl. oz.
benzovindiflupyr		i	G-E	x	x	i	G-E	21d	3
Captan 80 WDG	M	1.25-2.5 lb.	1.25-2.5 lb.	2.5 lb	1.25-2.5 lb.	1.2-2.5 lb.	1.2-2.5 lb.	48h	15 lb.
captan		s(G)	s(F)	F	G	E	i	0d	NA
Cevya	3	x	4 fl. oz.	x	x	3-4 fl. oz.	3-4 fl. oz.	12h	8 fl. oz.
mefentrifluconazole		x	E	x	x	G	G-E	14d	2
Cuprofix Ultra 40D	M	x	1.25-3 lb.	x	1.2-3 lb.	1.2-3 lb.	1.2-3 lb.	48h	50 lb.
copper sulfate		x	F	x	F	F	F-i	x	
Elevate 50 WDG	17	x	x	1 lb.	x	x	1 lb.	12h	3 lb.
fenhexamid		x	x	E	x	x	s	0d	3
Endura (70WG)	7	x	x	8 oz.	x	x	4.5 oz.	12h	24 oz.
boscalid		x	x	G	x	x	E	14d	varies
Fervent 475SC	3+7	x	8.5 fl. oz.	8.5 fl. oz.	x	8.5 fl. oz.	8.5 fl. oz.	12h	26 fl. oz.
isofetamid+tebuconazole		x	u	s	x	u	E	14d	NA
Flint Extra	11	x	3.5-3.8 fl. oz.	3.8 fl. oz.	3.8 fl. oz.	3.5-3.8 fl. oz.	3-3.5 fl. oz.	12h	23 fl. oz.
trifloxystrobin		x	E	G	s	F	E	14d	6
Forum	40	x	x	x	6 oz.	x	x	12h	24 oz.
dimethomorph		x	x	x	E	x	x	14d	4
Fracture	M	x	x	24.4-36.6 fl. oz.	x	x	20.5-24.4 fl. oz.	4h	NA
Banda de Lupinus albus doce (BLAD)		x	x	E	x	x	E	1d	5
Gatten	U13	x	x	x	x	x	6.4 fl. oz.	12h	1 lb.
flutianil		x	x	x	x	x	G-E	14d	4
Inspire Super (EW)	3+9	16-20 fl. oz.	16-20 fl. oz.	16-20 fl. oz.	x	x	16-20 fl. oz.	12h	80 fl. oz.
difenoconazole + cyprodinil		E	E	E	x	x	G	14d	NA
Intuity (SC)	11	x	x	6 fl. oz.	x	x	6 fl. oz.	12h	18 fl. oz.
mandestrobin		x	x	G-E	x	x	s	10d	3
Kenja 400SC	7	20-22 fl. oz.	x	20-22 fl. oz.	x	x	20-22 fl. oz.	12h	66 fl. oz.
isofetamid		G	x	F	x	x	F	14d	NA
Lifegard WG	M	x	4.5 oz.	x	4.5 oz.	4.5 oz.	4.5 oz.	4h	NA
Bacillus mycoides isolate J		x	x	x	F	x	F	0d	NA

(Continued)

Table 6-5. Grape Diseases – Prebloom Through Shatter[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Botrytis Bunch Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Luna Experience (SC)	7+3	x	8-8.6 fl. oz.	8-8.6 fl. oz.	x	8.6 fl. oz.	6-8.6 fl. oz.	12h/ 5d6	34 fl. oz.
fluopyram + tebuconazol		x	G	E	x	s	E	14d	NA
Luna Privilege (SC)	7	x	6-6.8 fl. oz.	6-6.8 fl. oz.	x	x	3.2-6.8 fl. oz.	12h	14 fl. oz.
fluopyram		x	G	E	x	x	G	7d	2
Luna Sensation (SC)	7+11	x	5-7.6 fl. oz.	5-7.6 fl. oz.	7.6 fl. oz.	5-7.6 fl. oz.	4-7.6 fl. oz.	12h	28 fl. oz.
fluopyram + trifloxystrobin		x	G	G-E	s	F-G	E	14d	6
Merivon (2.09SC)	7+11	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	12h	33 fl. oz.
fluxapyroxad + pyraclostrobin		E	G-E	s	s	G-E	E [r]	14d	6
Meteor	2	x	x	1-2 pts.	x	x	x	48h	x
Iprodione		x	x	G-E	x	x	x	7d	1 or 4
Mettle 125ME	3	3-5 fl. oz.	3-5 fl. oz.	x	x	x	3-5 fl. oz.	12h/7d7	10 oz.
tetraconazole		E	E	x	x	x	E [r]	14d	varies
Microthiol Disperss	M	x	x	x	x	3-10 lb.	3-10 lb.	24h	NA
sulfur		x	x	x	x	F	E	0d	NA
Miravis Prime	7+12	9.2-13.4 fl. oz.	9.2-13.4 fl. oz.	10.3-13.4 fl. oz.	x	9.2-13.4 fl. oz.	9.2-13.4 fl. oz.	12h	37 fl. oz.
pydiflumetofen+fludioxonil		u	E	G-E	x	F-G	G-E	14d	2
Orius 20AQ	3	x	8.6 oz.	x	x	x	8.6 oz.	12h	68.8 fl. oz.
tebuconazole		x	E	x	x	x	E	14d	NA
OSO 5% SC	19	x	x	6.5-13 fl. oz.	x	x	6.5-13 fl. oz.	4h	5 oz.
polyoxin D		x	x	G	x	x	G	0d	6
Pristine	11+7	8-12.5 oz.	8-12.5 oz.	8-23 oz.	8-12.5 oz.	8-12.5 oz.	8-12.5 oz.	12h/ 5d	69 oz.
pyraclostrobin + boscalid		E	E	G	E [r]	F	E	14d	varies
Procure 480SC	3	x	x	x	x	x	4-8 fl. oz.	24h	32 fl. oz.
triflumizole		x	x	s	x	x	E [r]	7d	4
ProPhyt	P07 (33)	x	x	x	2-4 pt	2-4 pt	x	4h	NA
potassium phosphite		x	x	x	G-E	G-E	x	0d	NA
Quadris Top (SC)	3+11	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12h	56 fl. oz.
difenoconazole + azoxystrobin		E	E	s	F	F	E	14d	NA
Quintec (2.08F)	13	x	x	x	x	x	4-6.6 fl. oz.	12h	33 fl. oz.
quinoxyfen		x	x	x	x	x	E	21d	5
Rally 40WSP	3	3-5 oz.	3-5 oz.	x	x	x	3-5 oz.	24h	2 lb.
myclobutanil		E	E	x	x	x	E[r]	14d	NA

(Continued)

Table 6-5. Grape Diseases – Prebloom Through Shatter[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Botrytis Bunch Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Ranman 400SC	21	x	x	x	2.1-2.75 fl. oz.	x	x	12h	17 fl. oz.
cyazofamid		x	x	x	E	x	x	30d	6
Reason 500SC	11	x	x	x	2.7 fl. oz.	x	x	12h	9 fl. oz.
fenamidone		x	x	x	G[r]	x	x	30d	NA
Revus	40	x	x	x	8 fl. oz.	x	x	4h	32 fl. oz.
mandipropamid		x	x	x	E	x	x	14d	NA
Revus Top	3+40	7 fl. oz.	7 fl. oz.	x	7 fl. oz.	7 fl. oz.	7 fl. oz.	12h	28 fl. oz.
difenoconazole + mandipropamid		E	E	x	E	E	E	14d	NA
Ridomil Gold Copper	4+M	x	x	x	5 lb. (1 pack)	x	x	48h	8 lb.
mefenoxam + copper hydroxide		x	x	x	E	x	x	42d	4
Rhyme	3	x	4-5 fl. oz.	x	x	x	4-5 fl. oz.	14d	30 fl. oz.
flutriafol		x	E	x	x	x	E	12h	6
Ridomil Gold MZ WG	4+M	x	x	x	2.5 lb.	x	x	48h	10 lb.
mefenoxam + mancozeb		x	x	x	E	x	x	66d	4
Roper DF	M	x	1.5-4	1.5-4	1.5-4	1.5-4	x	24h	24 lb.
mancozeb		x	E	i	E	E	x	66d	6
Rovral 4 F	2	x	x	1-2 pt.	x	x	x	48h	2 or 8 pt.
iprodione		x	x	G	x	x	x	7d	1 or 4
Scala SC	9	x	x	18 fl. oz.	x	x	x	12h	36 fl. oz.
pyrimethanil		x	x	G	x	x	x	7d	NA
Sovran (50WG)	11	x	3.2-4.8 oz.	3.2-6.4 oz.	4-6.4 oz.	3.2-4.8 oz.	3.2-4.8 oz.	12h	26 oz.
kresoxim-methyl		x	E	s	F [r]	F	E [r]	14d	4
Sulforix	M	x	x	x	x	1-2 gal., 1 pt.	1-2 gal., 1 pt.	48h	NA
calcium polysulfide		x	x	x	x	G-E	i	NA	8
Switch 62.5 WG	9+12	x	x	11-14 oz.	x	x	x	12h	56 oz.
cyprodinil + fludioxonil		x	x	G	x	x	x	7d	NA
Tanos	11+27	x	x	x	8 oz.	x	x	12h	72 oz.
famoxadone + cymoxanil		x	x	x	G [r]	x	x	30d	9
Tebustar 45WSP	3	x	4 oz.	x	x	x	4 oz.	12h	2 lb.
tebuconazole		x	E	x	x	x	E [r]	0d	NA
Topguard EQ	3+11	x	5-6 fl. oz.	8 fl. oz.	8 fl. oz	8 fl. oz.	5-6 fl. oz.	12h	34 fl. oz.
azoxystrobin + flutriafol		x	u	s	u	u	E	14d	6
Topsin M WSB	1	x	0.75-1.5 lb.	x	x	0.75-1.5 lb.	0.75-1.5 lb.	2d	6 lb.
thiophanate-methyl		x	F	x	x	G	E	7d	NA

(Continued)

Table 6-5. Grape Diseases – Prebloom Through Shatter[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Botrytis Bunch Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Torino (SC)	U6	x	x	x	x	x	3.4-6.8 oz.	4h	7 oz.
cyflufenamid		x	x	x	x	x	E	3d	1 or 2
Vangard WG	9	x	x	10 oz.	x	x	10 oz.	12h	30 oz.
cyprodinil		x	x	G-E	x	x	s	7d	NA
Vivando 2.5F	U8	x	x	x	x	x	10.3-15.4 fl. oz.	12h	43 fl. oz.
metrafenone		x	x	x	x	x	E	14d	3
Zampro	45+40	x	x	x	11-14 fl. oz.	x	x	12h	56 fl. oz.
ametoctradin + dimethomorph		x	x	x	E	x	x	14d	NA
Ziram 76DF	M3	x	3-4 lb.	3-4 lb.	3-4 lb.	3-4 lb.	x	48h	28 lb.
ziram		x	E	s	G	G	x	21d	NA

Footnotes: See how to read the spray schedule tables section at the beginning of the chapter.

Grape Shatter To Veraison (Berry Coloring) – Insects

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

Notes on insect pest management

- **Grape rootworm:** Occasional problems from grape rootworm (adult beetles) are also controlled by Sevin, Imidan, Danitol, Baythroid, or Brigade applied for grape berry moth control. When found, grape rootworm is typically a perimeter problem, low in the canopy.
- **Redbanded leafroller:** Although adult moths are commonly caught in traps, the larvae of this pest are not common in grapes in the Midwest.
- **Leafhoppers (including sharpshooters):** Examining the undersides of grape leaves indicates if leafhoppers are present.

Table 6-6. Grape Insects – Shatter Through Veraison[1]

Product And Formulation Active Ingredient	IRAC Code[2]	Grape berry-Moth	Grape Phylloxera	Japanese Beetle	Leafhopper	Red-banded Leaf-roller	Rose Chafer	Spider Mite	REI[3] PHI[4]	Max Amt[5] Max App[6]
Actara (25WDG)	4A	x	x	1.5-3.5 oz.	1.5-3.5 oz.	x	x	x	12h	7 oz.
thiamethoxam		x	x	G	G	x	x	x	5d	NA
Admire Pro (4.6F)	4A	x	7-14 fl. oz. (soil)	x	7-14 fl. oz. (soil); 1-1.4 fl. oz. (foliar)	x	x	x	12h	2.8/14 fl. oz.
imidacloprid		x	G	x	E	x	x	x	0/30d	NA
Agri-Mek SC (0.7SC) **(RUP)**	6	x	x	x	1.75-3.5 fl. oz.	x	x	1.75-3.5 fl. oz.	12h/ 4d	7 fl. oz.
abamectin		x	x	x	F	x	x	G	28d	2
Altacor eVo (35WDG)	28	2-4.5 oz.	x	3-4.5 oz.	x	x	x	x	4h	4.6 oz.
chlorantraniliprole		E	x	G	x	x	x	x	1d	3

(Continued)

Table 6-6. Grape Insects – Shatter Through Veraison[1] *(continued)*

Product And Formulation Active Ingredient	IRAC Code[2]	Grape berry-Moth	Grape Phylloxera	Japanese Beetle	Leafhopper	Red-banded Leaf-roller	Rose Chafer	Spider Mite	REI[3] PHI[4]	Max Amt[5] Max App[6]
Apollo SC (1SC)	10A	x	x	x	x	x	x	4-8 oz.	12h/ 14d	NA
clofentezine		x	x	x	x	x	x	E	21d	1
Assail 30SG	4A	2.5-5.3 oz.	2.5-5.3 oz.	2.5-5.3 oz.	2.5-5.3 oz.	x	2.5-5.3 oz.	x	12h	10.6 oz.
acetamiprid		u	G	G	E	x	E	x	3d	2
Avaunt eVo (30WDG)	22	5-6 oz.	x	3.5-6 oz.	5-6 oz.	x	x	x	12h	12 oz.
indoxacarb		G	x	G	s	x	x	x	7d	2
Azera 0.21EC	3A	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	12h	NA
azadirachtin + pyrethrins		u	u	u	u	u	u	u	0d	10
Baythroid XL (1EC) **(RUP)**	3A	2.4 -3.2 fl. oz.	x	x	1.6 -3.2 fl. oz.	x	x	x	12h	12.8 fl. oz.
beta-cyfluthrin		E	x	x	G	x	x	x	3d	NA
BeetleGONE! ag	11	x	x	1-17.5 lb.	x	x	x	x	4h	NA
B.t. galleriae		x	x	G	x	x	x	x	0d	NA
Belay (2.13SC)	4A	6 fl. oz. (foliar)	6-12 fl. oz. (soil)	2-4 fl. oz. (foliar)	6-12 fl. oz. (soil); 2-4 fl. oz. (foliar)	x	x	x	12h	12 fl. oz.
clothianidin		F	s	F	E	x	x	x	0/30d	1
Brigade 2EC **(RUP**)	3A	3.2-6.4 fl. oz.	x	3.2-6.4 fl. oz.	3.2-6.4 fl. oz.	x	x	6.4 fl. oz.	12h	7 fl. oz.
bifenthrin		G	x	G	G	x	x	u	30d	NA
Brigade WSB (10WP) **(RUP)**	3A	8-16 oz.	x	8-16 oz.	8-16 oz.	x	x	16 oz.	12h	16 oz.
bifenthrin		G	x	G	G	x	x	u	30d	NA
B.t. (Agree, Dipel, etc.)	11A	1-2 lb.	x	x	x	1-2 lb.	x	x	4h	NA
Bacillus thuringiensis		F	x	x	x	F	x	x	0d	NA
Closer SC (2SC)	4C	x	x	x	2.75-5.75 fl. oz.	x	x	x	12h	17 fl. oz.
sulfoxaflor		x	x	x	E	x	x	x	7d	4
Danitol 2.4EC **(RUP)**	3A	10.6-21.3 fl. oz.	10.6-21.3 fl. oz.	10.6-21.3 fl. oz.	5.3-10.6 fl. oz.	10.6-21.3 fl. oz.	10.6-21.3 fl. oz.	10.6-21.3 fl. oz.	24h	42.6 fl. oz.
fenpropathrin		E	E	E	G	u	E	G	21d	NA
Delegate WG (25WG)	5	3-5 oz.	x	x	x	3-5 oz.	x	x	4h	19.5 oz.
spinetoram		E	x	x	x	E	x	x	3d	5
Dibrom 8E **(RUP)**	1B	x	x	x	0.5-0.6 pt.	x	x	x	48h	6 pt.
naled		x	x	x	u	x	x	x	10d	NA
Entrust SC (2SC)	5	4-8 fl. oz.	x	x	x	4-8 fl. oz.	x	x	4h	23 fl. oz.
spinosad		G	x	x	x	G	x	x	3d	5

(Continued)

Table 6-6. Grape Insects – Shatter Through Veraison[1] *(continued)*

Product And Formulation Active Ingredient	IRAC Code[2]	Grape berry-Moth	Grape Phylloxera	Japanese Beetle	Leafhopper	Red-banded Leaf-roller	Rose Chafer	Spider Mite	REI[3] PHI[4]	Max Amt[5] Max App[6]
Envidor 2SC	23	x	x	x	x	x	x	16-34 fl. oz.	12h	34 fl. oz.
spirodiclofen		x	x	x	x	x	x	E	14d	1
Imidan 70W	1B	1.3-2.1 lb.	x	1.3-2.1 lb.	1.3-2.1 lb.	1.3-2.1 lb.	1.3-2.1 lb.	x	14d	6.5 lb.
phosmet		G	x	G	G	G	G	x	7/14d	NA
Intrepid 2F	18	8-16 fl. oz.	x	x	x	8-16 fl. oz.	x	x	4h	48 fl. oz.
methoxyfenozide		E	x	x	x	G	x	x	30d	NA
Kanemite 15SC	20B	x	x	x	x	x	x	21-31 fl. oz.	12h	62 fl. oz.
acequinocyl		x	x	x	x	x	x	F	7d	2
Magister SC (1.7SC)	21A	x	x	x	32-36 fl. oz.	x	x	32-36 fl. oz.	12h	36 fl. oz.
fenazaquin		x	x	x	u	x	x	u	7d	1
Malathion 5EC	1B	x	x	3 pt.	3 pt.	x	x	3 pt.	72h	NA
malathion		x	x	G	G	x	x	u	3d	2
Movento (2SC)	23	x	6-8 fl. oz.	x	x	x	x	6-8 fl. oz.	24h	12.5 fl. oz.
spirotetramat		x	E	x	x	x	x	s	7d	NA
Mustang Maxx (0.83EC) **(RUP)**	3A	4 fl. oz.	x	4 fl. oz.	4 fl. oz.	x	x	x	12h	24 fl. oz.
zeta-cypermethrin		E	x	E	E	x	x	x	1d	NA
Nealta (1.67SC)	25	x	x	x	x	x	x	13.7 fl. oz.	12h	28 fl. oz.
cyflumetofen		x	x	x	x	x	x	G	14d	2
Nexter SC (3.75SC)	21A	x	x	x	7.5-17 fl. oz.	x	x	7.5-17 fl. oz.	12h	NA
pyridaben		x	x	x	G	x	x	G	7d	2
Onager (1EC)	10A	x	x	x	x	x	x	12-24 oz.	12h	24 oz.
hexythiazox		x	x	x	x	x	x	E	7d	1
Platinum (755G)	4A	x	2.67-5.67 oz.	2.67-5.67 oz.	2.67-5.67 oz.	x	x	x	12h	5.67 oz.
thiamethoxam		x	G	F	G	x	x	x	60d	NA
Portal XLO (0.4EC)	21A	x	x	x	1-2 pt.	x	x	2 pt.	12h	2 pt.
fenpyroximate		x	x	x	F	x	x	E	14d	2
PQZ (1.87SC)	9B	x	x	x	3.2 fl. oz.	x	x	x	12h	4.8 fl. oz.
pyrifluquinazon		x	x	x	G	x	x	x	3d	2
Pyganic 5%EC	3A	x	x	4.5-15.6 fl. oz.	4.5-15.6 fl. oz.	4.5-15.6 fl. oz.	x	4.5-15.6 fl. oz.	12h	NA
pyrethrins		x	x	F	u	u	x	u	0d	10
Scorpion 355L	4A	1.75-5.25 fl. oz.	9.0-13.25 fl. oz.**	1.75-5.25 fl. oz.	1.75-5.25 fl. oz.	x	x	x	12h	21.25 fl. oz.
dinotefuran		F	s	u	G	x	x	x	1d	NA

(Continued)

Table 6-6. Grape Insects – Shatter Through Veraison[1] *(continued)*

Product And Formulation Active Ingredient	IRAC Code[2]	Grape berry-Moth	Grape Phylloxera	Japanese Beetle	Leafhopper	Red-banded Leaf-roller	Rose Chafer	Spider Mite	REI[3] PHI[4]	Max Amt[5] Max App[6]
Sevin XLR Plus (4F)	1A	2 qt.	x	1-2 qt.	1-2 qt.	2 qt.	1-2 qt.	x	2d/6d	10 qt.
carbaryl		G	x	E	G	G	E	x	7d	5
Sivanto Prime (1.67SC)	4D	x	x	x	7-14 fl. oz.	x	x	x	4h	28 fl. oz.
flupyradifurone		x	x	x	G	x	x	x	0/30d	NA
Surround WP (95WP)	UN	x	x	25-50 lb.	25-50 lb.	x	25-50 lb.	x	4h	NA
kaolin		x	x	F	F	x	F	x	0	NA
Transform WG	4C	x	x	x	1.5-2.75 oz.	x	x	x	24h	8.5 oz.
sulfoxaflor		x	x	x	E	x	x	x	7d	4
Vendex 50WP **(RUP)**	12B	x	x	x	x	x	x	1-2.5 lb.	48h	4 lb.
fenbutatin-oxide		x	x	x	x	x	x	F	28d	2
Venom (70SG)	4A	1-3 oz. (foliar)	5-7.5 oz. (soil)	x	1-3 oz. (foliar)	x	x	x	12h	12 oz.
dinotefuran		F	s	x	G	x	x	x	1/28d	NA
Verdepryn 100SL (0.83SL)	28	8.2-11 fl. oz.	x	8.2-11 fl. oz.	x	8.2-11 fl. oz.	x	x	4h	33 fl. oz.
cyclaniliprole		E	x	u	x	u	x	x	7d	3
Zeal (72WP)	10B	x	x	x	x	x	x	2-3 oz.	12h	3 oz.
etoxazole		x	x	x	x	x	x	E	14d	1

****soil applications use higher rate**

Footnotes: See how to read the spray schedule tables section at the beginning of the chapter.

Grape Shatter To Veraison (Berry Coloring) – Diseases

Notes on disease management

- Begin shatter applications when unfertilized berries fall from clusters, about 7-10 days after bloom or 7-10 days after the last spray.
- First cover applications should follow shatter by 7-10 days. Thereafter, sprays for disease control can be applied every 10-14 days until veraison. If heavy rainfall occurs, shorten the interval between sprays. Refer to labels for application timing and harvest restrictions. 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 diseases may be required throughout the growing season.

Postharvest interval (PHI) reminder

- Pay close attention to the PHI on products that contain mancozeb (66 days) or mefenoxam (60 days).

Fungicide resistance alert

- The downy and powdery mildew pathogens are especially prone to fungicide resistance. Avoid back-to-back applications of any one systemic fungicide class (i.e., FRAC 3, 7, 11, 21, 40).
- See Fungicide Resistance Management, page 160, for information about fungicide resistance development in powdery and downy mildews. See Generic Fungicides table for product(s) with the same active ingredient, page 251.

Table 6-7. Grape Diseases – Shatter To Veraison[1]

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Abound (SC)	11	x	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	4h	90 fl. oz.
azoxystrobin		x	E	E [r]	F	E [r]	14d	varies
Aliette WDG	33	x	x	3-5 lb.	x	x	12h	NA
aluminum tris		x	x	E	x	x	15d	3
Aprovia (EC)	7	8.6-10.5 fl. oz.	8.6-10.5 fl. oz.	x	8.6-10.5 fl. oz.	8.6-10.5 fl. oz.	12h	32 fl. oz.
benzovindiflupyr		i	G-E	x	i	G-E	21d	3
Captan 80 WDG	M	1.25-2.5 lb.	1.25-2.5 lb.	1.25-2.5 lb.	1.2-2.5 lb.	1.2-2.5 lb.	48h	15 lb
captan		s(G)	s(F)	G	E	i	0d	NA
Cevya	3	x	4 fl. oz.	x	3-4 fl. oz.	3-4 fl. oz.	12h	8 fl. oz.
mefentrifluconazole		x	E	x	G	G-E	14d	2
Cuprofix Ultra 40D	M	x	1.25-3 lb.	1.2-3 lb.	1.2-3 lb.	1.2-3 lb.	48 h	50 lb.
copper sulfate		x	F	F	F	F-i	x	NA
Endura (70WG)	7	x	x	x	x	4.5 oz.	12h	24 oz.
boscalid		x	x	x	x	E	14d	varies
Fervent 475SC	3+7	x	8.5 fl. oz.	x	8.5 fl. oz.	8.5 fl. oz.	12h	26 fl. oz.
isofetamid+tebuconazole		x	u	x	u	E	14d	NA
Flint Extra	11	x	3.5-3.8 fl. oz.	3.8 fl. oz.	3.5-3.8 fl. oz.	3-3.5 fl. oz.	12h	23 fl. oz.
trifloxystrobin		x	E	s	F	E	14d	6
Forum	40	x	x	6 oz.	x	x	12h	24 oz.
dimethomorph		x	x	E	x	x	14d	4
Fracture	M	x	x	x	x	20.5-24.4 fl. oz.	4h	NA
Banda de Lupinus albus doce (BLAD)		x	x	x	x	F	1d	5
Gatten	U13	x	x	x	x	6.4 fl. oz.	12h	1 lb.
flutianil		x	x	x	x	G-E	14d	4
Inspire Super (EW)	3+9	16-20 fl. oz.	16-20 fl. oz.	x	x	16-20 fl. oz.	12h	80 fl. oz.
difenoconazole + cyprodinil		E	E	x	x	G	14d	NA
Kenja 400SC	7	20-22 fl. oz.	x	x	x	20-22 fl. oz.	12h	66 fl. oz.
isofetamid		G	x	x	x	F	14d	NA
Lifegard WG	M	x	4.5 oz.	4.5 oz.	4.5 oz.	4.5 oz.	4h	NA
Bacillus mycoides isolate J		x	x	F	x	F	0d	NA
Luna Experience (SC)	7+3	x	8-8.6 fl. oz.	x	8.6 fl. oz.	6-8.6 fl. oz.	12h/5d6	34 fl. oz.
fluopyram + tebuconazol		x	G	x	s	E	14d	NA
Luna Privilege (SC)	7	x	6-6.8 fl. oz.	x	x	3.2-6.8 fl. oz.	12h	14 fl. oz.
fluopyram		x	G	x	x	G	7d	2
Luna Sensation (SC)	7+11	x	5-7.6 fl. oz.	7.6 fl. oz.	5-7.6 fl. oz.	4-7.6 fl. oz.	12h	28 fl. oz.
fluopyram + trifloxystrobin		x	G	s	F-G	E	14d	6

(Continued)

Table 6-7. Grape Diseases – Shatter To Veraison[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Merivon (2.09SC)	7+11	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	4-5.5 fl. oz.	12h	33 fl. oz.
fluxapyroxad + pyraclostrobin		E	G-E	s	G-E	E [r]	14d	6
Mettle 125ME	3	3-5 fl. oz.	3-5 fl. oz.	x	x	3-5 fl. oz.	12h/7d7	10 oz.
tetraconazole		E	E	x	x	E [r]	14d	varies
Microthiol Disperss	M	x	x	x	3-10 lb.	3-10 lb.	24h	NA
sulfur		x	x	x	F	E	0d	NA
Miravis Prime	7+12	9.2-13.4 fl. oz.	9.2-13.4 fl. oz.	x	9.2-13.4 fl. oz.	9.2-13.4 fl. oz.	12h	37 fl. oz.
pydiflumetofen+fludioxonil		u	E	x	F-G	G-E	14d	2
OSO 5% SC	19	x	x	x	x	6.5-13 fl. oz.	4h	5 oz.
polyoxin D		x	x	x	x	G	0d	6
Pristine	11+7	8-12.5 oz.	8-12.5 oz.	8-12.5 oz.	8-12.5 oz.	8-12.5 oz.	12h/5d6	69 oz.
pyraclostrobin + boscalid		E	E	E [r]	F	E	14d	varies
Procure 480SC	3	x	x	x	x	4-8 fl. oz.	24h	32 fl. oz.
triflumizole		x	x	x	x	E [r]	7d	4
ProPhyt	33	x	x	2-4 pt.	2-4 pt.	x	4h	NA
potassium phosphite		x	x	G-E	G-E	x	0d	NA
Quadris Top (SC)	3+11	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12h	56 fl. oz.
difenoconazole + azoxystrobin		E	E	F	F	E	14d	NA
Quintec (2.08F)	13	x	x	x	x	4-6.6 fl. oz.	12h	33 fl. oz.
quinoxyfen		x	x	x	x	E	21d	5
Rally 40WSP	3	3-5 oz.	3-5 oz.	x	x	3-5 oz.	24h	2 lb.
myclobutanil		E	E	x	x	E[r]	14d	NA
Ranman 400SC	21	x	x	2.1-2.75 fl. oz.	x	x	12h	17 fl. oz.
cyazofamid		x	x	E	x	x	30d	6
Reason 500SC	11	x	x	2.7 fl. oz.	x	x	12h	9 fl. oz.
fenamidone		x	x	G[r]	x	x	30d	NA
Revus	40	x	x	8 fl. oz.	x	x	4h	32 fl. oz.
mandipropamid		x	x	E	x	x	14d	NA
Revus Top	3+40	7 fl. oz.	7 fl. oz.	7 fl. oz.	7 fl. oz.	7 fl. oz.	12h	28 fl. oz.
difenoconazole + mandipropamid		E	E	E	E	E	14d	NA
Rhyme	3	x	4-5 fl. oz.	x	x	4-5 fl. oz.	14d	30 fl. oz.
flutriafol		x	E	x	x		12h	6
Ridomil Gold Copper	4+M	x	x	5 lb. (1 pack)	x	x	48h	8 lb.
mefenoxam + copper hydroxide		x	x	E	x	x	42d	4
Ridomil Gold MZ WG	4+M	x	x	2.5 lb.	x	x	48h	10 lb.
mefenoxam + mancozeb		x	x	E	x	x	66d	4
Sovran (50WG)	11	x	3.2-4.8 oz.	4-6.4 oz.	3.2-4.8 oz.	3.2-4.8 oz.	12h	26 oz.
kresoxim-methyl		x	E	F [r]	F	E [r]	14d	4

(Continued)

Table 6-7. Grape Diseases – Shatter To Veraison[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Black Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	REI[3] PHI[4]	Max Amt[5] Max App[6]
Sulforix	M	x	x	x	1-2 gal., 1 pt.	1-2 gal., 1 pt.	48h	NA
calcium polysulfide		x	x	x	G-E	i	NA	8
Switch 62.5 WG	9+12	x	x	x	x	x	12h	56 oz.
cyprodinil + fludioxonil		x	x	x	x	x	7d	NA
Tanos	11+27	x	x	8 oz.	x	x	12h	72 oz
famoxadone + cymoxanil		x	x	G [r]	x	x	30d	9
Tebustar 45WSP	3	x	4 oz.	x	x	4 oz	12h	2 lb.
tebuconazole		x	E	x	x	E [r]	0d	NA
Topguard EQ	3+11	x	5-6 fl. oz.	8 fl. oz.	8 fl. oz.	5-6 fl. oz.	12h	34 fl. oz.
azoxystrobin+flutriafol		x	u	u	u	E	14d	6
Topsin M WSB	1	x	0.75-1.5 lb.	x	0.75-1.5 lb.	0.75-1.5 lb.	2d	6 lb.
thiophanate-methyl		x	F	x	G	E	7d	NA
Torino (SC)	U6	x	x	x	x	3.4-6.8 oz.	4h	7 oz.
cyflufenamid		x	x	x	x	E	3d	1 or 2
Vangard WG	9	x	x	x	x	10 oz.	12h	30 oz.
cyprodinil		x	x	x	x	s	7d	NA
Vivando 2.5F	U8	x	x	x	x	10.3-15.4 fl. oz.	12h	43 fl. oz.
metrafenone		x	x	x	x	E	14d	3
Zampro	45+40	x	x	11-14 fl. oz.	x	x	12h	56 fl. oz.
ametoctradin + dimethomorph		x	x	E	x	x	14d	NA
Ziram 76DF	M3	x	3-4 lb.	3-4 lb.	3-4 lb.	x	48h	28 lb.
ziram		x	E	G	G	x	21d	NA

Footnotes: See how to read the spray schedule tables section at the beginning of the chapter.

Grape Veraison to Harvest – Insects

Notes on insect pest management

- Continue to monitor for insect and mite pests and apply insecticide as needed. Refer to product labels for specific insects, rates, and harvest restrictions.
- **Multi-colored Asian lady beetle:** Scout vineyards several days before harvest to determine the abundance of multi-colored 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. See Multi-colored Asian Lady Beetle section on page 162.
- **RESIDUE REMINDER:** Wettable powder formulations may leave visible residues on fruit at harvest.
- Pay close attention to the preharvest invervals on products.

Table 6-8. Grape Insect – Veraison Through Harvest[1]

Product And Formulation Active Ingredient	IRAC Code[2]	Grape Berry Moth	Green June Beetle	Japanese Beetle	Leafhopper	Multi-colored Asian Lady Beetle	Spider Mite	Spotted-Wing Drosophila	Stink Bug	REI[3] PHI[4]	Max Amt[5] Max App[6]
Actara (25WDG)	4A	x	x	1.5-3.5 oz.	1.5-3.5 oz.	x	x	x	4 oz.	12h	7 oz.
thiamethoxam		x	x	G	G	x	x	x	G	5d	NA
Admire Pro (4.6F)	4A	x	x	x	7-14 fl. oz. (soil); 1-1.4 fl. oz. (foliar)	x	x	x	x	12h	2.8/14 fl. oz.
imidacloprid		x	x	x	E	x	x	x	x	0/ 30d	NA
Agri-Mek SC (0.7SC) **(RUP)**	6	x	x	x	1.75-3.5 fl. oz.	x	1.75-3.5 fl. oz.	x	x	12h/ 4d	7 fl. oz.
abamectin		x	x	x	F	x	G	x	x	28d	2
Altacor eVo (35WDG)	28	2-4.5 oz.	x	3-4.5 oz.	x	x	x	x	x	4h	4.6 oz.
chlorantraniliprole		E	x	G	x	x	x	x	x	1d	3
Apollo SC (1SC)	10A	x	x	x	x	x	4-8 oz.	x	x	12h/ 14d	NA
clofentezine		x	x	x	x	x	E	x	x	21d	1
Assail 30SG	4A	2.5-5.3 oz.	x	2.5-5.3 oz.	2.5-5.3 oz.	x	x	x	x	12h	10.6 oz.
acetamiprid		u	x	G	E	x	x	x	x	3d	2
Avaunt eVo (30WDG)	22	5-6 oz.	x	3.5-6 oz.	5-6 oz.	x	x	x	x	12h	12 oz.
indoxacarb		G	G	G	s	x	x	x	x	7d	2
Azera 0.21EC	3A	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	16-56 fl. oz.	12h	NA
azadirachtin + pyrethrins		u	u	u	u	u	u	u	u	0d	10
Baythroid XL (1EC) **(RUP)**	3A	2.4-3.2 fl. oz.	x	x	1.6 -3.2 fl. oz.	x	x	2.4-3.2 fl. oz.	x	12h	12.8 fl. oz.
beta-cyfluthrin		E	x	x	G	x	x	E	x	3d	NA
BeetleGONE! ag	11	x	x	1-17.5 lb.	x	x	x	x	x	4h	NA
B.t. galleriae		x	x	G	x	x	x	x	x	0d	NA
Belay (2.13SC)	4A	6 fl. oz. (foliar)	x	2-4 fl. oz. (foliar)	6-12 fl. oz. (soil); 2-4 fl. oz. (foliar)	2-4 fl. oz. (foliar)	x	x	x	12h	12 fl. oz.
clothianidin		F	x	F	E	E	x	x	x	0/ 30d	1
Brigade 2EC **(RUP)**	3A	3.2-6.4 fl. oz.	x	3.2-6.4 fl. oz.	3.2-6.4 fl. oz.	x	6.4 fl. oz.	x	x	12h	7 fl. oz.
bifenthrin		G	x	G	G	x	u	x	x	30d	NA
Brigade WSB (10WP) **(RUP)**	3A	8-16 oz.	x	8-16 oz.	8-16 oz.	x	16 oz.	x	x	12h	16 oz.
bifenthrin		G	x	G	G	x	u	x	x	30d	NA

(Continued)

Table 6-8. Grape Insect – Veraison Through Harvest[1] *(continued)*

Product And Formulation Active Ingredient	IRAC Code[2]	Grape Berry Moth	Green June Beetle	Japanese Beetle	Leafhopper	Multi-colored Asian Lady Beetle	Spider Mite	Spotted-Wing Drosophila	Stink Bug	REI[3] PHI[4]	Max Amt[5] Max App[6]
B.t. (Agree, Dipel, etc.)	11A	1-2 lb.	x	x	x	x	x	x	x	4h	NA
Bacillus thuringiensis		u	x	x	x	x	x	x	x	0d	NA
Closer SC (2SC)	4C	x	x	x	2.75-5.75 fl. oz.	x	x	x	x	12h	17 fl. oz.
sulfoxaflor		x	x	x	E	x	x	x	x	7d	4
Danitol 2.4EC **(RUP)**	3A	10.6-21.3 fl. oz.	x	10.6-21.3 fl. oz.	5.3-10.6 fl. oz.	x	10.6-21.3 fl. oz.	10.6-21.3 fl. oz.	10.6-21.3 fl. oz.	24h	42.6 fl. oz.
fenpropathrin		E	x	E	G	x	G	E	G	21d	NA
Delegate WG (25WG)	5	3-5 oz.	x	x	x	x	x	x	x	4h	19.5 oz.
spinetoram		E	x	x	x	x	x	E	x	3d	5
Dibrom 8E **(RUP)**	1B	x	x	x	0.5-0.6 pt.	x	x	0.5-0.6 pt.	x	48h	6 pt.
naled		x	x	x	u	x	x	u	x	10d	NA
Entrust SC (2SC)	5	4-8 fl. oz.	x	x	x	x	x	x	x	4h	23 fl. oz.
spinosad		G	x	x	x	x	x	G	x	3d	5
Envidor 2SC	23	x	x	x	x	x	16-34 fl. oz.	x	x	12h	34 fl. oz.
spirodiclofen		x	x	x	x	x	E	x	x	14d	1
Imidan 70W	1B	1.3-2.1 lb.	x	1.3-2.1 lb.	1.3-2.1 lb.	x	x	1.3-2.1 lb.	x	14d	6.5 lb.
phosmet		G	x	G	G	x	x	G	x	7/ 14d	NA
Intrepid 2F	18	8-16 fl. oz.	x	x	x	x	x	x	x	4h	48 fl. oz.
methoxyfenozide		E	x	x	x	x	x	x	x	30d	NA
Kanemite 15SC	20B	x	x	x	x	x	21-31 fl. oz.	x	x	12h	62 fl. oz.
acequinocyl		x	x	x	x	x	F	x	x	7d	2
Magister SC (1.7SC)	21A	x	x	x	32-36 fl. oz.	x	32-36 fl. oz.	x	x	12h	36 fl. oz.
fenazaquin		x	x	x	u	x	u	x	x	7d	1
Malathion 5EC	1B	x	x	3 pt.	3 pt.	x	3 pt.	3 pt.	x	72h	NA
malathion		x	x	G	G	x	u	G	x	3d	2
Movento (2SC)	23	x	x	x	x	x	6-8 fl. oz.	x	x	24h	12.5 fl. oz.
spirotetramat		x	x	x	x	x	s	x	x	7d	NA
Mustang Maxx (0.83EC) **(RUP)**	3A	4 fl. oz.	x	4 fl. oz.	4 fl. oz.	2-4 fl. oz.	x	x	x	12h	24 fl. oz.
zeta-cypermethrin		E	x	E	E	G	x	E	x	1d	NA
Nealta (1.67SC)	25	x	x	x	x	x	13.7 fl. oz.	x	x	12h	28 fl. oz.
cyflumetofen		x	x	x	x	x	G	x	x	14d	2

(Continued)

Table 6-8. Grape Insect – Veraison Through Harvest[1] *(continued)*

Product And Formulation Active Ingredient	IRAC Code[2]	Grape Berry Moth	Green June Beetle	Japanese Beetle	Leafhop-per	Multi-colored Asian Lady Beetle	Spider Mite	Spotted-Wing Drosophila	Stink Bug	REI[3] PHI[4]	Max Amt[5] Max App[6]
Nexter SC (3.75SC)	21A	x	x	x	7.5-17 fl. oz.	x	7.5-17 fl. oz.	x	x	12h	NA
pyridaben		x	x	x	G	x	G	x	x	7d	2
Onager (1EC)	10A	x	x	x	x	x	12-24 oz.	x	x	12h	24 oz.
hexythiazox		x	x	x	x	x	E	x	x	7d	1
Portal XLO (0.4EC)	21A	x	x	x	1-2 pt.	x	2 pt.	x	x	12h	2 pt.
fenpyroximate		x	x	x	F	x	E	x	x	14d	2
PQZ (1.87SC)	9B	x	x	x	3.2 fl. oz.	x	x	x	x	12h	4.8 fl. oz.
pyrifluquinazon		x	x	x	G	x	x	x	x	3d	2
Pyganic 5%EC	3A	x	x	4.5-15.6 fl. oz.	4.5-15.6 fl. oz.	x	4.5-15.6 fl. oz.	4.5-15.6 fl. oz.	4.5-15.6 fl. oz.	12h	NA
pyrethrins		x	x	F	u	G	u	F	u	0d	10
Scorpion 35SL	4A	1.75-5.25 fl. oz.	x	1.75-5.25 fl. oz.	1.75-5.25 fl. oz.	1.75-5.25 fl. oz.	x	x	x	12h	21.25 fl. oz.
dinotfuran		F	x	u	G	G	x	x	x	1d	NA
Sevin XLR Plus (4F)	1A	2 qt.	2 qt.	1-2 qt.	1-2 qt.	x	x	x	x	2d/ 6d	10 qt.
carbaryl		G	E	E	G	x	x	x	x	7d	5
Sivanto Prime (1.67SC)	4D	x	x	x	7-14 fl. oz.	x	x	x	x	4h	28 fl. oz.
flupyradifurone		x	x	x	G	x	x	x	x	0/ 30d	NA
Surround WP (95WP)	UN	x	25-50 lb.	25-50 lb.	25-50 lb.	x	x	x	x	4h	NA
kaolin		x	u	F	F	x	x	x	x	0	NA
Transform WG	4C	x	x	x	1.5-2.75 oz.	x	x	x	x	24h	8.5 oz.
sulfoxaflor		x	x	x	E	x	x	x	x	7d	4
Vendex 50WP **(RUP)**	12B	x	x	x	x	x	1-2.5 lb.	x	x	48h	4 lb.
fenbutatin-oxide		x	x	x	x	x	F	x	x	28d	2
Venom (70SG)	4A	1-3 oz. .(foliar)	x	x	1-3 oz. (foliar)	1-3 oz. (foliar)	x	x	x	12h	6 oz.; 7.5 oz.**
dinotefuran		F	x	x	G	G	x	x	x	1/ 28d	1**
Verdepryn 100SL (0.83SL)	28	8.2-11 fl. oz.	x	8.2-11 fl. oz.	x	x	x	8.2-11 fl. oz.	8.2-11 fl. oz.	4h	33 fl. oz.
cyclaniliprole		E	x	u	x	x	x	E	s	7d	3
Zeal (72WP)	10B	x	x	x	x	x	2-3 oz.	x	x	12h	3 oz.
etoxazole		x	x	x	x	x	E	x	x	14d	1

**** denotes soil application**

Footnotes: See how to read the spray schedule tables section at the beginning of the chapter.

Grape Veraison to Harvest – Diseases

Notes on disease management

- **Botrytis bunch rot:** See comments under Grape Bloom for Topsin M, Rovral, Vangard, and Elevate. See Botrytis Bunch Rot, page 1160. Same as for Grape Bloom, pages 163-166.
- **Sour rot complex:** Mix Oxidate or Blight Ban 506 with an insecticide (for Drosophila control). See discussion on page 160.
- **Black rot:** Sprays for black rot should not be needed at this time.
- **Ripe rot:** A fungicide application at veraison may be required if disease pressure high (wet and warm). See page 159 for additional information on ripe rot.

Table 6-9. Grape Diseases – Veraison Through Harvest[1]

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Anthracnose Fruit rot	Black Rot	Botrytis Bunch Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	Bitter Rot	Ripe Rot	REI[3] PHI[4]	Max Amt[5] Max App[6]
Abound (SC)	11	x	x	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	10-15.5 fl. oz.	x	x	4h	90 fl. oz.
azoxystrobin		x	x	E	s	E [r]	F	E [r]	x	x	14d	varies
Aliette WDG	33	x	x	x	x	3-5 lb.	x	x	x	x	12h	NA
aluminum tris		x	x	x	E	x	x	x	x	x	15d	3
Captan 80 WDG	M	1.25-2.5 lb.	1.25-2.5 lb.	1.25-2.5 lb.	2.5 lb.	1.25-2.5 lb.	1.2-2.5 lb.	1.2-2.5 lb.	x	x	48h	15 lb.
captan		s(G)	s(F)	F	G	E	i	s(G)	x	x	0d	NA
Cevya	3	x	x	4 fl. oz.	x	x	3-4 fl. oz.	3-4 fl. oz.	x	x	12h	8 fl. oz.
mefentrifluconazole		x	x	E	x	x	G	G-E	x	x	14d	2
Cuprofix Ultra 40D	M	x	x	1.25-3 lb.	x	1.2-3 lb.	1.2-3 lb.	1.2-3 lb.	x	x	48 h	50 lb.
copper sulfate		x	x	F	x	F	F	F-i	x	x	x	NA
Elevate 50 WDG	17	x	x	x	1 lb.	x	x	1 lb.	x	x	12h	3 lb.
fenhexamid		x	x	x	E	x	x	s	x	x	0d	3
Endura (70WG)	7	x	x	x	8 oz.	x	x	4.5 oz.	x	x	12h	24 oz.
boscalid		x	x	x	G	x	x	E	x	x	14d	varies
Fervent 475SC	3+7	x	x	8.5 fl. oz.	8.5 fl. oz.	x	8.5 fl. oz.	8.5 fl. oz.	x	x	12h	26 fl. oz.
isofetamid+tebuconazole		x	x	u	s	x	u	E	x	x	14d	NA
Flint Extra	11	x	x	3.5-3.8 fl. oz.	3.8 fl. oz.	3.8 fl. oz.	3.5-3.8 fl. oz.	3-3.5 fl. oz.	x	x	12h	23 fl. oz.
trifloxystrobin		x	x	E	G	s	F	E	x	x	14d	6
Forum	40	x	x	x	x	6 oz.	x	x	x	x	12h	24 oz.
dimethomorph		x	x	x	x	E	x	x	x	x	14d	4
Fracture	M	x	x	x	24.4-36.6 fl. oz.	x	x	20.5-24.4 fl. oz.	x	x	4h	NA
Banda de Lupinus albus doce (BLAD)		x	x	x	E	x	x	E	x	x	1d	5

(Continued)

Table 6-9. Grape Diseases – Veraison Through Harvest[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Anthracnose Fruit rot	Black Rot	Botrytis Bunch Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	Bitter Rot	Ripe Rot	REI[3] PHI[4]	Max Amt[5] Max App[6]
Gatten	U13	x	x	x	x	x	x	6.4 fl. oz.	x	x	12h	1 lb.
flutianil		x	x	x	x	x	x	G-E	x	x	14d	4
Inspire Super (EW)	3+9	16-20 fl. oz.	16-20 fl. oz.	16-20 fl. oz.	16-20 fl. oz.	x	x	16-20 fl. oz.	x	x	12h	80 fl. oz.
difenoconazole + cyprodinil		E	E	E	x	x	x	G	x	x	14d	NA
Intuity (SC)	11	x	x	x	6 fl. oz.	x	x	6 fl. oz.	x	x	12h	18 fl. oz.
mandestrobin		x	x	x	G-E	x	x	s	x	x	10d	3
Kenja 400SC	7	20-22 fl. oz.	20-22 fl. oz.	x	20-22 fl. oz.	x	x	20-22 fl. oz.	x	20-22 fl. oz.	12h	66 fl. oz.
isofetamid		G	G	x	F	x	x	F	x	u	14d	NA
Lifegard WG	M	x	x	x	x	4.5 oz.	x	4.5 oz.	x	x	4h	NA
Bacillus mycoides isolate J		x	x	x	x	F	x	F	x	x	0d	NA
Luna Experience (SC)	7+3	x	x	8-8.6 fl. oz.	8-8.6 fl. oz.	x	8.6 fl. oz.	6-8.6 fl. oz.	x	x	12h/ 5d6	34 fl. oz.
fluopyram + tebuconazol		x	x	G	E	x	s	E	x	x	14d	NA
Luna Privilege (SC)	7	x	x	6-6.8 fl. oz.	6-6.8 fl. oz.	x	x	3.2-6.8 fl. oz.	x	x	12h	14 fl. oz.
fluopyram		x	x	G	E	x	x	G	x	x	7d	2
Luna Sensation (SC)	7+11	x	x	5-7.6 fl. oz.	5-7.6 fl. oz.	7.6 fl. oz.	5-7.6 fl. oz.	4-7.6 fl. oz.	x	x	12h	28 fl. oz.
fluopyram + trifloxystrobin		x	x	G	G-E	s	F-G	E	x	x	14d	6
Merivon (2.09SC)	7+11	4 to 5.5 fl. oz.	4 to 5.5 fl. oz.	4 to 5.5 fl. oz.	4 to 5.5 fl. oz.	4 to 5.5 fl. oz.	4 to 5.5 fl. oz.	4-5.5 fl. oz.	x	4-5.5 fl. oz.	12h	33 fl. oz.
fluxapyroxad + pyraclostrobin		E	G-E	E	s	s[r]	G-E	E [r]	x	s(G)	14d	6
Meteor	2	x	x	x	1.5-2 pts.	x	x	x	x	x	48h	x
Iprodione		x	x	x	G-E	x	x	x	x	x	7d	1 or 4
Mettle 125ME	3	3-5 fl. oz.	3-5 fl. oz.	3-5	x	x	x	3-5 fl. oz.	x	x	12h/ 7d7	10 oz.
tetraconazole		E	E	u	x	x	x	E [r]	x	x	14d	varies
Microthiol Disperss	M	x	x	x	x	x	3-10 lb.	3-10 lb.	x	x	24h	NA
sulfur		x	x	x	x	F	E	x	x	x	0d	NA
Miravis Prime	7+12	9.2-13.4 fl. oz.	9.2-13.4 fl. oz.	9.2-13.4 fl. oz.	10.3-13.4 fl. oz.	x	9.2-13.4 fl. oz.	9.2-13.4 fl. oz.	x	x	12h	37 fl. oz.
pydiflumetofen+fludioxonil		u	E	G-E	F-G	x	G-E	F-G	x	x	14d	2

(Continued)

Table 6-9. Grape Diseases – Veraison Through Harvest[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Anthracnose Fruit rot	Black Rot	Botrytis Bunch Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	Bitter Rot	Ripe Rot	REI[3] PHI[4]	Max Amt[5] Max App[6]
OSO 5% SC	19	x	x	x	6.5-13 fl. oz.	x	x	6.5-13 fl. oz.	x	x	4h	5 oz.
polyoxin D		x	x	x	G	x	x	G	x	x	0d	6
Pristine	11+7	8-12.5 oz.	8-12.5 oz.	8-12.5 oz.	8-23 oz.	8-12.5 oz.	8-12.5 oz.	8-12.5 oz.	x	x	12h/ 5d6	69 oz
pyraclostrobin + boscalid		E	E	G	E [r]	F	E	u	x	x	14d	varies
Procure 480SC	3	x	x	x	x	x	x	4-8 fl. oz.	x	x	24h	32 fl. oz.
triflumizole		x	x	s	x	x	E [r]	x	x	x	7d	4
ProPhyt	33	x	x	x	x	2-4 pt.	2-4 pt.	x	x	x	4h	NA
potassium phosphite		x	x	x	G-E	G-E	x	x	x	x	0d	NA
Quadris Top (SC)	3+11	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	12-14 fl. oz.	x	x	12h	56 fl. oz.
difenoconazole + azoxystrobin		E	E	s	F	s[r]	E	G	x	x	14d	NA
Rally 40WSP	3	3-5 oz.	3-5 oz.	3-5 oz.	x	x	x	3-5 oz.	x	x	24h	2 lb.
myclobutanil		E	E	x	x	x	E[r]	x	x	x	14d	NA
Revus	40	x	x	x	x	8 fl. oz.	x	x	x	x	4h	32 fl. oz.
mandipropamid		x	x	x	E	x	x	x	x	x	14d	NA
Revus Top	3+40	7 fl. oz.	7 fl. oz.	7 fl. oz.	x	7 fl. oz.	7 fl. oz.	7 fl. oz.	x	x	12h	28 fl. oz.
difenoconazole + mandipropamid		E	E	E	x	E	E	F	x	x	14d	NA
Rhyme	3	x	x	4-5 fl. oz.	x	x	x	4-5 fl. oz.	x	x	14d	30 fl. oz.
flutriafol		x	x	E	x	x	x	E	x	x	12h	6
Scala SC	9	x	x	x	18 fl. oz.	x	x	x	x	x	12h	36 fl. oz.
pyrimethanil		x	x	x	G	x	x	x	x	x	7d	NA
Sovran (50WG)	11	x	x	3.2-4.8 oz.	3.2-6.4 oz.	4-6.4 oz.	3.2-4.8 oz.	3.2-4.8 oz.	x	x	12h	26 oz.
kresoxim-methyl		x	x	s	E-F [r]	E-F [r]	E	E-F [r]	x	x	14d	4
Sulforix	M	x	x	x	x	1-2 gal., 1 pt.	1-2 gal., 1 pt.	1 pt./ 100 g.	x	x	48h	NA
calcium polysulfide		x	x	x	x	G-E	i	F-G	x	x	48h	8
Switch 62.5 WG	9+12	x	x	x	11-14 oz.	x	x	x	x	x	12h	56 oz.
cyprodinil + fludioxonil		x	x	x	G	x	x	x	x	x	7d	NA
Tebustar 45WSP	3	x	x	4 oz.	x	x	x	4 oz.	x	x	12h	2 lb.
tebuconazole		x	x	E	x	x	x	E [r]	x	x	0d	NA

(Continued)

Table 6-9. Grape Diseases – Veraison Through Harvest[1] *(continued)*

Product And Formulation Active Ingredient	FRAC Code[2]	Anthracnose Foliar	Anthracnose Fruit rot	Black Rot	Botrytis Bunch Rot	Downy Mildew	Phomopsis Blight	Powdery Mildew	Bitter Rot	Ripe Rot	REI[3] PHI[4]	Max Amt[5] Max App[6]
Topguard EQ	3+11	x	x	5-6 fl. oz.	8 fl. oz.	8 fl. oz.	8 fl. oz.	5-6 fl. oz.	x	x	12h	34 fl. oz.
azoxystrobin+flutriafol		x	x	u	s	u	u	E	x	x	14d	6
Topsin M WSB	1	x	x	0.75-1.5 lb.	x	x	0.75-1.5 lb.	0.75-1.5 lb.	0.75-1.5 lb.	x	2d	6 lb.
thiophanate-methyl		x	x	F	x	x	G	E	G	x	7d	NA
Torino (SC)	U6	x	x	x	x	x	x	3.4-6.8 oz.	x	x	4h	7 oz.
cyflufenamid		x	x	x	x	x	x	E	x	x	3d	1 or 2
Vangard WG	9	x	x	x	10 oz.	x	x	10 oz.	x	x	12h	30 oz.
cyprodinil		x	x	x	G-E	x	x	s	x	x	7d	NA
Vivando 2.5F	U8	x	x	x	x	x	x	10.3-15.4 fl. oz.	x	x	12h	43 fl. oz.
metrafenone		x	x	x	x	x	x	E	x	x	14d	3
Zampro	45+40	x	x	x	x	11-14 fl. oz.	x	x	x	x	12h	56 fl. oz.
ametoctradin + dimethomorph		x	x	x	x	E	x	x	x	x	14d	NA

Footnotes: See how to read the spray schedule tables section at the beginning of the chapter.

Grape Postharvest – Foliar Diseases

Downy mildew, powdery mildew: In some years, these diseases may cause defoliation well before the onset of cool weather in the fall. Postharvest 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. Postharvest 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

Disease Management

Anthracnose

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 lime-sulfur or Sulforix application.

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 develops on mature berries (8 percent or greater sugar), it more likely to be bitter rot than black rot.

If bitter rot is a problem, pre-harvest applications of captan may be beneficial. Observe all pre-harvest restrictions.

Grape ripe rot

Ripe rot symptoms appear on 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.

Ripe rot is very difficult to manage. The systemic FRAC 11 fungicides (Abound, Sovran, Flint, and products that contain a FRAC 11 fungicide such as Pristine, Merivon, Luna Sensation and Quadris Top) or FRAC 12 fungicides (Miravis Prime, Switch) are moderately effective against ripe rot but must be applied during the critical period for berry infections. 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. Vangard and Elevate are also at risk for fungicide resistance development. We therefore recommend limiting Rovral, Elevate, and Vangard applications to two per year to reduce the probability of developing isolates of *Botrytis* resistant to these materials. In addition, consider alternating applications of Rovral, Elevate, and Vangard during the growing season. Note: Removing leaves around clusters on mid- or low- wire cordon-trained vines before bunch closing has been shown to reduce *Botrytis*-caused losses.

Grape sour rot

Sour rot occurs late in the season near harvest (15 percent or greater sugar; 15 Brix) on berries damaged from bird pecks, rain cracking, and insects. The most obvious sour rot symptom is a pre-harvest decay accompanied by a strong 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* bunch rot, 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. Both yeasts and bacteria require some type of physical injury or wound to infect the berries, so bird pecks, fruit fly injury (genus Drosophila) 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. For images and more information on sour rot see https://ohioline.osu.edu/factsheet/plpath-fru-50.

The most effective sour rot control is to minimize the populations of yeasts, bacteria, and fruit flies. Starting at 15 Brix, apply an insecticide (Mustang Maxx, Delegate, and malathion) to control fruit flies and an antimicrobial (Oxidate, Fracture) to reduce yeasts and bacteria-associated with sour rot.

Fungicide resistance management

A spray program should be thoughtfully developed to prevent and slow the development of fungicide-resistant pathogens in the vineyard. 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 one sequential applications of a high-risk fungicide (FRAC 11, 3, 7) should be applied before alternating to a fungicide with a different mode of action. High-risk fungicides have restrictions on how much and how often they can be applied. Do not overuse fungicides. It is unlawful to apply fungicides in a manner inconsistent with the product label.

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 denature 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 pants and to accumulate in soil, copper fungicides in conventional production systems have largely been replaced with other 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 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 but 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 blight.

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. 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.
6. Some products are incompatible with copper. Do not mix copper products with anything that will acidify the spray mixture (such as phosphorus acid fungicides).
7. Avoid copper and lime sprays on fruit destined for fresh market.

Late season applications of copper, captan, and sulfur

Broad-spectrum fungicides such as copper, captan, and sulfur should be avoided within 30-45 days of harvest. These products can interfere with the fermentation process by killing the yeast, resulting in the fermentation getting stuck. Stuck fermentations are hard to get going again and make the juices more susceptible to bacterial contamination or hydrogen sulfide production. Removing leaves around the clusters (leaf pulling) reduces the risk of fungal infections late in the season and thus reduces reliance on late season fungicides applications.

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 each management section identify the various insecticide modes of action group. Rotating to insecticides with a different IRAC code should help avoid development of insecticide resistance.

Insect Management

Spotted-wing Drosophila

Spotted-wing Drosophila (SWD) is a serious 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 than 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: https://www.canr.msu.edu/swd/.

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.

Multi-colored Asian lady beetle

The multi-colored 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 defensive 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

This insect can be a serious pest in southern parts of our region. There are no insecticides currently labeled for use against this pest in grapes, but it can be managed with the biocontrol tactic of insect-parasitic nematodes. Research on the behavioral tactic of pheromone mating disruption has looked promising, but no mating disruption product is currently registered for control of this pest on grapes.

Spotted lanternfly

The spotted lanternfly is an invasive planthopper that is currently spreading throughout the Midwest. This insect feeds on plant sap causing wilting, dieback, and even death.

Currently, spotted lanternfly is believed to pose the greatest threat to the grape, hops, and hardwood industries. Know how to identify this pest and remain vigilant for its appearance in your vineyard and orchard systems. Consult your state entomologist and state department of Agriculture for guidance on identifying this pest, its preferred invasive host tree (tree of heaven), and potential use of monitoring traps.

Wasps in fruit plantings

Almost anywhere fruit is produced, wasps can become a nuisance or, in some cases, a severe pest to field workers. 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.

Table 6-10. 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 Bunch Rot	Phomopsis	Eutypa	Crown Gall	Anthracnose	Sulfur[2]	Copper[3]	2,4-D[4]	Dicamba[4]
Arandell	+	+	+	+	++	?	?	+	?	?	++	?
Aromella	+	+++	+	+	++	?	?	+	?	?	+++	+++
Aurore	+++	++	++	+++	+	+++	++	+	No	++	?	?
Baco Noir	+++	+	++	++	+	++	+++	+	No	?	?	?
Brianna	?	+	?	+	?	?	?	?	Yes	+++	++	+

(Continued)

Table 6-10. Relative Disease Susceptibility And Chemical Sensitivity Among Grape Cultivars *(continued)*

Cultivar	Susceptible Or Sensitive To[1]											
	Black Rot	Downy Mildew	Powdery Mildew	Botrytis Bunch Rot	Phomopsis	Eutypa	Crown Gall	Anthracnose	Sulfur[2]	Copper[3]	2,4-D[4]	Dicamba[4]
Cabernet Franc	+++	+++	+++	+	?	?	+++	++	No	?	+	+++
Cabernet Sauvignon	+++	+++	+++	+	+++	+++	+++	?	No	+	+	?
Catawba	+++	+++	++	+	+++	+	+	++	No	++	++	++
Cayuga White	+	++	+	+	++	+	++	+++	No	+	+	+++
Chambourcin	+++	+	+++	++	+	?	++	+	Yes	?	+++	++
Chancellor	+	+++	+++	+	+++	+	+++	++	Yes	+++	++	?
Chardonel	++	++	++	++	+++	++	++	+	No	?	++	+++
Chardonnay	++	+++	+++	+++	+++	++	+++	+++	No	+	++	+++
Concord	+++	+	++	+	+++	+++	+	+	Yes	+	+++	++
Corot noir	+	+++	+	+	++	+	+	+	No	?	++	+++
Cynthiana/Norton	+	++	+	+	+	?	+	+	Yes	?	+++	+++
DeChaunac	+	++	++	+	+++	+++	++	++	Yes	+	+	++
Delaware	++	+++[5]	++	+	+++	+	+	++	No	+	+++	?
Edelweiss	?	?	?	?	?	?	?	?	?	?	++	?
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	?	?	?
Niagara	+++	+++	++	+	+++	+	++	++	No	+	+++	++
Noiret	+++	++	++	+	+	?	++	+	No	?	++	+++
Petite Pearl	+++	+	+	+	+	?	+	+	?	?	+	?
Pinot gris	+++	+++	+++	++	?	+++	+++	?	No	?	?	?
Pinot noir	+++	+++	+++	+++	?	?	+++	?	No	+	?	?
Reliance	+++	+++	++	+	++	?	?	+++	No	+	+	?
Riesling	+++	+++	+++	+++	++	++	+++	?	No	+	+	++

(Continued)

Table 6-10. Relative Disease Susceptibility And Chemical Sensitivity Among Grape Cultivars *(continued)*

Cultivar	Susceptible Or Sensitive To[1]											
	Black Rot	Downy Mildew	Powdery Mildew	Botrytis Bunch Rot	Phomopsis	Eutypa	Crown Gall	Anthracnose	Sulfur[2]	Copper[3]	2,4-D[4]	Dicamba[4]
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.

Vole Control in Fruit Plantings

Mice, also 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 need to be 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.
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 pre-harvest 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 lb per acre per application at a minimum interval of 21 days. The maximum application per growing season is 20 lb. per acre.

Growth Regulator PHIs and REIs

Growth Regulator Pre-harvest Intervals and Restricted Entry Intervals

Trade Name	Common Name	Preharvest Interval (Days)						REI (Hours)
		Apple	Pear	Peach	Sweet Cherry	Tart Cherry	Plum	
Apogee, Cryova[2], Kudos, Pro-Hex[2]	Prohexadione-calcium	45	—[1]	—	20	—	—	12
Amid Thin-W	NAD	2	2	—	—	—	—	48
Blush		7	—	—	—	—	—	4
Cytokin[2]	kinetin	0	0	0	0	0	0	4
Ethrel, Motivate, Ethephon	ethephon	7	—	—	7	7	—	48
Fruitone N	NAA	2	2	—	—	—	—	48
K-Salt Fruit Fix 200	NAA	2	2	—	—	—	—	24
K-Salt Fruit Fix 800	NAA	2	2	—	—	—	—	48
MaxCel, Exilis	6-benzladenine	86	86	—	—	—	—	12
ProGibb	gibberellic acid (GA3)	—	—	—	0	0	0	4
ProVide	GA4 + 7	—	—	—	—	—	—	4
Promalin, Typy, Cytoplex HMS, Perlan	6BA + GA4 + 7	0	NB[3]	0	NB[3]	—	—	4/24
ReTain	AVG	7	7	7	—	—	7	12

[1] — = not registered or not recommended

[2] Check label for state registration

[3] Non-bearing trees only.

Chemical Weed Control in Fruit Crops

Controlling weeds in fruit plantings is important. Weeds may reduce yields by competing for water and nutrients, harbor insects and other pests, and serve as alternate hosts for diseases. Herbicides can provide good weed management with less labor and frequently at a lower cost compared to manual weed control.

Proper Application

Herbicide effectiveness depends on the selection of the appropriate product and application of the product at the proper time, and the proper rate, with the proper equipment. The level of weed management depends largely on the operator's skill and attention to detail. 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 amount of herbicide needed per acre of crop is 4/10 of the broadcast amount per acre. Make sprayer adjustments and calibrations as precise as possible to assure accurate and uniform applications. Improper application can damage fruit plantings and may result in illegal residues on the fruit crop. Over- or under-application also can reduce the profitability of the planting. 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. The HRAC code on the label indicates what group the chemical is in and chemicals with the same number function the same way. We recommend that you rotate herbicides with different modes of action 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. Use caution when tank mixing herbicides that are not specifically 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 herbicides to gain better weed control. **Always follow label recommendations. Improper mixing can form chemical compounds that are not compatible and that may damage your sprayer.**

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. 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.

Site Preparation Before Planting

Management of perennial weeds in perennial fruit crops can be challenging. Growers should strive to eradicate established perennial weeds during site preparation in the season prior to establishing the crop. Most perennial weeds cannot be controlled effectively in the spring before planting or once the crop is planted. 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 cultivation as green "flushes" of weed seedlings appear. An alternative is to apply paraquat (Gramoxone) or glufosinate (Rely or generics) for contact non-selective weed control as flushes of weed seedlings appear.

Establishment of a grass crop on the site several years before planting will give the grower more options for control of perennial broadleaf weeds. Alternatively, cultivation combined with a non-selective herbicide can also be an effective strategy.

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 255-260 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.

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 Grape

Weed Problem	Material And Rate Per Acre	Notes And Comments
Pre-emergence		
Annual and perennial grasses and broadleaves	Alion (indaziflam (1.67 lb. a.i. /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 4G (dichlobenil 4% a.i./lb.) at 100-150 lb.	For perennial weed control, apply to untilled ground over old weed growth from November 15 to Feb 15; alternately apply late fall or very early spring before May 15 and incorporate immediately. For annual weed control, surface apply. Shallow incorporation or sprinkler irrigation is recommended when application is made during periods of high temperatures. Do not apply until 4 weeks after transplanting. Use higher rate for perennial weed control. Annual maximum rate 150 lbs./A.
Annual broadleaves and suppression of grasses	Chateau SW (flumioxazin 51% a.i.) at 6-12 oz. in 15 gal. water minimum Chateau EZ (flumioxazin 41.4% a.i.) at 6-12 oz. in 15 gal. water minimum	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. Should be applied to weed free surface. Also has post-emergence activity. **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. New plantings of "own-rooted varieties", such as Concord, should be planted so that all roots are a minimum 8 inches below the soil surface to be treated. In some situations, this may require hilling soil around newly planted vines so that the settled depth of the hill will be 4 to 5 inches above the vineyard floor.
Annual broadleaves and annual grasses	Chateau Complete (flumioxazin 30% a.i. + rimsulfuron 8.25%) at 6-12 oz.	**Not registered in all states.** Do not apply more than 12 oz. per acre per year. Do not apply to crops established less than one year. If weeds are emerged at the time of application, apply with an adjuvant (0.25% v/v non-ionic surfactant or 1 qt./A crop oil concentrate). For complete control of emerged weeds, addition of a labelled burndown product required.
Annual grasses and broadleaves	Devrinol 2-XT (napropamide 2 lb. a.i./gal.) at 2 gal.	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 gal per acre per crop cycle.
Broadleaves	Gallery 75 DF (isoxaben 0.75 lb. a.i./lb) at 0.66-1.33 lb. **Gallery SC is for non-bearing only**	Apply any time prior to germination of target weeds or immediately after cultivation. **Specific Use Restrictions:** • Do not apply within 165 days of harvest. • Do not apply Gallery 75 Dry Flowable more than twice per crop year (harvest to harvest) up to a maximum total of 1.33 lb. of product per acre per crop year.
Annual broadleaves and suppression of grasses	Goal 2XL (oxyfluorfen 2 lb. a.i./gal./) at 5-8 pt. in minimum of 20 gal. water	**Dormant Application Only:** Effective both pre-emergence (5-8 pt.) and post-emergence (2-8 pt.) 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 pt. 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 feet above ground.
Annual broadleaves and suppression of grasses	GoalTender (oxyfluorfen 4 lb. a.i./gal.) at 2.5-4 pt. in minimum of 20 gal. water	**Dormant Application Only:** Effective both pre-emergence as a banded application (2.5-4 pt.) and post-emergence (1-4 pt.) 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 4 pt per year on a band application basis. **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.

(Continued)

Herbicide Recommendations For Grape (*continued*)

Weed Problem	Material And Rate Per Acre	Notes And Comments
Annual grasses and broadleaves	Karmex DF (diuron 80% a.i.) at 2-6 lb. in 25-40 gal. 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 pt. in 40-50 gal. 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 pt./A/year. Some Special Local Needs Labels (FIFRA 24(c)) are labelled as Restricted Use Pesticides (RUP), whereas the national label remains a general use pesticide. **Age restriction:** Do not apply to vines less than 1 year old.
Annual grasses and broadleaves	Matrix FVN or SG (rimsulfuron 25% a.i.) at 4 oz. in a minimum of 10 gal. 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.
Annual and perennial grasses and broadleaves	Mission (flazasulfuron 25% a.i.) at 2.14-2.85 oz. in 15-50 gal. water	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 potential injury. **Age Restriction:** Apply to grapes established 3 years or more.
Annual grasses and broadleaves	Princep 4L (simazine 4 lb. a.i./ gal.) at 2-4 qt. in 25-40 gal. 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 broadleaf weeds	Prowl 3.3 EC (pendimethalin 3.3 lb. a.i./ gal.) at 2.4-4.8 qt.	**Non-Bearing Only.** Use rates of this product vary by soil texture and organic matter. Most effective in controlling weeds mechanically incorporated or when incorporated into the weed germination zone by adequate rainfall or overhead irrigation after application. Apply only to dormant grapevines. ▪ DO NOT apply if buds have started to swell. Application after buds have started to swell may result in leaf distortion. ▪ DO NOT apply to newly transplanted trees or vines until ground has settled and no cracks are present.
Annual grasses and certain broadleaves	Prowl H2O (pendimethalin 3.8 lb. a.i./ gal.) at 3.2-6.3 qt. in minimum of 20 gal. water	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, pre-plant surface, or pre-emergence. For best results, rain or irrigation is needed within 21 days of application. Not effective on germinated weeds. Do not allow spray to contact leaves, shoots, or buds. For new plantings, do not apply until soil has settled and no cracks are present.
Annual grasses and certain broadleaves	Snapshot 2.5TG (isoxaben+trifluralin 2.5% a.i.) at 100-200 lb.	**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 lb. 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 lb. in minimum of 20 gal. 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.

(Continued)

Herbicide Recommendations For Grape (*continued*)

Weed Problem	Material And Rate Per Acre	Notes And Comments
Annual grasses and certain broadleaves	Surflan As Specialty Herbicide (oryzalin 4 lb. a.i./ gal.) at 2-6 qt. in 20-40 gal. of water	**No longer in production - supply extremely limited to not available.** 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 (0.5 inch) is required for activation. Minimum 2.5 months between applications. Do not exceed 12 qt. per year.
Annual grasses and broadleaves	Treflan HFP 4EC (trifluralin 4 lb. a.i./ gal.) at 1-4 pt. in 5-40 gal. water	In a new planting, apply 1-4 pt. and incorporate within 24 hours. In an established planting, apply 2-4 pt. prior to weed germination or immediately after removal of weeds with tillage or other herbicides and incorporate within 24 hours.
Annual and perennial broadleaves	Trellis (isoxaben 75% a.i.) at 0.67-1.33 lb. in minimum of 10 gal. water Trellis SC (isoxaben 4.16 lb. a.i./gallon) at 16-31 oz.	**Non-bearing:** Apply any time before target weeds germinate or immediately after cultivation. **Bearing:** Apply before target weeds germinate or immediately after cultivation. Do not exceed 2 applications per crop year or exceed 1.33 lb. (1.0 lb isoxaben) per acre per crop year. Do not apply Trellis SC more than twice per crop year (harvest to harvest) up to a maximum total of 1.0 lb. a.i. (31 fl. oz.) per crop year. Do not apply Trellis SC to newly transplanted vines until soil has been settled and no cracks are present of plant injury may occur.
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 gal. water	Apply as a broadcast or banded soil application directed to the base of the 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. **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 gal. water	Apply as a broadcast or banded soil application directed to the base of the 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. **Age Restriction:** Apply to crops that have been growing for at least 3 years and are in good condition.
Post-emergence		
Annual broadleaves	Aim EC (carfentrazone 2 lb. a.i./gal.) at 1-2 fl. oz. in 20 gal. 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. **Sucker Management:** Apply when suckers are green. Do not allow spray to contact desirable fruit, foliage, or green bark.
Annual broadleaves and suppression of grasses	Chateau SW (flumioxazin 51% a.i.) at 6-12 oz. in 15 gal. water minimum Chateau EZ (flumioxazin 41.4% a.i.) at 6-12 oz. in 15 gal. water minimum	Include an adjuvant (0.25% v/v non-ionic surfactant or 1 qt./A crop oil concentrate) for post-emergence use. See Pre-emergence section for other notes and restrictions.

(Continued)

Herbicide Recommendations For Grape (*continued*)

Weed Problem	Material And Rate Per Acre	Notes And Comments
Annual broadleaves and grasses	Chateau Complete (flumioxazin 30% a.i. + rimsulfuron 8.25%) at 6-12 oz.	**Not registered in all states.** Do not apply more than 12 oz. per acre per year. Do not apply to crops established less than one year. If weeds are emerged at the time of application, apply with an adjuvant (0.25% v/v non-ionic surfactant or 1 qt./A crop oil concentrate). For complete control of emerged weeds, addition of a labelled burndown product required. See Pre-emergence section for details.
Most annual and perennial grasses	Fusilade DX (fluazifop-p-butyl 2 lb. a.i./gal.) at 16-24 fl. oz. in 25 gal. 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 and a maximum of 3 applications per year.
Annual grasses and broadleaves	Gamma (tiafenacil 0.7 lb. a.i./lb.) 0.5-1.5 oz. in minimum of 10 gal. water	**Not labelled in all states.** Apply as a directed spray. Use a methylated seed oil (MSO) product that contains modified vegetable oil with at least 15% surfactant emulsifier or reduced performance can occur. MSO should be applied at a concentration equal to 1% v/v (1 gallon per 100 gallons spray carrier) of the final spray volume. Do not allow contact with green stems or foliage. Do not reapply within 14 days. Do not apply within 7 days of harvest. **Age restriction:** Do not apply to grapes established less than 2 years
Annual broadleaves	Goal 2XL (oxyfluorfen 2 lb. a.i./gal./) at 2-8 pt. in minimum of 20 gal. water	See Pre-emergence section for details.
Annual broadleaves	GoalTender (oxyfluorfen 4 lb. a.i./gal.) at 1-4 pt. in minimum of 40 gal. water	See Pre-emergence section for details.
Most annual grasses and broadleaves and top kill of perennial weeds	Gramoxone SL 3.0 (paraquat 3 lb. a.i./gal.) at 1.7-2.7 pt. in minimum of 10 gal. 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. Harvest at normal crop maturity. **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. Only certified applicators can mix, load and apply. Not to be used by uncertified persons working under the supervision of a certified applicator. Applicators must complete an EPA- approved paraquat training every 3 years https:// www.epa.gov/ pesticide-worker- safety/paraquat-dichloride-training-certified-applicators Containers under 120 gallons will have "closed-system" packaging to be used with a closed-transfer system.**
Most annual grasses and broadleaf weeds and top kill of biennial and perennial weeds	Homeplate (caprylic acid 45.14% + Capric acid 34.74%) at 3-9% solution if used alone or 1% solution when tank mixed	**OMRI listed.** Use includes vegetation burndown, directed and shielded sprays, and sucker control. May be used any time during the year and works best during warm and dry conditions. Reapply if rain falls within 3 hours of application. Avoid contact with desirable foliage and green bark. **Sucker control:** Apply before suckers become woody.
Annual and perennial grasses and broadleaves	Mission (flazasulfuron 25% a.i.) at 2.14-2.85 oz. in 15-50 gal. water	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.

(Continued)

Herbicide Recommendations For Grape (*continued*)

Weed Problem	Material And Rate Per Acre	Notes And Comments
Annual and perennial grasses	Poast 1.5EC (sethoxydim 1.5 lb. a.i./gal.) at 1.5-2.5 pt. in minimum of 5 gal. water	Apply as a directed spray to actively growing grasses before tillering. Always add COC at 1% v/v. Do not exceed 2.5 pt. per application or exceed 5 pt. per season.
Annual grasses and broadleaves	Reglone (diquat 2 lb. a.i./gal.) at 1.5-2 pt. in minimum 15 gals. of water	**Non-bearing Only:** May only be used on crops that will not be harvest within 1 year of application. Apply as a directed spray using a shield for contact burn of weeds. Apply when wind speed is 3-10 miles per hour. 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.
Annual and perennial grasses and broadleaves	Rely 280 (glufosinate 24.5% a.i. (2.34 lb./gal.)) at 48-82 fl. oz. in minimum of 15 gal. 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. Add AMS to the spray tank if spray water is hard. Do not exceed 246 fl. oz. per acre per year. Do not make more than 3 applications at a maximum rate of 82 fl. oz. per acre per year. For spot application, mix 1.7 fl. oz./gal.
Annuals and some perennial grasses and broadleaves	Roundup Weather-Max 5.5EC (glyphosate 5.5 lb. a.i./gal.) at 11 fl. oz. to 3.3 qt. in 10-40 gal. 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 lb./100 gal. in hard water or drought conditions (see label). Do not allow spray to contact any part other than mature bark. Can be mixed with labeled pre-emergence herbicides.
Annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lb. 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 with Inside Technology (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 0.17 lb. a.i./gal.) at 3.0-4.0 fl. oz. in minimum of 20 gal. water	**Not registered in all states.** Use as a directed spray from dormancy, prior to bloom and postharvest. 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 per year or 3 applications per growing season.

Relative Effectiveness Of Herbicides For Fruit Crops[1]

	Grasses						Annual Broadleaves																		Perennial Weeds				
Herbicide	Barnyardgrass	Crabgrass	Foxtails	Goosegrass	Panicum, Fall		Chickweed	Cocklebur	Groundsel, Common	Henbit	lambsquarters	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
Bellum	N	N	N	N	N		G	G	N	N	G	F	F	G	G	F	G	N	F	N	G	G	G		N	N	N	N	N
Broadloom	N	N	N	N	N		N	F	F2	N	F	N	F	F	N	N	N	F	F2	F	G	F	N		N	N	N	N	N
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
Chateau Complete	G	G	G	G	G		F	F	N	N	G	G	G	N	G	G	G	G	G	G	F	F	F		N	N	N	N	N
Crew	G	G	G	G	N		G	N	F	G	G	G	G	G	G	N	N	G	G	N	G	N	N		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	N2	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
Optogen	F	F	F	F	F		F	F	N	G	F	N	F	F	G	F	G	F	G	N	F	G	F		N	N	N	N	N
Pindar GT	F	N	N	N	N		N	G	N	N	G	G	N	N	G	N	G	F	N	N	F	G	N		N	N	N	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	N2	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
Spartan	N	F	N	N	G		G	N	N	N	F	N	G	F	G	G	G	G	N	F	F	N	G		N	N	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	N2	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
Velpar	G	N	F	N	G		G	N	G	N	G	F	N	N	N	N	N	N	G	N	G	F	N		F2	N	N	N	N
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
Broadloom	N	N	N	N	N		N	F	F2	N	F	N	F	F	N	N	N	F	F2	F	G	F	N		N	N	N	N	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
Chateau Complete	G	G	G	G	G		F	F	N	N	G	G	G	N	G	G	G	G	G	G	F	F	F		N	N	N	N	N
Crew	G	G	G	G	N		G	N	F	G	G	G	G	G	G	N	N	G	G	N	G	N	N		N	N	N	N	N
Embed	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
Fusilade	G	G	G	G	G		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		N	F2	N	N	N
Gamma	F	F	N	N	N		F	N	N	G	N	F	N	N	N	N	N	N	N	F	N	G	F		F	G	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	N	N	N	N
Homeplate	F2	F2	F2	F2	F2		G	F2	F2	F2	F2	F2	F2	F2	F2	F2	F2	F2	F2	F2	F2	F2	F2		N2	N	N	N	N2

(Continued)

Relative Effectiveness Of Herbicides For Fruit Crops[1] (*continued*)

	Grasses						Annual Broadleaves																	Perennial Weeds				
Herbicide	Barnyardgrass	Crabgrass	Foxtails	Goosegrass	Panicum, Fall		Chickweed	Cocklebur	Groundsel, Common	Henbit	lambsquarters	marestail	Morningglory, Annual	Mustards	Nightshades	Palmer Amaranth	Pigweed	Purslane	Ragweed	Shepherdspurse	Smartweeds	Velvetleaf	Waterhemp		Dandelion	Johnsongrass	Nutsedge, Yellow	Thistle, Canada	Woodsorrel, Yellow
Post-emergence																												
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
Optogen	F	F	F	F	F		F	F	N	G	F	N	F	F	G	F	G	F	G	N	F	G	F		N	N	N	N	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
Reglone	G	G	G	G	G		G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G		N	N	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
Scythe	F[2]	F[2]	F[2]	F[2]	F[2]		G	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]		N[2]	N	N	N	N[2]
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
Starane Ultra	N	N	N	N	N		G	G	N	N	N	N	F	F	F	N	N	N	F	N	N	G	N		N	N	N	N	N
Stinger	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
Targa	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
Treevix	N	N	N	N	N		N	G	F	N	G	G	G	G	G	N	G	G	G	G	G	G	G		N	N	N	N	N
Trellis	N	N	N	N	N		G	N	F	G	G	F	N	G	G	N	N	G	N	G	G	N	N		N	N	N	N	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
Velpar	G	N	F	N	G		G	N	G	N	G	F	N	N	N	N	N	N	G	N	G	F	N		F[2]	N	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
Zalo	G	G	G	G	G		G	G	N	N	G	F	G	G	F	G	G	G	G	G	G	G	G		N	N	N	N	N

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

[2]Provides partial control.

Small Fruit Herbicide REI, PHI And Special Notes

Trade Name	Common Name	WSSA	Risk of Resistance	REI	Strawberry	Raspberry	Blackberry	Grape	Blueberry
Aim EC	carfentrazone-ethyl	14	medium	12	0	15	15	3	0
Alion	indaziflam	21	medium	12	--	14	14	14	14
Amine 4	2,4-D amine	4	low	48	N/A	--	--	--	--
Callisto	mesotrione	27	medium	12	--	no bloom to harvest	no bloom to harvest	--	no bloom to harvest
Casoron 4G	dichlobenil	20	medium	12	--	N/A	N/A	N/A	N/A
Chateau SW/EZ	flumioxazin	14	medium	12	Row middle application - Do not apply after fruit set	7	7	60	7
Chateau Complete	flumioxazin + rimsulfuron	14 + 2	medium	12	--	--	--	60	21
Devrinol DF-XT	napropamide	15	low	24	N/A[5]	N/A	N/A	70	N/A
Fusilade DX	fluazifop	1	high	12	14	1	1	50	NB/10 mo
Gallery DF or SC	isoxaben	21	medium	12	--	NB/1 yr	NB/1 yr	NB/1 yr	NB/1 yr
Gama	tiafenacil	14	medium	12				7	
GoalTender	oxyfluorfen 41%	14	medium	24	Fallow PP	--	--	Fallow PP| Dormant	--
Goal 2XL	oxyfluorfen 22.3%	14	medium	24	Fallow PP	--	--	Fallow PP| Dormant	--
Gramoxone SL 3.0	paraquat	22	medium	24	21	N/A[3]	N/A[3]	N/A[5]	N/A[3]
Homeplate	Caprylic + capric acids		low	12	N/A	N/A	N/A	N/A	N/A
Karmex DF	diuron	7	medium	12	--	0	0	0	0
Kerb SC	pronamide	3	low	24	--	--	--	N/A[1]	N/A[2]
Matrix FNV	rimsulfuron	2	medium	4	--			14	--
Mission	flazasulfuron	2	medium	12	--	--	--	75	--
Optogen	bicyclopyrone	27	medium	24	30	--	--	--	--
Poast 1.5 EC	sethoxydim	1	high	12	7	45	45	50	1 HB/30 LB
Princep 4L	simazine	5	medium	12	--	N/A[6]	N/A[6]	N/A[8]	N/A[6]
Prowl	pendimethalin	3	low	12	--	--	--	NB/1 yr	--
Prowl H2O	pendimethalin	3	low	12	35	--	--	21	--
Reglone	diquat	22	medium	24	--	NB/1 yr	NB/1 yr	NB/1 yr	NB/1 yr
Rely 280	glufosinate	10	medium	12	--	--	--	14	14
Roundup	glyphosate	9	low	12	14	14	14	14	14
Sandea	halosulfuron	2	low	12	--			--	14
Scythe	pelargonic acid	26	low	12	N/A	N/A	N/A	N/A	N/A
Select Max	clethodim	1	high	12	4	7	7		14 HB/45 LB
Sinbar WDG	terbacil	5	medium	12	110	70	70	--	N/A
Sinbar WDG	terbacil	5	medium	12	110	70	70	--	N/A

(Continued)

Small Fruit Herbicide REI, PHI And Special Notes (continued)

Trade Name	Common Name	WSSA	Risk of Resistance	REI	Strawberry	Raspberry	Blackberry	Grape	Blueberry
Snapshot	isoxaben+ trifluralin	21+3	medium	12	--	NB/1 yr	NB/1 yr	NB/1 yr	NB/1 yr
Solicam DF	norflurazon	12	medium	12	--	Dormant	Dormant	60	60
Spartan	sulfentrazone	14	medium	12	preplant only	--	--	--	--
Spur, Stinger	clopyralid	4	medium	12	N/A[1]	--	--	--	--
Surflan 4AS	oryzalin	3	low	24	--	N/A	N/A	N/A	HB N/A
Treflan	trifluralin	3	low	12	--	--	--	60	--
Trellis	isoxaben 75%	21	medium	12	--	NB/1 yr	NB/1 yr	NB/1 yr|60	NB/1 yr
Trellis SC	isoxaben 45.45%	21	medium	12	--	NB/1 yr	NB/1 yr	NB/1 yr|60	NB/1 yr|60[4]
Ultra Blazer	acifuorfen	14	medium	48	60/120	--	--	--	--
Velpar L CU	hexazinone	5	medium	48	--	--	--	--	HB 90/LB 450
Venue	pyrafluflen ethyl	14	medium	12	--	--	--	0	--
Zeus Prime XC	carfentra-zone- ethyl+ sulfentrazone	14	medium	12	--	3	3	3	3
Zeus XC	sulfentrazone	14	medium	12	--	3	3	3	3

-- = not labeled
DS/NCC = Directed Spray/No Crop Contact N/A - no PHI specified\
1 = application must be in the fall, after the fruit is harvested, but prior to soil freeze-up
2 = application in the fall or early winter, but prior to soil freeze-up and snow cover
3 = apply before emergence of new canes or shoots
4 = PHI for Highbush Blueberry only, no PHI stated for Lowbush Blueberry
5 = See label
6 = do not apply when fruit is present or illegal residues may result
7 = apply late fall to early spring prior to weed emergence. Do not apply more than once per calendar year
8 = apply anytime between harvest and early spring. Do not apply more than once per calendar year

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) Quadris (Syngenta)	azoxystrobin	Aframe (Syngenta) Azaka (FMC) Azoxystar, Equation
Aliette 80WDG (Bayer)	fosetyl-Al	Legion 80WDG (Makhteshim) Linebacker WDG (NovaSource)
Apogee (BASF)	prohexadione-calcium (Pro-Ca)	Cryova PGR (Makhteshim) Kudos (Fine Americas) Pro Hex (Axil Solutions) Regalis PLUS (BASF)
Bravo Weather Stick (Syngenta)	chlorothalonil	Echo (Sipcam Agro) Equus DF (Sipcam Agro, AMVAC) Chlorothalonil 720 (Albaugh)
Captec 4L (Arysta LifeScience North America LLC)	captan	Has several formulations including 50W
Copper	copper hydroxide	Champ (Nufam) Kocide (Certis) KOP-Hydroxide (Drexel) Nu-Cop (Albaugh)
	copper octanoate	Camelot-O (SePRO) Cueva (Certis)
	copper oxychloride	COC (Albaugh)
	copper oxychloride+copper hydroxide	Badge (Gowan)
	copper (cuprous) oxide	Nordox (NOROX Industrier)
	copper sulfate (basic)	Basic Copper (Albaugh) Cuprofix (UPL)
	copper sulfate pentahydrate	KOP-5 (Drexel) Mastercop (ADAMA) Phyton 35 (Phyton Corp)
Dithane M45 (Dow AgriSciences)	mancozeb	Manzate Max (United Phosphorus, Inc) Penncozeb (several formulations) Roper (Loveland) Koverall (Cheminova)
Elite 45DF	tebuconazole	Orius 3.6F (Makhteshim) Orius 20AQ (Makhteshim) TebuStar 3.6 L (Albaugh) TebuStar 45WSP (Albaugh) Tebuzol 45DF (United Phosphorous, Inc.)
PH-D (United Phosphorous Inc.)	Polyoxin D zinc salt	Affirm (Nufarm) OSO (Certis Biologicals)
ProBlad Verde SymAgro	Banda Lupinus Albus Doce	Fracture (FMC)
Prophyt (Helena)	Phosphite (mono- and dibasic salts	AgriFos (Monterey)/Agri-Fos (AgriChem) K-Phite (Plant Food Systems) Phostrol (Nufarm) Reliant (Quest Products)
Quilt Xcel (Syngenta)	azoxystrobin+ propiconazole	Aframe Plus (Syngenta) Cover XL (AgriStar)

(Continued)

Generic Fungicides (continued)

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Rally 40WSP (Dow AgriSciences)	myclobutanil	Sonoma 40WSP (Albaugh)
Ridomil 2E (Syngenta)	metalaxyl	Metastar 2E (Arysta Life Science)
Ridomil Gold SL (Syngenta)	mefenoxam	Apron XL (Syngenta) ReCon Bold SL (Atticus) Thrive 4M (Albaugh) 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)
Tilt (Syngenta)	propiconazole	Propimax 41.8L (Dow AgriSciences) Bumper 41.8L (Makhteshim) Orbit 41.8L (Syngenta)
Topsin-M 70WDG (United Phosphorous Inc.)	thiophanate methyl	Thiophanate Methyl 85WSB (Makhteshim) T-Methyl EAG 70WSB (Nufarm) T-Methyl 70WWSB (Arysta Life Science)

Generic Insecticides

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Acramite (UPL)	bifenazate	Actuate (Atticus) Bifenamite 2SC (Albaugh) Bizate (Loveland) Engulf (Nufarm) Floramite SC (OHP) Floramite SC/LS (UPL) Vigilant 4SC (UPL)
Admire Pro (Bayer)	imidacloprid	Acronyx 4F (Atticus) Advise Four (WinField) Alias 4F (ADAMA) Macho 2FL, 4 (Albaugh) Madari 4F (Avalaire) Malice 75WSP (Loveland) Midash 2SC, Forte 4F (Sharda) Montana 2F, 4F (Albaugh) Nuprid 4F Max (Nufarm) Prey 1.6F (Loveland) Provoke (Innvictis) Sherpa 1.6F (Loveland) Viloprid 4, FC 1.7 (Vive) Widow 2F (Loveland) Willowood 4SC (Generic) Wrangler 4F (Loveland)

(Continued)

Generic Insecticides *(continued)*

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Agri-Mek SC (Syngenta)	abamectin	Abacus 0.15EC (Rotam) Abamex 0.15ED (Nufarm) Abba Ultra 0.30EC (Amvac) Averland 0.7FC (Vive) Borrada 0.15EC (ADAMA) Enterik 0.15LV, 0.7SC (Atticus) Reaper 0.15EC Advance 0.15EC Clearform 0.15EC (Loveland) Willowood Abamectin 0.15LV, 0.7SC (Generic)
Asana XL 0.66EC (Valent)	esfenvalerate	S-Fenvalostar 0.66EC (LG Life Sciences)
Assail 30SG, 30SC, 70WP (UPL)	acetamiprid	Afflict 30SG, 70WP (Aceto) Anarchy 30SG, 70WP (Loveland) ArVida 30SG (Atticus) Intruder Max 70WP (UPL)
Baythroid XL 1EC (Bayer)	Beta-cyfluthrin, cyfluthrin	Cryptoid XL 1EC (Atticus) Tombstone 2E (Loveland) Tombstone Helios 2E (Loveland)
Brigade 2EC, eVo (FMC)	bifenthrin	Banister 2EC (Avalaire) Batallion 2EC (Atticus) Bi-Dash 2EC (Sharda) Bifen 2AG Gold (WinField) Bifender 1.75FC (Vive) Bifenthrin 2EC (Aceto) Bifenture 2EC (UPL) Discipline 2EC (Amvac) Fanfare 2EC (ADAMA) GCS Bifentrhin 2EC, LFC 1.5EC (Generic) Lancer 2EC, FC 1.5EC (Albaugh) Reveal 2EC, Endurx 2EC (Innvictis) Sniper 2EC (Loveland) Tundra 2EC (Winfield)
Cygon 400EC (FMC)	dimethoate	Dimate 4EC (Winfield) Dimethoate 400, 400EC, 4EC (Loveland, FMC, Drexel)
Dimilin	diflubenzuron	Diflumax 2L (Helm Agro) Dimilin 2L, 25W (UPL) Durant 2L (Atticus) Micromite 2L (UPL) Unforgiven (Loveland)
Dipel (Valent)	*Bacillus thuringienisis*	Agree (Certis) Biobit (Valent) Bt Now (BioSafe) CryMax (Certis) Deliver (Certis) Javelin (Certis) Leprotec (Vestaron) Xentari (Valent)
Esteem 0.86EC, 35WP (Valent) Knack 0.83EC (Valent)	pyriproxyfen	Pitch (0.83EC), Pitch 35WP (ADAMA)

(Continued)

Generic Insecticides *(continued)*

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Intrepid 2F (Corteva AgriSciences)	methoxyfenozide	GCS Methoxy 2F (Generic) Inspirato 2F (Atticus) Invertid 2F (Loveland) Invicar 2SC (Albaugh) Thwartex (Agsurf) Troubador 2F (Helena) Turnstyle 2F (UPL) Vexer (Innvictis) Zylo (UPL)
Mustang Maxx (FMC)	zeta-cypermethrin	Cortes Maxx (Atticus)
Pounce 25WP (FMC)	permethrin	Arctic 3.2EC (Winfield) Permethrin 3.2EC (Loveland) Perm-Up 3.2EC, 25DF (UPL) Permastar AG (LG Life Sciences)
Savey 50DF, Onager, Onager Optek, Hexy- gon, Hexygon IQ (Gowan)	hexythiazox	Hexamite (Albaugh) Hexcel EW (Atticus)
Sevin XLR Plus, 4L (Novasource)	carbaryl	Carbaryl 4L (Drexel, Loveland)
Warrior II 2.08CS (Syngenta)	lambda-cyhalothrin	Actylis Lambda-Cy (Aceto) Calvary II (Growmark) Crusader 1EC, 2ME (Albaugh) Firestone (Altitude) Grizzly Too, Z 1CS (Winfield) Kaiso 24WG (Nufarm) Kendo 22.8CS (Helm) L - C Insecticide (Drexel) Lambda-Cy AG (Winfield) Lambda-Cy 1EC (UPL) Lambdastar 1CS, Plus (FarmHannong) Lambda T 1EC (Helena) Lamcap II (Syngenta) Lunge (UPL) Nufarm Lambda-Cyhalothrin 1EC (Nufarm) Paradigm 1VC (Winfield) Province II (Tenkoz) Ravage 1EC (Innvictus) Serpent 1EC (Atticus) Silencer 1EC (ADAMA) Willowood Lambda-Cy 1EC (Generic)
Zeal (Valent)	etoxazole	Suremite SC (Aceto) Zara WSB, Zara SC (Atticus)

Generic Herbicides[1]

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Aim® EC Herbicide (FMC Corporation)	carfentrazone-ethyl	Antik™ EC (Atticus Ag) Longbow™ EC (Nufarm Americas, Inc.) Maxunitech Carfentrazone 2 EC (Maxunitech North America, Inc.) Quinark™ EW (Atticus Ag) Shark® EW (FMC Corporation)
Alion® Herbicide (Bayer CropScience)	Indaziflam	Sage™ (Altamont)
Amine4 2,4-D (Tenkoz)	2,4-D amine	2,4-D Amine 4 (WinField United) 2,4-D/Amine 4 Heribicide (WinField United) Amine 4 2,4-D (Loveland Products, Inc.) Amine 6 (Loveland Products, Inc.) Base Camp® Amine 4 (Wilber-Ellis Company LLC) Clean Amine® (Loveland Products, Inc.) Cornbelt® 4Lb. Amine (Van Diest Supply Company) De-Amine® 4 (Drexel Chemical Company) Defy® Amine 4 (ADAMA) Embed® Extra (Corteva Agrisciences) Embed™ (Corteva Agriscience) Orchard Clean® (Nufarm Americas, Inc.) Orchard Master® Broadleaf Herbicide (PBI-Gordon Professional) Orchard Star® (Albaugh, LLC Agricultural Products) Rugged® Herbicide (WinField United) Saber® (Loveland Products, Inc.) Savage® Dry Soluble (Loveland Products, Inc.) Solution Water Soluble® (Nufarm Americas, Inc.) Usha 6 (Sharda USA LLC) Weedar® 64 (Nufarm Americas, Inc.) WeeDestroy® AM-40 Amine Salt (Nufarm Americas, Inc.)
Assure® II Herbicide (Amvac Chemical Corporation)	quizalofop p-ethyl	Targa® (Gowan Company, LLC)
Callisto (Syngenta Crop Protection, LLC)	mesotrione	Atticus Cavallo™ 4 SC (Atticus Ag) Bellum® (Albaugh, LLC Agricultural Products) Meso Star (Sharda USA LLC) Mesotrione 4SC (Albaugh, LLC Agricultural Products) MesoTryOne™ 4L (Drexel Chemical Company) Motif ® Herbicide (UPL NA Inc.) Undercover™ (Innvictis Crop Care, LLC)

(Continued)

Generic Herbicides[1] *(continued)*

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Chateau WDG (Valent USA)	flumioxazin	Chateau® EZ (Valent U.S.A. LLC) Chateau® Herbicide SW (Valent U.S.A. LLC) Flumi® 51 WDG (NuFarm Americas, Inc.) Flumi® SX Herbicide (Valent U.S.A. LLC) Flumigard Herbicide (Alligare, LLC) Flumigard SC (Alligare, LLC) Flumioxazin 51WDG Select (Alligare, LLC) Semera 51.0% WDG (Atticus EcoCore) Semera SC (Atticus EcoCore) SureGuard Herbicide (Nufarm Americas, Inc.) Tuscany ® (Nufarm Americas, Inc.) Tuscany ® SC Herbicide (Nufarm Americans, Inc.) Varsity ® (Innvictis Crop Care, LLC) Varsity ® SC (Innvictis Crop Care, LLC) Zaltus™ SC (Atticus Ag)
Gallery 75 DF / SC (Corteva Agrisciences)	isoxaben	Trellis and Trellis SC (Corteva AgriSciences)
Goal ® 2XL Herbicide (Nufarm Americas, Inc.)	oxyfluorfen	Collide ™ Herbicide (UPL NA Inc.) Galigan® 2E (ADAMA) Galigan® H2O Herbicide (ADAMA) GoalTender® Herbicide (Nufarm Americas, Inc.) Govee™ (Innvictis Crop Care, LLC) Oxystar ® 2E (Albaugh, LLC Agricultural Products) Oxystar® 4L (Albaugh, LLC Agricultural Products) ScrollOVR™ (Atticus Ag) Scroll™ 2 XL (Atticus Ag) Willowood OxyFlo 2EC (Generic Crop Science LLC)
Gramoxone (Syngenta Crop Protection, LLC)	paraquat	Axill Solutions Paraquat 3SL (Axill Solutions, LLC) Devour™ (Innvictis Crop Care, LLC) Gramoxone® SL 3.0 (Syngenta Crop Protection, LLC) Helmquat 3SL (Helm Agro US, Inc.) Paraquat Concentrate (Solera Sources Dynamics, LLC) Para-Shot 3.0 (Sharda USA LLC) Parazone® 3SL (Amvac Chemical Corporation) Quik-Quat™ (Drexel Chemical Company) Willowood Paraquat 3SL (Generic Crop Science LLC)
HomePlate® (Certis USA, L.L.C.)	caprylic acid + capric acid	Fireworxx™ (OHP, Inc.) SUPPRESS® Herbicide EC (SAN Group Biotech USA Inc.)
Karmex DF (ADAMA)	diuron	Direx 4L (ADAMA) Diuron 4L/80 DF (Alligare, LLC) Diuron 4L/80 (Drexel, Chemical Company) Diuron 4L (ADAMA) Diuron 4L (Loveland Products, Inc.) Diuron 80 (Drexel Chemical Company) Diuron 80 DF (Alligare, LLC) Diuron 80 (WDG Weed Killer (Loveland Products, Inc.) Drill (Sharda USA LLC)

(Continued)

Generic Herbicides *(continued)*

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Kerb SC (Corteva AgriSciences)	pronamide	Kerb® 50-W Herbicide (Corteva Agriscience) Kerb® SC (RUP) (Corteva Agriscience) Willowood Pronamide 3.3SC (Generic Crop Science LLC) Willowood Pronamide 50WSP (Generic Crop Science LLC)
Matrix® FNV/SG (Corteva AgriSciences)	rimsulfuron	DuPont Matrix® SG (Corteva Agriscience) Grapple™ (Nufarm Americas, Inc.)Hinge™ (Albaugh, LLC Agricultural Products) Matrix® FNV (Corteva Agriscience) Pruvin® Herbicide (ADAMA) Revolt™ (Innvictis Crop Care, LLC) Tetris™ SG (Atticus Ag)
Poast (BASF)	sethoxydim	Segment (BASF)
Princep® 4L (Syngenta Crop Protection, LLC)	simazine	Princep® Caliber 90® Herbicide (Syngenta Crop Protection, LLC) Simazine 4L (Drexel Chemical Company) Simazine 4L (WinField United) Simazine 4L Flowable (Loveland Products, Inc.) Simazine 90DF (Drexel Chemical Company) Simazine 90 WDG (Loveland Products, Inc.) Sim-Trol® 4L Simazine Flowable Herbicide (Sipcam Agro USA, Inc.) Sim-Trol® 90DF Simazine Dry Flowable Herbicide (Sipcam Agro USA, Inc.)
Prowl® 3.3 EC herbicide (BASF Ag Products)	pendimethalin	Acumen ® Herbicide (TENKOZ, Inc.) Acumen® Microcap (TENKOZ, Inc.) Framework® 3.3 EC Herbicide (WinField United) Pendulum® 2G granule herbicide (BASF Professional and Specialty Solutions) Pendulum® 3.3 EC herbicide (BASF Professional and Specialty Solutions) Pendulum® AquaCap™ herbicide (BASF Professional and Specialty Solutions) Pin-Dee™ 3.3 EC (Drexel Chemical Company) Pin-Dee™ 3.3 T & O (Drexel Chemical Company) Prowl® H2O herbicide (BASF Ag Products) Satellite® 3.3 herbicide (UPL NA Inc.) Satellite® Flex (UPL NA Inc.) Satellite® HydroCap herbicide (UPL NA Inc.) Stealth® Herbicide (Loveland Products, Inc.)
Reglone (Syngenta Crop Protection, LLC)	diquat	Aceto Diquat 2L AG (Aceto Life Sciences, L.L.C. d/b/a Actylis) Capone™ Desiccant (Atticus Ag) Dessicash Ag (Sharda USA LLC) Nufarm Diquat 2 L (Nufarm Americas, Inc.) Nufarm Diquat SPC 2 L (Nufarm Americas, Inc.) Verdure-X-Herbicide (Helm Agro US, Inc.)

(Continued)

Generic Herbicides *(continued)*

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Rely 280 (BASF Agricultural Solutions US LLC)	glufosinate-ammonium	Axill Solutions Glufosinate 280SL (Axill Solutions, LLC) Cheetah® Herbicide (Nufarm Americas, Inc.) Fever™ (Innvictis Crop Care, LLC) Forfeit® 280 (Loveland Products, Inc.) Inflame™ 280 SL (Atticus Ag) Interline® Herbicide (UPL NA Inc.) Lifeline® (UPL NA Inc.) Opportunity (Sharda USA LLC) Reckon™ 280SL (Solera Source Dynamics, LLC) Refer® 280 SL Herbicide (Summit Agro USA, LLC) Rely® 280 Herbicide (BASF Ag Products) Scout™ Herbicide (Valent U.S.A. LLC) Surmise® (Albaugh, LLC Agricultural Products) Surmise® 5 (Albaugh, LLC Agricultural Products) Total TNV (WinField United) Total® 2.3 (WinField United) Total® Herbicide (WinField United) Willowood Glufosinate 280SL (Generic Crop Science LLC)
Roundup PowerMAX® Herbicide (Bayer CropScience)	glyphosate	Abundit® Edge (Corteva Agriscience) Aquamaster® (Bayer CropScience) Buccaneer® 5 Extra (TENKOZ, Inc.) Buccaneer® Plus (55467-9) (TENKOZ, Inc.) Clearout™ 5 Extra (Albaugh, LLC Agricultural Products) Cornerstone K Herbicide (WinField United) Cornerstone® 5 Plus (WinField United) Cornerstone® Plus (1381-192) (WinField United) Credit® 41 Extra (Nufarm Americas, Inc.) Credit® 5.4 Extra (Nufarm Americas, Inc.) Credit® Xtreme (Nufarm Americas, Inc.) Duramax® Herbicide (Corteva Agriscience) Durango® DMA® Herbicide (Albaugh, LLC Agricultural Products) Envy™ (Innvictis Crop Care, LLC) Envy™ Intense (Innvictis Crop Care, LLC) Envy™ Six Max (Innvictis Crop Care, LLC) Four Power Plus® (Loveland Products, Inc.) Gly Star® 5 Extra (Albaugh, LLC Agricultural Products) Gly Star® K-Plus (Albaugh, LLC Agricultural Products) Gly Star® Original (Albaugh, LLC Agricultural Products) Gly Star® Plus (Albaugh, LLC Agricultural Products) Honcho® K6 Herbicide (Bayer CropScience) Honcho® Plus (Bayer CropScience) Mad Dog® (Loveland Products, Inc.) Mad Dog® Plus (Loveland Products, Inc.) Makaze® Herbicide (Loveland Products, Inc.)

(Continued)

Generic Herbicides *(continued)*

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Roundup PowerMAX® Herbicide (Bayer CropScience) ***(Continued)***	glyphosate	Roundup PowerMAX® 3 Herbicide (Bayer CropScience) Roundup PowerMAX® Herbicide (Bayer CropScience) Roundup PowerMAX® II (Bayer CropScience) Roundup Ultra® (Bayer CropScience) Roundup WeatherMAX® Herbicide (Bayer CropScience) Shar-Max Glyphosate 41% SL (Sharda USA LLC) Willowood Glypho 6 (Generic Crop Science LLC) Wynca USA™ Sunphosate 41% Herbicide (Wynca USA) Wynca USA™ Sunphosate® 5 MAX (Wynca USA)
Sandea® (Gowan Company, LLC)	halosulfuron	Herbivore® Herbicide (WinField United)
Select Max® Herbicide with Inside Technology™ (Valent U.S.A. LLC)	clethodim	Arrow® 2 EC (ADAMA) Avatar™ (Innvictis Crop Care, LLC) Avatar™ S2™ (Innvictis Crop Care, LLC) Axill Solutions Clethodim 2EC (Axill Solutions, LLC) Ceridian™ 2 EC (Atticus Ag) Cleanse® (WinField United) Cleanse® 2EC (WinField United) Clethodim 2E (Albaugh, LLC Agricultural Products) Dakota™ (Albaugh, LLC Agricultural Products)Envoy Plus™ Herbicide (Valent U.S.A. LLC Professional Products) Shadow® (UPL NA Inc.) Shadow® 3EC (UPL NA Inc.) Signature Clethodim (Albaugh, LLC Agricultural Products) Trizenta™ 3EC Herbicide (UPL NA Inc.) Trizenta™ Herbicide (UPL NA Inc.) Vaquero® (Wilbur-Ellis Company LLC) Volunteer® (TENKOZ, Inc.) Volunteer® Herbicide (42750-72-55467) (TENKOZ, Inc.) Volunteer® Herbicide (70506-484-55467) (TENKOZ, Inc.) Willowood Clethodim 2EC (Generic Crop Science LLC)
Stinger® Herbicide (Corteva AgriSciences)	clopyralid	Bite (Sharda USA LLC) Clean Slate (Nufarm Americas, Inc.) GCS Clopy 360SL (Generic Crop Science LLC) Spur® (Albaugh, LLC Agricultural Products) Stigmata™ (Atticus Ag)
Starane® Ultra Herbicide (Corteva Agriscience)	fluroxypyr	Comet® Selective Herbicide (Nufarm Americas, Inc.) Fancy (Sharda USA LLC) Stark™ Ultra (Atticus Ag)
Surflan AS	oryzalin	Fugitive (ADAMA) Oryzalin 4 AS (ADAMA)
Trellis® (Corteva Agriscience)	isoxaben	Trellis® SC (Corteva Agriscience) Gallery® 75 Dry Flowable Specialty Herbicide (Corteva Agriscience) Gallery® SC (Corteva Agriscience)

(Continued)

Generic Herbicides *(continued)*

Original Trade Name (Current Manufacturer)	Common Name	Other Trade Names (Manufacturers)
Treflan™ 4L Herbicide (Loveland Products, Inc.)	trifluralin	Treflan HFP Herbicide (Gowan Company, LLC) Treflan TR-10 Granular Herbicide (Gowan Company, LLC) Trifluralin 10G (Loveland Products, Inc.) Trifluralin 4 EC Herbicide (Aceto Life Sciences, L.L.C. d/b/a Actylis) Trifluralin 4EC (Albaugh, LLC Agricultural Products) Trifluralin 4EC (Drexel Chemical Company) Trifluralin HF (Loveland Products, Inc.) Trust (WinField United)
Ultra Blazer (United Phosphorus)	acifluorfen	Acifin 2 L (Summit) Acifluorfen 20.1% (Sharda) Avalanche Ultra (WinField) Derecho (Atticus) Levity (Innvictis) Uproar (WinField)
Velpar DF VU/L VU (Bayer)	hexazinone	Tide Hexazinone 2 SL/75 WDG (Tide Int'l) Velossa (Helena) Velpar L CU/DF CU (Tessenderlo)
Venue® (Nichino America, Inc.)	pyraflufen ethyl	Venue® Max Herbicide (Nichino America, Inc.)
Zeus /XC (FMC Corporation)	sulfentrazone	Maxunitech Sulfentrazone 4 SC Herbicide (Maxunitech North America, Inc.) Passage™ Herbicide (Alligare, LLC) Shutdown® Herbicide (UPL NA Inc Willowood Sulfen 4SC (Generic Crop Science LLC) Zone 4F (Helm Agro US, Inc.)

[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

Fruit Grower Newsletters

Arkansas

University of Arkansas Division of Agriculture Cooperative Extension Service offers *Arkansas Fruit, Vegetable, and Nut Update*. 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. To subscribe, go to: https://www.uaex.uada.edu/farm-ranch/crops-commercial-horticulture/horticulture/ar-fruit-veg-nut-update-blog/

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 Educator: Bronwyn Aly (1715 College Ave., Carmi, IL 62821, 618-395-2441, baly@illinois.edu); or Commercial Agriculture Educator: Nathan Johanning, 901 Illinois Avenue. PO Box 117, Waterloo, IL 62298, 618-939-3434). 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*, a newsletter issued biweekly throughout the growing season, that provides timely information on diseases and insects throughout the state, cultural practices and announcements about upcoming events. Subscribe to the online version free of charge at fff.hort.purdue.edu or receive a printout via first class mail for $15 a year.

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://yardandgarden.extension.iastate.edu/

Kentucky

Cooperative Extension issues a monthly newslet- ter, Kentucky Fruit Facts (https://horticulture.mgcafe.uky.edu/ky-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 subscribe, send an email message:

TO: listserv@lsv.uky.edu
SUBJECT: Fruit Facts
MESSAGE: subscribe KY-FRUITFACTS

Followed by a blank line

OR to unsubscribe, the lines:
signoff KY-FRUITFACTS
Followed by a blank line

You should receive confirmation by return email. If you have a problem, or if you wish to communicate with a person about"fruitfacts", the owner's address (the TO: line of the message) is: owner-ky-fruit-facts@lsv.uky.edu

Ohio

Ohio Fruit News (OFN) is published six times a year by the Department of Plant Pathology at The Ohio State University, CFAES-Wooster. The newsletter is available free of charge in electronic format at u.osu.edu/fruitpathology/fruit-news-2/, or as a printed copy by request. To subscribe, contact Melanie Lewis Ivey at ivey.14@osu.edu or 330-263-3849.

The Ohio State University Extension Specialty Crop Team maintains an online blog, Fruit, Vegetable, and Specialty Crop News (u.osu.edu/vegnetnews/). New posts are added daily and feature timely updates and information on all specialty food crops.

The *Ohio Grape-Wine Electronic Newsletter (OGEN)* is available at ohiograpeweb.cfaes.ohio-state.edu/news. To subscribe, email Maria Smith at smith.127203@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, Ohio, New Mexico, North Carolina, Wisconsin, and Saskatchewan, Canada.

The Ohio Sensitive Crop Registry is available at www.agri.ohio.gov/scr https://agri.ohio.gov/divisions/plant-health/resources/oscr.

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

Network for Environment and Weather Applications (NEWA)

NEWA collects weather data through the Internet from weather stations primarily located on farms and generates real-time weather data summaries, crop production tools, and IPM forecasts.

Contact your NEWA State coordinators for additional information on purchasing a weather station and connecting to NEWA for IPM weather tools and IPM crop forecasts. If you don't have a state coordinator you can contact Dan Olmstead at newa@cornell-ipm.org.

Illinois: Elizabeth Wahle, University of Illinois at Urbana-Champagne; 618-344-4230; wahle@illinois.edu.

Kentucky: Brent Arnoldussen, University of Kentucky; 859-257-4721; bar244@uky.edu.

Ohio: Melanie Lewis Ivey, The Ohio State University, CFAES-Wooster; 330-263-3849; ivey.14@osu.edu

Wisconsin: Amaya Atucha, University of Wisconsin-Madison; 608-262-6452; atucha@wisc.edu

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. Check with your local County Extension Office or Diagnostic lab for any costs associated with this service.

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 soft fruit (i.e., strawberry, raspberry, blackberry, etc.) in 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 (aphid, 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 or formaldehyde, or without rubbing 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 page 288).

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
479-502-9713
https://www.uaex.uada.edu/yard-garden/plant-health
Clinic: https://www.facebook.com/UAEXPlant-HealthClinic
Contact:
Taylor Klass, tklass@uada.edu

Illinois

University of Illinois Plant Clinic
S-417 Turner Hall
1102 S. Goodwin Ave.
University of Illinois
Urbana, IL 61801
217-333-0519
https://extension.illinois.edu/plant-clinic
plantclinic@illinois.edu
www.facebook.com/UofIPlantClinic
Contacts:
Diane Plewa, dplewa@illinois.edu, (217) 300-3441

Indiana

Plant and Pest Diagnostic Laboratory
Purdue University
LSPS 101
915 Mitch Daniels Blvd, LSPS 116
West Lafayette, IN 47907-2054
765-494-7071
Fax: 765-494-3958
https://ag.purdue.edu/department/btny/ppdl/index.html.
ppdl-samles@purdue.edu
www.facebook.com/PurduePPDL
Contacts:
Tom Creswell, creswell@purdue.edu
John Bonkowski, jbonkows@purdue.edu

Iowa

Iowa State University Plant and Insect Diagnostic Clinic
2445 ATRB
2213 Pammel Dr
Ames, IA 50011
515-294-0581
Fax: 515-294-9420
https://yardandgarden.extension.iastate.edu/pidc
pidc@iastate.edu
www.facebook.com/ISUPIDC

Kentucky

Plant Disease Diagnostic Laboratory Agricultural Science Building-North
1100 South Limestone Street
University of Kentucky
Lexington, KY 40546-0091
859-257-8949
Fax: 859-323-1961
https://plantpathology.mgcafe.uky.edu/extension/diagnostic-laboratories
Contact:
Julie Beale, jbeale@uky.edu

Ohio

C. Wayne Ellett
The Ohio State University, CFAES-Wooster
234 Selby Hall
1680 Madison Avenue
Wooster, OH 44691
Phone: 330-263-3650
Email: ppdc@osu.edu
ppdc.osu.edu
Contact:
Francesca Rotondo, rotondo.11@osu.edu
CFAES-Wooster, 330-263-3650

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, hudelson@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 https://nifacontacts.ipmcenters.org/PSEPDirectory.cfm.

University of Arkansas
https://uaex.uada.edu/farm-ranch/pest- management/pesticide-licensing/private-applicator- training.aspx

University of Illinois
https://extension.illinois.edu/psep

Iowa State University
www.extension.iastate.edu/psep

University of Kentucky
https://entomology.mgcafe.uky.edu/uk-pesticide-safety-education-program-psep

Ohio State University
pested.osu.edu

Purdue University
https://ag.purdue.edu/department/extension/ppp/

University of Wisconsin
https://fyi.extension.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): 765-494-5249
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:
888-233-7745 or 317-233-7745
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:
800-621-8431 or 312-353-2000

Iowa

Iowa Statewide Poison Control Center Emergency Phone Number: 800-222-1222
Administrative Phone Number: 712-273-7757

Kentucky

Kentucky Regional Poison Control Center: 800-222-1222

KY Environmental Response: 800-928-2380 or 502-564-2380

Ohio

Ohio Poison Exposure Centers: 800-222-1222
TDD number: 800-253-7955

Wisconsin

Wisconsin Poison Center: 800-222-1222

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 2026-2027

The Midwest Fruit Pest Management Guide 2026-2027 was developed by the Midwest Fruit Workers Group.

Printed copies of this publication are available from the Purdue Extension Education Store, https://edustore.purdue.edu. A free PDF download also is available from the Education Store.

Citation

Long, E., Leach, A., Athey, K., Wimmer, M., Arnoldussen, B., Yadav, R., Meyer, S., Purcell, M., Santiago, J., Holland, L., Joshi, N., Whale, E., Babadoost, M., Vos, R., Slack, S., Cloyd, R., Bessin, R., Ivey, M., Wright, S., Beckerman, J., Leonberger, K., Gauthier, N. 2025. Midwest Fruit Pest Management Guide 2026-2027. Available online at: https://ag.purdue.edu/department/hla/extension/_docs/id-465.pdf

Additional Contributors

University of Arkansas
Entomology: Neelendra Joshi

University of Illinois
Entomology: Kacie Athey*
Horticulture: Elizabeth Wahle*, James Santiago*
Plant Pathology: Mohammed Babadoost*

Iowa State University
Horticulture: Randall Vos*, Suzanne Slack

Kansas State University
Entomology: Raymond Cloyd

University of Kentucky
Entomology: Ric Bessin*
Horticulture: Shawn Wright*, Brent Arnoldussen*, Elayna Stirn
Plant Pathology: Nicole Gauthier*, Kim Leonberger*

University of Minnesota
Horticulture: Madeline Wimmer*

Ohio State University
Entomology: Ashley Leach*
Horticulture: Ram Yadav*
Plant Pathology: Melanie Ivey*

Purdue University
Entomology: Elizabeth Long*
Horticulture: Stephen Meyer, Miranda Purcell

University of Wisconsin
Plant Pathology: Leslie Holland*

*Section Editor

Disclaimer

Reference in this publication to any specific commercial product, process, or service, or the use of any trade, firm, or corporation name is for general informational purposes only and does not constitute an endorsement, recommendation, or certification of any kind by Midwest Fruit Workers Group or their institutions. Individuals using such products assume responsibility for their use in accordance with current directions of the manufacturer.

Non-Discrimination Statement

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call 800-795-3272 or 202-720-6382 (TDD).

USDA is an equal opportunity provider and employer.

Acknowledgements

Authors would like to sincerely thank Tammy Luck, Lead Administrative Assistant, Department of Entomology, Purdue University for her dedicated work in formatting this guide.

Authors would like to acknowledge Dr. Janna Beckerman for her years of devoted work to the development of this guide.