



Midwest Commercial Small Fruit and Grape Spray Guide

2008

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2008 Midwest Commercial Small Fruit and Grape Spray Guide

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Midwest Small Fruit Pest Management Handbook

The *Midwest Small Fruit Pest Management Handbook* is a companion publication to this spray guide that contains additional information on control strategies for small fruit diseases, insect pests, and weeds. Pesticide safety, sprayer calibration, plant nutrition, and weed identification are also covered. Copies of the publication (OSU Bul. 861) may be available from your state Extension office or from Ohio State University Extension Publications, 385 Kottman Hall, 2021 Coffey Rd., Columbus, OH 43210-1044, (614) 292-1607. It is also available online at the Midwest Small Fruit & Grape Net at <http://extension.osu.edu/~sfgnet>.

Legal Responsibilities for Pesticide Use

Pesticides suggested in this publication have been registered by the Pesticides Regulation Division of the Environmental Protection Agency. At the time this bulletin was published, these pesticides were registered for use as indicated on the individual product labels. These registrations can change at any time. In order to keep you informed of the latest updates on pesticide registrations, a Web version of this publication is updated regularly and can be viewed online at www.hort.purdue.edu/hort/ext/extpubs.shtml.

It is your responsibility as a pesticide user to read and follow all current label directions for the specific pesticide being used. The legal limitations on the use of these pesticides should be strictly observed to prevent excessive residues in or on harvested fruit. All growers should read product labels, follow directions carefully, and observe pre-harvest intervals and application rates. Some of the pesticides suggested in this publication are on the EPA Restricted Use List, and users must be certified private applicators to purchase and apply these materials.

The pesticide label is a legal document.

Check this publication online at www.hort.purdue.edu/hort/ext/extpubs.shtml for the most recent information concerning pesticide registrations.

Pesticide Emergency and Poison Control Centers

Nationwide phone numbers:

Pesticide Poisoning: Call the **Poison Center**
(800) 222-1222

This number will automatically connect you to the poison center nearest you.

National Pesticide Information Retrieval System
(NPIRS): (765) 494-6616

National Pesticide Information Center:
(800) 858-7378

CHEMTREC (800) 424-9300

▶ Arkansas

Arkansas Poison Control and Drug Information Center Emergency Toll-Free Phone Number:
(800) 376-4766

▶ Illinois

Illinois Poison Control Centers Emergency Nationwide: (800) 222-1222
Emergency TTY/TDD: (312) 906-6185

▶ Indiana

Indiana Poison Center: (800) 222-1222,
Pesticide Poisoning

Indiana Department of Environmental Management: (765) 233-7745,
Pesticide Spill Reporting

Purdue Pesticide Programs: (765) 494-4566,
General Information

Office of Indiana State Chemist: (765) 494-1492
Pesticide Certification and Training

Environmental Protection Agency Region 5:
(312) 886-5220

▶ Iowa

Iowa Statewide Poison Control Center Emergency Phone Number: (800) 222-1222
Administrative Phone Number: (712) 279-3710
Web: www.iowapoisson.org
E-mail: poisonpal@iowapoisson.org

A joint effort by St. Luke's Regional Medical Center, Iowa Health System and University of Iowa Hospitals and Clinics: 2720 Stone Park Blvd., Sioux City, Iowa 51104

▶ Kansas

Mid-America Poison Control Center, University of Kansas Medical Center, Kansas City, KS 66103
Phone: (800) 222-1222
Kansas City residents may phone: (913) 588-6633
Emergency TDD: (913) 588-6639
Web: www.kumed.com/poison

▶ Kentucky

Kentucky Regional Poison Control Center:
(800) 222-1222

Metro Louisville residents may phone:
(502) 589-8222

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

▶ Missouri

Missouri Regional Poison Center: (800) 366-8888

All Poison Control Centers are coordinated through Cardinal Glennon Memorial Hospital in St. Louis. This facility has a 24-hour Poison Control Hotline staffed by professionals. The Center will refer you to your closest Poison Control Hospital for treatment.

▶ Nebraska

Nebraska Regional Poison Center: (800) 222-1222

Anyone with a poisoning emergency can call the toll-free telephone number for help. Personnel at the Resource Center will give you first-aid information and direct you to local treatment centers if necessary.

▶ Ohio

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

All calls will be automatically routed to the regional Ohio Poison Exposure Center closest to you. This number should be called to receive medical assistance if you are involved in a pesticide exposure poisoning.

▶ Oklahoma

The Oklahoma Poison Control Center:
(800) 222-1222
Web: www.oklahomapoison.org

▶ West Virginia

West Virginia Poison Control Center:
(800) 222-1222

Charleston, WV residents may call: (304) 388-4211
Pollution, Toxic Chemical & Oil Spills, National:
(800) 424-8802

West Virginia Department of Natural Resources:
(800) 642-3074

Fruit Grower Newsletters

Arkansas

University of Arkansas Cooperative Extension publishes a bi-monthly newsletter that covers timely and pertinent issues in horticulture and pest management, and announcements of upcoming events. It is sent by first class mail to Arkansas growers and by e-mail to all county Extension offices. It also is available at www.aragriculture.org/News/fruit_nut/default.htm. To subscribe, contact Jo Salazar, Horticulture Dept. Plant Science Bldg., Fayetteville, AR 72701; e-mail: Salazar@uark.edu.

Illinois

University of Illinois Extension publishes *The Illinois Fruit & Vegetable News*. This newsletter covers production practices and insect and disease management. It is available at www.ipm.uiuc.edu/ifvn/index.html. For information, or to order, contact Rick Weinzierl, Department of Crop Sciences, University of Illinois, AW-101 Turner Hall, 1102 S. Goodwin Avenue, Urbana, IL 61801; phone: (217) 333-6651; e-mail: weinzier@uiuc.edu.

Indiana

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

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

Kentucky

A Cooperative Extension newsletter, *Kentucky Fruit Facts*, is issued monthly to all Kentucky growers at no cost. This service supplies timely information on disease and insect activity throughout the state, as well as cultural information. To obtain this service, send your name, address and present fruit interests to: *Kentucky Fruit Facts*, c/o Joe Masabni, PO Box 469, Princeton, KY 42445; phone: (270) 365-7541; e-mail: jmasabni@uky.edu. *Kentucky Fruit Facts* is also available at www.ca.uky.edu/fruitfacts.

Missouri

The Institute for Continental Climate Viticulture and Enology (ICCVE) at the University of Missouri in Columbia publishes a quarterly electronic newsletter, *The Midwest Winegrower*. The newsletter includes educational articles on grape growing and winemaking; insect, disease, and weed management; industry news; and notices of events in the region. Those interested in receiving the newsletter should contact Andy Allen at: ICCVE, 108 Eckles Hall, University of Missouri, Columbia, MO 65211-5140; phone: (573) 882-6752; e-mail: AllenRA@missouri.edu.

Nebraska

The University of Nebraska-Lincoln Extension publishes a quarterly newsletter — *The Nebraska Vine Lines*. This newsletter covers production practices, news of the industry, and insect, disease, and weed management. For information, contact Paul Read, Department of Agronomy and Horticulture, University of Nebraska, Lincoln, NE 68983-0724; phone: (402) 472-5136.

Ohio

The Ohio Fruit ICM (Integrated Crop Management) Newsletter covers timely topics related to the management of fruit. Approximately 30 issues are published weekly in the summer and monthly in the winter. To subscribe, send \$48 payable to the Ohio State University Extension to: Ohio Fruit ICM Newsletter, OSU South Centers—Horticulture, 1864 Shyville Rd., Piketon, OH 45661; phone: (740) 289-2071; e-mail: wright.705@osu.edu. E-mail delivery is free by signing up at <http://ipm.osu.edu/fruit/index.html>.

The Ohio Grape-Wine Electronic Newsletter (O-GEN) is available at www.oardc.ohio-state.edu/grapeweb/OGEN/ogen.htm. To subscribe to *O-GEN*, e-mail dami.1@osu.edu.

Oklahoma

Oklahoma State University Cooperative Extension publishes a quarterly newsletter on grape management issues related to Oklahoma called *Le Vigneron*. This newsletter covers vine management, insect and disease control topics, and other information relevant to grape growers. For information contact Eric T. Stafne, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078; phone: (405) 744-5409; e-mail: eric.t.stafne@okstate.edu. The newsletter also is available at: www.hortla.okstate.edu/grapes/levigneron.html.

Foreword

Commercial fruit production has become a highly skilled, technical profession. Concerns about pesticide residues, operator risks, and the environment dictate that all fruit growers exercise extreme caution in the use of all pesticides, and indeed, all chemicals. The Environmental Protection Agency (EPA) has designated a number of fruit pesticides as “restricted use.” Growers who plan to use these restricted materials must be certified as private applicators. Certification requires that applicators understand the following: labels and labeling, safety factors, potential environmental concerns, identification of common pests encountered, pesticides and their use, proper equipment use, application techniques, and applicable state and federal regulations. Training programs are offered to help you in certification. Contact your county Extension office for information.

The pest management recommendations in this guide have been formulated to provide you up-to-date information on pesticides and their applicability to your problem. It is suggested that you use this information to set up your own spray program. You should keep accurate records of materials used, dates of application, areas treated, stages of growth, and weather conditions. Pages 71 and 74 of this guide contain sample record sheets. In case of questions, nothing beats a good set of records. Records are required by EPA for Restricted Use Pesticide applications. Some states may require records for general use pesticides (e.g., Kentucky has this requirement).

Handling Pesticides

1. Know the pesticide toxicity and act accordingly.
2. When mixing pesticides do not breathe the dust, powder, or vapor. Always mix outdoors.
3. Do not smoke, eat, or drink when handling or applying pesticides.
4. Stay out of drift from spray or dust.
5. Rinse liquid containers with water at least three times and pour rinsate into spray tank as it is being filled. Punch holes in metal and plastic containers and crush. Dispose of these and all other pesticide containers where there will be no contamination of crops or water supply. Do not re-use pesticide containers.
6. Use an adequate respirator and protective clothing, especially when mixing pesticides. Necessary protective equipment is listed on pesticide labels.
7. Have a “buddy” around when using acutely toxic organophosphates, just in case.

8. For maximum safety, get an appropriate blood test before the season starts and test periodically during the season.
9. Consult a doctor immediately if unusual symptoms develop 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 or smoking.
11. Bathe and change clothes daily, and wash contaminated clothing separate from other laundry.
12. Always store a pesticide in its original container, never in an unmarked container. Never trust your memory.
13. Always store pesticides under lock and key and keep them away from children.
14. Always use an anti-siphon device when filling the spray tank from a domestic water source.
15. The label is the law. Read and follow all label instructions carefully.

Management Tips for Safety

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

11. Provide pesticide safety training for pesticide handlers and other workers to comply with Worker Protection Standards (WPS).
12. Regularly inspect and maintain personal protective equipment used when applying pesticides.

Pesticide Use and the Law

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

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

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

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

Pesticide labels include two very important statements:

Re-entry or restricted entry interval (REI)

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

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

Determining Spray Volume and Rate

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

Dilute Spraying

The objective of spraying is to distribute the spray material uniformly over the plants or plant parts of particular concern. Pesticide recommendations are based on the amount of dilute spray needed to wet plants thoroughly, to the point of “runoff.” In typical blueberry, raspberry, or grape plantings with plants 5 to 7 feet tall and 3 to 5 feet wide and set in rows 9 to 10 feet apart, and in most strawberry plantings, 200 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.

Low Volume Spraying

Low volume, or concentrate, spraying refers to the use of less water per acre in applying 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. It is suggested that the amount of pesticide used per acre in low volume sprays of 3x or higher may be reduced by 20 to 25 percent compared to that used when applied dilute. This savings can be

realized because sprays are not applied to runoff with low volume application. For example, if 4 lb/acre is the dilute rate, 3.0 to 3.2 lb/acre can be used if the application is made by low volume application.

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

Using low volume sprays requires less labor, less water, less time, and fewer refills than 1x or dilute mixtures. However, low volume sprays have disadvantages. Here are some precautions to follow when making low volume pesticide applications:

1. Use extreme care in calibrating the sprayer and maintaining a constant sprayer speed. As gallonage is decreased, errors become much more critical.
2. Choose calm, yet good drying conditions for spraying. This may mean spraying at night or early in the morning. Good coverage cannot be achieved in windy conditions (over 5 mph).
3. Prune plants well to create an open canopy for spray penetration. Spray droplets will not penetrate dense foliage.
4. Choose pesticide formulations that will mix satisfactorily. Pay careful attention to increased operator hazards and drift problems.

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

Calculate Tree Row Volume Gallonage

Step 1. Calculate feet of row/acre.

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

Step 2. Calculate cu ft of TRV/acre.

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

Step 3. Select density factor.

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

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

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

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

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

Step 4. Calculate TRV gallonage/acre.

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

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

Example

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

Determining Material Rate

Most fungicide and insecticide labels list appropriate rates of material per acre. These rates should be followed closely for best results. A few materials also list an approximate spray volume in which to apply the material for best results. Again, these recommendations should be followed closely.

Determining Material Rate

Using TRV

For a few materials, rates are listed per 100 gallons. In these cases the rate of material can be calculated by using the TRV method. Calculate the TRV gallonage

for the planting. Multiply this gallonage by the recommended dilute pesticide rate per 100 gallons to determine the rate of pesticide per acre for dilute (1x) application. For example, a fungicide is recommended at 2.0 lb/100 gal and is to be applied in a planting with a TRV gallonage base of 94 gal/acre.

Therefore, the rate per acre for this pesticide at 1x concentration is:

$$\frac{2 \text{ lb}}{100 \text{ gal}} \times \frac{94 \text{ gal}}{\text{acre}} = 1.9 \text{ lb/acre}$$

To determine the rate of fungicide or insecticide per acre when spraying low volume (3x or greater), first calculate the dilute TRV rate as above. Multiply this rate by 0.75 to obtain a concentrate TRV rate. For example, a fungicide is recommended at 2.0 lb/100 gallons dilute and is to be applied at 3x in a planting with a TRV base of 94 gal/acre. The rate of pesticide per acre to be applied is calculated as:

$$\text{TRV pesticide rate/acre} \times (0.75) = \text{concentrate pesticide application rate/acre: } 1.9 \text{ lb/acre} \times 0.75 = 1.4 \text{ lb/acre}$$

So, 1.4 lb of pesticide would be added to 31 gallons of water (94 gal/acre ÷ 3 = 3x low volume) for each acre to be sprayed.

Spraying Small Volumes

In some cases the grower may wish to apply small volumes of pesticides with backpack or hand-held sprayers or wipers. The following table will help make the conversion from rate per 100 gallons to rate per gallon. Care should be taken to measure pesticide amounts accurately because errors will be magnified at small volumes.

Approximate Dilutions for Small Volumes of Spray Mixes

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

Calibrating Single Nozzle and Boom Sprayers

Calibration is an essential step in the use of any application equipment. For boom sprayers, a satisfactory spray pattern can be achieved only if the output from individual nozzles does not differ more than 10%.

Owner's manuals for sprayers contain specific instructions for calibration and adjustment. A good time to calibrate is in early spring, right after the sprayer has been reassembled and is being readied for early season operations. Check for worn disks and be sure that all nozzle tips have the same angle and capacity rating. The use of wettable powder sprays enlarges nozzle openings, so calibration of each nozzle is essential. Use only clean water when calibrating sprayers. Start the season with a calibrated sprayer, and depending on the number of gallons sprayed and the cleanliness of the water you have used, calibrate the sprayer again according to intervals specified in the owner's manual (or no later than halfway through the spray season).

To Check Nozzle Uniformity

Follow these steps to check nozzle uniformity:

- Step 1.** Hang a container under each nozzle.
- Step 2.** Operate the sprayer at the usual application pressure until about a pint of water has been collected in each container.
- Step 3.** Measure and record the output of each nozzle. Measurements can be made by a "dip stick" method, but using a graduated cylinder with

indications for fluid ounces or milliliters is better.

- Step 4.** Determine the total output collected from all nozzles.
- Step 5.** Determine the average per nozzle by dividing the total output by the number of nozzles on the boom.
- Step 6.** Multiply the average (Step 5) by 5% (0.05).
- Step 7.** Subtract this figure (Step 6) from the average (Step 5). This will be the lower limit of the 10% allowable spread.
- Step 8.** Add the 5% figure (Step 6) to the average (Step 5). This will be the upper limit of the 10% allowable spread.
- Step 9.** The allowable 10% spread is between the low figure (Step 7) and the high figure (Step 8).
- Step 10.** Compare the output of each nozzle to these low and high figures.
- Take apart and clean or replace all nozzles with outputs less than the lower limit.
 - Replace all nozzles with outputs greater than the upper limit.
- Step 11.** After cleaning or replacing nozzles, repeat steps 1 through 10 to make sure your repairs have been successful. Output of new nozzles often fails to match the average of existing nozzles.

Spray Pattern Alignment

Single and double spray patterns can be aligned on a driveway or other flat surface. The edges of a single spray pattern should overlap only very slightly and be offset just enough so that the sprays from adjacent nozzles do not collide.

Alignment of nozzles in a double spray or double overlap pattern requires that adjacent nozzle angles be offset slightly so that the area to be treated receives spray from two nozzles, yet the spray patterns do not collide. Remember, a double or overlapping spray pattern will use twice as much spray per acre as a single spray pattern if pump pressure and sprayer speed remain the same. A double spray pattern is most useful for treating dense or tall vegetation.

Calibration of Air-Blast Sprayers

Accurate calibration is the only way to ensure that a sprayer is applying the intended amount of chemical. The operator must know the amount of water that will be applied per unit of area in order to make a proper spray mix. Failure to calibrate a sprayer can

result in crop injury, creation of a hazardous situation, and wasted money. Frequent calibration identifies worn nozzles and keeps the operator aware of factors affecting application rate, such as travel speed, pressure, and type of nozzle in use.

Precalibration 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

The rate of travel needed for proper distribution of spray within the canopy can be determined by trial by placing water sensitive spray paper at various locations within the trellis. For proper pesticide application, the air within the canopy must be completely replaced with spray-laden air from the sprayer. In general, a travel speed of 1 to 3 miles per hour has proved satisfactory, depending on the size and density of the canopy, and capacity of the sprayer.

Before a sprayer can be calibrated, the travel speed must be determined in miles per hour (mph). To determine the travel speed, load the sprayer with clear water and make a test run in the vineyard. Always make the test run in the vineyard or on similar ground as tractor speed changes 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. Speed can be calculated 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. The following formula can be used to determine travel speed:

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

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

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

Determining Nozzle Flow Rate

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

To determine gpm, it is necessary to know the travel speed of the sprayer (mph), the gallons per acre (gpa) to be applied, and the spacing (W) between the rows

of plants. Once these three variables are measured or selected, a simple equation can be used to calculate the gpm. This equation is for one side of the sprayer manifold only. Double the calculated answer if both sides of the sprayer are to be used. Once the nozzle and whirlplate combinations are determined, place the same size nozzles and whirlplates in both sides of the sprayer if both sides are to be used.

Step 1. Calculate the total gpm required per side:

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

gpm = gallons per minute (per side)

gpa = gallons per acre

mph = speed (in miles per hour)

W = spacing between rows (in feet)

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

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

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

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

Step 3. Install the nozzles in their proper outlets. Inspect and clean all nozzles and outlets and determine that the sprayer is operating correctly. Nozzles are a very important part of the sprayer; if any defects or wear are showing in the nozzles, 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. The sprayer should be operated 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 gpm output of 4. The sprayer was operated for five minutes at 150 psi on the gauge. After the five minutes, the sight gauge read 75 gals. The actual output was:

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

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

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

Repeat these calibration procedures whenever changes are made in the speed, gallons per acre, or row spacing. Periodically check the output from the nozzles during the spraying season. Remember, the effectiveness of the spray material is directly dependent on your skill as an operator.

Field test to confirm calculations:

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

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

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

Spray Water pH

Several pesticides break down rapidly in alkaline water. In a matter of hours (or, in extreme instances, only minutes), 50% or more of the active ingredient may be hydrolyzed to yield a less active compound. Captan, Cygon, Imidan, Kelthane, Malathion, and Omite are examples of compounds that are especially vulnerable to alkaline hydrolysis.

Both well and pond water in the Midwest tend to be alkaline (pH above 7.0). To ensure the maximum

effectiveness of pesticide applications, check the pH of spray mixes in the spray tank and add buffering agents if necessary to adjust the pH to neutral (7.0). Buffering agents include Buffercide, Buffer-X, Unifilm B, and LI 700 Acidiphactant. 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 Bordeaux mixture, fixed copper, or other copper compounds.

Spray Adjuvants

Several types of additives are available to improve the effectiveness of spray applications. Known collectively as adjuvants, they include:

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

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

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

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

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

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

CAUTION: Some surfactants used in combination with certain pesticides can function as activators, causing plant injury. 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 result in crop injury or reduced effectiveness, particularly when adjuvants are mixed with emulsifiable concentrates.

Tips on Using This Spray Guide

This guide lists recommended materials for the common disease and insect pests of grapes and small fruit. These recommendations cover the various options available to growers. Using *all* listed materials is not recommended. Rather, growers are advised to appropriately use one or more of the various options. Growers should consult a text, such as the *Midwest Small Fruit Pest Management Handbook* (see inside front cover) to gain a thorough understanding of each pest and appropriate control measures.

This spray guide lists pests, recommended control measures, and comments by growth stage through the growing season. It is important that users understand the material listings and the various uses of the word "or." There are two uses of the word "or" in this text, particularly in regard to fungicides for disease control:

1. "or" is italicized and placed below a material when different materials can be used to control the same disease, but *only one* of the suggested materials should be used. For example, see the recommended materials for control of Black rot, Phomopsis cane and leaf spot, and Downy mildew on page 1.

Mancozeb 75DF <i>or</i>
Captan 50WP <i>or</i>
Ziram 76DF <i>or</i>
About 2.08F <i>or</i>
Sovran 50WG <i>or</i>
Pristine 38WG

In this list, the use of "or" means only one of the six recommended materials should be applied at the specified rates.

2. “**OR**” is used in combination with “**plus**” when options including combinations of materials are suggested. For example, see the list of recommended materials for control of Black rot and Downy mildew at the “Shatter” timing on page 6.

Captan 50WP <i>or</i>
Phosphorous acid <i>or</i>
Alliette 80WDG plus
Ferbam 76WP <i>or</i>
Mancozeb 75DF <i>or</i>
Ziram 76DF OR
Abound 2.08F <i>or</i>
Sovran 50WG <i>or</i>
Pristine 38WG <i>or</i>
Adament 50WG

This means to use one of the two major options:

a. The combination of either Captan, phosphorus acid, or Alliette **plus** either Ferbam, mancozeb, or Ziram. For example: use Captan **plus** Ferbam, phosphorus acid **plus** mancozeb, Alliette **plus** Ferbam, etc., in any combination of one product from the top list plus one product from the lower list.

OR

b. Either Abound, Sovran, Pristine or Adament alone.

The reasoning behind this recommendation is that (in this example) Captan, phosphorous acid and Alliette are all good against downy mildew, but weak against black rot, and since both diseases are a risk during the shatter stage of development, another product with good activity against black rot (such as Ferbam, Mancozeb or Ziram) should be tank mixed with one of the other products to control both diseases. The “**OR**” designates that another option is to use one of the strobilurin fungicides (Abound, Sovran, Pristine, or Adament) alone because those products are effective against both downy mildew and black rot.

Summary

Pesticide recommendations may seem confusing to the novice because there are so many options for materials to use for certain diseases or insect pests. For this reason, we strongly recommend that growers refer to the *Midwest Small Fruit Pest Management Handbook* (see front inside cover) to develop a thorough understanding of pest management. With fungicides in particular, a single material may control one or more diseases, but not all. So, when several diseases are a threat, a combination of materials may be required for control. Additionally, insect pests may be a problem at the same time, so insecticides may be needed. In most cases, multiple fungicides and insecticides can be tank mixed together and applied at one time. In most cases there are no problems mixing materials, however, certain materials are incompatible with each other. Refer to the comments sections in this guide, and the pesticide label for recommendations. Most problems are associated with using copper or sulfur fungicides in combination with, or relatively soon after applications of oils. These instances are fairly rare. Problems may occur when tank mixing products of different formulations, such as emulsifiable concentrates and wettable powders. Most pesticide labels give instructions on loading, tank mixes, etc., and we recommend that growers follow the label directions closely to avoid problems.

Certain fungicides and insecticides may be phytotoxic (cause foliar damage) to certain crops and/or varieties. For example, many grape varieties are sensitive to sulfur or copper. Table 4 on page 23 lists variety sensitivity to these materials. Additionally, some grape varieties are sensitive to endosulfan insecticide and certain strobilurin fungicides, and some strawberry varieties are sensitive to Sinbar herbicide. Always read the comments associated with the materials in this guide.

Pesticide choices can be limited by variety, disease or insect pressure and other factors. Grower preference, experience with materials, and price often influence decisions as well. Pest management in small fruit crops is relatively easy so long as the grower understands 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*. If you still have questions, contact the manufacturer or your state Extension specialist for clarification.

Grape Spray Schedule

Dormant			
Apply before buds swell.			
Pest/Problem	Material	Rate/Acre	Comments
Anthracnose	Fungicide Resistance Alert: See note on page 20 on fungicide resistance development in powdery and downy mildew.		
	Lime sulfur solution	10 gal	This dormant application is aimed at reducing overwintering inoculum on canes. See page 18 for more information on anthracnose.

Bud Swell			
Apply just before buds show green.			
Pest/Problem	Material	Rate/Acre	Comments
European red mite and/or scale insects	Superior oil (70-sec.)	4 gal	
Flea beetle adults, Climbing cutworm	Scout at least weekly as bud swell occurs.		
	Sevin XLR (4EC)	2 qt	Other formulations may be available.
	Danitol 2.4EC	5.3-21.3 fl oz	Use lower rate for flea beetle, higher rate for cutworms.
	Baythroid 2E or XL	2.4-3.2 fl oz	
	Renounce 20WP	3-4 oz	

Bud Break to Bloom			
Begin applications after ½-inch new shoot growth; repeat at 7-10 day intervals or according to label instructions and environmental conditions for disease development.			
Pest/Problem	Material	Rate/Acre	Comments
Black rot, Phomopsis cane and leaf spot, Downy mildew	Mancozeb 75DF <i>or</i>	3-4 lb	Early sprays for black rot are especially critical where this disease has been a problem in previous years. Mancozeb is sold under the trade names Dithane M-45, Manzate 200, and Penncozeb. If black rot is a problem in the vineyard, Mancozeb would be the fungicide of choice. Captan is less effective than Mancozeb for black rot control. See Table 1, page 21.
	Captan 50WP <i>or</i>	3-4 lb	Captan has a 3-day re-entry interval limitation on grapes for the 80WDG formulation. Captan is also available as a 50WP and Captec 4L formulation. These formulations may also have the reduced re-entry interval on the label by the 2008 growing season. All older Captan products will still have the 4-day re-entry label. Always check the label. Captan is weak for black rot control.
	Ziram 76DF <i>or</i>	3-4 lb	
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See notes on Abound, Sovran, and Pristine, pages 18-19.
	Sovran 50WG <i>or</i>	3.2-6.4 oz	
	Pristine 38WG	6-10.5 oz	Do not apply Pristine to Concord or other American type grapes as injury may occur.

Pest/Problem	Material	Rate/Acre	Comments
Flea beetle, Climbing cutworm	Same as for bud swell spray.		
Powdery mildew	Fungicide Resistance Alert: See note on page 20 on fungicide resistance development in powdery and downy mildew.		
	Nova 40WP <i>or</i>	3-5 oz	On varieties highly susceptible to powdery mildew, a fungicide for powdery mildew control should be included in these early sprays. Primary infections of powdery mildew can occur during this period. See important note on powdery mildew fungicide resistance, page 20.
	Rubigan 1EC <i>or</i>	3 fl oz	Refer to Rubigan label for further information on recommended rates. Fenarimol is the active ingredient in Rubigan EC. Vintage SC is a different formulation of fenarimol and is very similar to Rubigan EC. Vintage SC is registered for use on grapes and has less smell (odor) than Rubigan EC.
	Procure 50WS <i>or</i>	4-8 oz	
	Elite 45DF <i>or</i>	4 oz	
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See notes on Abound, Flint, Sovran and Pristine, pages 18-19.
	Sovran 50WG <i>or</i>	3.2-6.4 oz	
	Flint 50WG plus	1.5-4.0 oz	
	Sulfur <i>or</i>	See comments.	Use sulfur with caution. See note on page 18. Do not use Captan or sulfur within 2 weeks of applying JMS Stylet Oil, or stylet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe vine damage.
	JMS Stylet Oil <i>or</i>	1-2% conc.	
	Quintec 2.08F <i>or</i>	3-4 fl oz	
	Endura 70WG <i>or</i>	4.5 oz	
	Potassium salts OR	See comments.	See note on potassium salts, page 20.
	Pristine 38WG <i>or</i>	6-10.5 oz	See notes on Abound, Flint, Sovran and Pristine, pages 18-19.
	Adament 50WG	4-7.2 oz	Do not apply on Concord grapes. See notes on page 19.
Downy mildew	Fungicide Resistance Alert: See note on page 20 on fungicide resistance development in powdery and downy mildew.		
	Ridomil Gold MZ <i>or</i>	2.5 lb	See comments on the use of Ridomil for downy mildew control, pages 17-18.
	Ridomil Gold Copper <i>or</i>	2 lb	
Phosphorous acid <i>or</i>	See comments.	See comments on use of phosphorous acid for downy mildew control, page 18.	

Pest/Problem	Material	Rate/Acre	Comments
Downy mildew (continued)	Aliette 80WDG <i>or</i>	3-5 lb	
	Mancozeb 75DF <i>or</i>	3-4 lb	
	Captan 50WP <i>or</i>	3-4 lb	
	Ziram 76DF <i>or</i>	3-4 lb	
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See comments on Abound, Sovran, and Pristine, pages 18-19. Do not apply Pristine on Concord or other American type grapes as injury may occur.
	Sovran 50WG <i>or</i>	3.2-6.4 oz	
	Pristine 38WG <i>or</i>	6-10.5 oz	
	Fixed Copper	See comments.	See comments on copper use, page 19-20.
Black rot, Phomopsis cane and leaf spot, Powdery mildew, Downy mildew	Mancozeb 75DF plus	3 lb	
	Sulfur OR	See comments.	Use sulfur with caution. See note on sulfur, page 19.
	JMS Stylet Oil <i>or</i>	1-2% conc.	Do not use Captan or sulfur within 2 weeks of applying JMS Stylet Oil, or stilet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe vine damage.
	Bayleton 50WP <i>or</i>	2-6 oz	Bayleton is not recommended for control of powdery mildew because of reduced efficacy. It is still effective against black rot.
	Nova 40WP <i>or</i>	3-5 oz	
	Rubigan 1EC <i>or</i>	3 fl oz	
	Procure 50WS <i>or</i>	4-8 oz	
	Elite 45DF <i>or</i>	4 oz	
	Endura 70WG <i>or</i>	4.5 oz	
	Quintec 2.08F <i>or</i>	3-4 fl oz	
	Potassium salts plus	See comments.	See note on potassium salts, page 20.
	Mancozeb 75DF <i>or</i>	3 lb	
	Captan 50WP <i>or</i>	3 lb	
	Ziram 76DF OR	3-4 lb	
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See note on Abound, Sovran, Flint, and Pristine, pages 18-19.
	Sovran 50WG <i>or</i>	3.2-6.4 oz	
	Flint 50WG plus	1.5-4.0 oz	Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur. Flint is not recommended for downy mildew control.
	Sulfur <i>or</i>	See comments.	Use sulfur with caution. See note on sulfur, page 18.

Grape (continued)**Bud Break to Bloom (continued)**

Pest/Problem	Material	Rate/Acre	Comments
Black rot, Phomopsis cane and leaf spot, Powdery mildew, Downy mildew (continued)	Endura 70WG <i>or</i>	4.5 oz	
	Quintec 2.08F <i>or</i>	3-4 fl oz	
	Potassium salts OR	See comments.	See note on potassium salts, page 20.
	Pristine 38WG	6-10.5 oz	Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur.

Note on Critical Period for Disease Control

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

Ten-inch Shoots

Apply when new shoots are about 10 inches long.

Pest/Problem	Material	Rate/Acre	Comments
Flea beetle larvae	Same as for bud swell spray.		Flea beetle larvae may be present any time between 4- and 10-inch shoot growth and bloom.
Redbanded leafroller, Rose chafer	Redbanded leafroller and rose chafer may be present any time between 4- and 10-inch shoot growth and bloom.		
	Danitol 2.4EC	10.7 fl oz	
	Sevin XLR(4EC)	2 qt	Other formulations may be available.
	Intrepid 2F	10-16 fl oz	Redbanded leafroller only.
	SpinTor 2SC	4-8 fl oz	
	Entrust 80WP	1.25-2.5 oz	
European red mite	Assail 30SG	2.5 oz	Rose chafer only.
	Kelthane 50WP	2.5 lb	
	Nexter 75WP	4.4-5.2 oz (1-1.5 bags)	
	Fujimite 5EC	2 pt	
	Envidor 2SC	16-18 fl oz	

Pre-Bloom

Apply just before bloom.

Pest/Problem	Material	Rate/Acre	Comments
Flea beetle larvae, Rose chafer, Redbanded leafroller*, Grape berry moth*	Same as for 10-inch shoot spray (if needed).		*Pheromone traps for grape berry moth and redbanded leafroller will indicate if they are present and help determine the need for control.
Grape scale	Malathion 8F	2-2.5 pt	Not a common pest in most of the Midwest. In southern areas (such as Arkansas), 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).

Bloom			
Apply when caps begin to fall.			
Pest/Problem	Material	Rate/Acre	Comments
Black rot, Phomopsis cane and leaf spot	Same as bud break to bloom, see page 1.		If wet weather persists during bloom or if the interval between the pre-bloom and shatter spray is greater than 7-10 days, a fungicide application during bloom may be necessary.
Downy mildew	Same as bud break to bloom, see page 1.		
Powdery mildew	Same as bud break to bloom, see page 2.		
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 nearly immune to this pest.		
	Endosulfan 50WP	2 lb	Apply at bloom and repeat 10-14 days later. Endosulfan can severely injure Concord, Baco Noir, Chancellor, Colobel, Cascade, Cynthiana/Norton, Chambourcin, and other cultivars. Refer to product label. EC formulations are more likely to cause phytotoxicity than WP formulations. Since bees do not pollinate grapes there is no danger to bees at this time unless they are working on other blooming plants in the area being sprayed. Mow before spraying to eliminate blooms on weeds.
	Endosulfan 3EC	1.33 qt	
	Danitol 2.4EC	10.7 fl oz	
	Assail 30SG	2.5 oz	
Admire Pro	7-14 fl oz		
Grape scale	Same as Pre-Bloom, see page 4.		
Botrytis bunch rot	This spray is critical in vineyards or on varieties (especially French hybrids or Vinifera) where Botrytis bunch rot has been a problem. See note on Botrytis bunch rot control on page 17.		
	Topsin M WSB <i>or</i>	1-1.5 lb	Apply Topsin M at 1-1.5 lb/A at first bloom (no later than 5% bloom), and repeat 14 days later if severe disease conditions persist. Topsin M is also available in 70WDG and 4.5 FL formulations.
	Rovral 50WP <i>or</i>	1.5-2 lb	Rovral may be applied at 1.5-2.0 lb/A four times: 1. Early to midbloom; 2. Prior to bunch closing; 3. Beginning of fruit ripening; 4. Prior to harvest if needed. Do not make more than 4 applications of Rovral per season. Do not apply within 7 days of harvest.
	Vanguard 75WG <i>or</i>	10 oz	Vanguard is registered for use at 10 oz/A when used alone, or at 5-10 oz/A when used in a tank mix. Timing of application is approximately the same as for Rovral. No more than 20 oz of Vanguard may be applied per acre per crop season. Vanguard cannot be applied within 7 days of harvest.
	Elevate 50WG <i>or</i>	1 lb	Elevate may be applied at 1 lb/A and the timing of application is approximately the same as Rovral and Vanguard. No more than 3 lb of Elevate may be applied per acre per season. Elevate can be applied up to, and including, the day of harvest (0-day PHI).
	Scala 5SC	18 fl oz	Scala is registered for use at 18 fl oz alone, or at 9 fl oz when used in a tank mix. Timing of application is approximately the same as for Rovral.

Shatter			
Apply when unfertilized berries fall from clusters, about 7-10 days after bloom or 7-10 days after last spray.			
Pest/Problem	Material	Rate/Acre	Comments
Black rot, Downy mildew	Captan 50WP <i>or</i>	3-4 lb	
	Phosphorous acid <i>or</i>	See comments.	See note on phosphorous acid on page 18.
	Aliette 80WDG plus	3-5 lb	
	Ferbam 76WP <i>or</i>	3 lb	No more than 3 applications of Ferman may be made per season on grapes. See label for additional information.
	Mancozeb 75DF <i>or</i>	4 lb	
	Ziram 76DF OR	3-4 lb	
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See notes on Abound, Sovran, and Pristine on pages 18-19.
	Sovran 50WG <i>or</i>	3.2-6.4 oz	
	Pristine 38WG <i>or</i>	6-10.5 oz	
	Adament 50WG	4-7.2 oz	Adament is excellent for control of powdery mildew and black rot, but is weak on downy mildew. Do not apply to Concord grapes. See comments on page 19.
Black rot, Downy mildew, Powdery mildew	If Nova, Rubigan, Procure, Abound, Sovran, Flint, or sulfur is not being used and powdery mildew starts to develop, incorporate one of these fungicides into the spray program.		
	Bayleton 50WP <i>or</i>	2-6 oz	A maximum of 18 oz of Bayleton may be applied per acre per season. Bayleton is not recommended for control of powdery mildew.
	Nova 40WP <i>or</i>	3-5 oz	A maximum of 24 oz of Nova may be applied per acre per season.
	Rubigan 1EC <i>or</i>	4-5 fl oz	
	Procure 50WS <i>or</i>	4-8 oz	
	Elite 45DF <i>or</i>	4 oz	
	Endura 70WG <i>or</i>	4.5 oz	
	Sulfur <i>or</i>	See comments.	Use sulfur with caution. See note on page 18.
	JMS Stylet Oil plus	1-2% conc.	Do not use Captan or sulfur within 2 weeks of a stylet oil application, or stylet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe damage to the vine. Stylet oil should not be used on table grapes, because it removes the bloom or waxy coating and affects the appearance of the berry.
	Mancozeb 75DF <i>or</i>	4 lb	
	Ziram 76DF <i>or</i>	3-4 lb	

Pest/Problem	Material	Rate/Acre	Comments
Black rot, Downy mildew, Powdery mildew (<i>continued</i>)	Captan 50WP <i>or</i>	3-4 lb	
	Phosphorous acid <i>or</i>	See comments.	See note on phosphorous acid, page 18.
	Aliette 80WDG OR	3-5 lb	
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See note on Abound, Flint, Sovran, and Pristine, pages 18-19.
	Sovran 50WG <i>or</i>	3.2-6.4 oz	
	Flint 50WG plus	1.5-4.0 oz	Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur. Flint is not recommended for downy mildew control.
	Sulfur <i>or</i>	See comments.	Use sulfur with caution. See note on page 18.
	JMS Stylet Oil <i>or</i>	1-2%	Do not use Captan or sulfur within 2 weeks of a stylet oil application, or stylet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe damage to the vine. Stylet oil should not be used on table grapes, because it removes the bloom or waxy coating and affects appearance of the berry.
	Quintec 2.08F <i>or</i>	3-4 fl oz	
	Endura 70WG <i>or</i>	4.5 oz	
	Potassium salts OR	See comments.	See note on potassium salts, page 20.
	Pristine 38WG	6-10.5 oz	Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur. Flint is not recommended for downy mildew control.
Grape berry moth	Pheromone traps offer help in determining presence and timing of grape berry moth. Berry moth emergence begins in late May and June; there may be three generations per year. Occasional problems from grape rootworm (adult beetles) are also controlled by Sevin, Imidan, Danitol, Baythroid, Renounce, Capture, Brigade, Lannate, or Diazinon applied for berry moth control.		
	Sevin XLR (4EC)	2 qt	Other formulations may be available.
	Sevin 4F	2 qt	
	Imidan 70WP	1.3-2.1 lb	
	Danitol 2.4EC	10.7 oz	
	Baythroid 2E or XL	2.4-3.2 fl oz	
	Renounce 20WP	3-4 oz	
	Capture 2EC	3.2-6.4 fl oz	
	Brigade 2EC	3.2-6.4 fl oz	
	Brigade 10WP (WSB)	8-16 oz	
	Lannate SP	0.5-1 lb	
	Lannate LV	1.5-3 pt	
	Diazinon AG500 (4EC)	1-2 pt	
	Clutch 50WDG	3 oz	
	Avaunt 30WG	5-6 oz	
	Intrepid 2F	4-8 fl oz	Apply Intrepid at initiation of egg hatch and 10-18 days later.

Pest/Problem	Material	Rate/Acre	Comments
Grape berry moth (continued)	SpinTor 2SC	4-8 fl oz	Do not apply more than 3 sprays of SpinTor or Entrust in any 30-day period. Limit 23.2 oz SpinTor or 7.5 oz Entrust per season. See Table 9, page 46 for restrictions on Entrust usage.
	Entrust 80WP	1.25-2.5 oz	
	Bt (<i>Bacillus thuringiensis</i>)		See Table 10 on page 47 for a list of products that contain <i>Bacillus thuringiensis</i> . See individual product labels for rates and application details.
	Isomate GBM	400 ties	Isomate-GBM and 3M Sprayable Pheromone are mating disruption products to control only grape berry moth. See comments on mating disruption on page 17. This strategy should be considered only for vineyards at least 5 acres in size.
	3M Sprayable Pheromone	2 fl oz	
Leafhoppers including Sharpshooters	Examining the undersides of grape leaves will indicate if leafhoppers are present.		
	Provado Solupak 75WP	0.8-1.0 oz	
	Provado 1.6F	3-4 fl oz	
	Admire Pro	7-14 fl oz	
	Actara 25WG	1.5-3 oz	
	Platinum 2SC	8-17 fl oz	
	Clutch 50WDG	1-3 oz	
	Assail 30SG	2.5 oz	
	Venom 20SG	0.44-0.66 lb	
	Sevin XLR (4 EC)	1-2 qt	Other formulations may be available.
	Danitol 2.4EC	5.3 fl oz	
	Capture 2 EC	3.2-6.4 fl oz	
	Brigade 2EC	3.2-6.4 fl oz	
	Brigade 10WP (WSB)	8-16 oz	
	Baythroid 2E or XL	2.4-3.2 fl oz	
	Renounce 20WP	2-4 oz	
	Mustang Max 0.8EC	4 oz	
	Nexter 75WP	5.2-10.67 oz (1.5-3 bags)	
	Applaud 70WP	9-12 oz	Applaud kills nymphs, not adults.
	Imidan 70WP	1.3-2.1 lb	
	Lannate SP	8-16 fl oz	
	Lannate LV	1.5-3 pt	
	Diazinon AG500 (4 EC)	1-2 pt	
	Surround 95WP	12.5-50 lb	Surround may leave residues on grapes at harvest. Repeat applications might be necessary.
	Pyganic 1.4%EC	16-64 fl oz	
Pyganic 5%EC	4.5-18 fl oz		
Fujimite 5EC	1-2 pt		

Pest/Problem	Material	Rate/Acre	Comments
Rose chafer, Japanese beetle	Sevin XLR (4 EC)	1-2 qt	Other formulations may be available.
	Imidan 70WP	1.3-2.1 lb	
	Danitol 2.4EC	10.7 fl oz	
	Capture 2EC	3.2-6.4 fl oz	Japanese beetle only.
	Brigade 2EC	3.2-6.4 fl oz	Japanese beetle only.
	Brigade 10WP (WSB)	8-16 oz	Japanese beetle only.
	Surround 95WP	12.5-50 lb	Surround may leave residues on grapes.
	Assail 30SG	2.5 oz	
	Clutch 50WDG	3 oz	Japanese beetle only.
	Actara 25 WDG	1.5-3 oz	Japanese beetle only.
	Platinum 2SC	8-17 fl oz	Japanese beetle only.
	Avaunt 30 WG	5-6 oz	Japanese beetle only.
	Pyganic 1.4%EC	16-64 oz	
	Pyganic 5%EC	5-18 fl oz	
Redbanded leafroller	Although adult moths are commonly caught in traps, the larvae of this pest are not common in grapes in the Midwest.		
	Sevin XLR (4 EC)	2 qt	Other formulations may be available.
	Imidan 70WP	1.3-2.1 lb	
	Danitol 2.4EC	10.7 fl oz	
	Intrepid 2F	4-8 fl oz	Intrepid should target small larvae.
	SpinTor 2SC	4-8 fl oz	
	Entrust 80WP	1.25-2.5 oz	
	Surround 95WP	12.5-50 lb	Surround may leave residues on grapes at harvest.
Grape mealybug	This pest is not common in the Midwest.		
	Imidan 70WP	1.3-2.1 lb	
	Provado Solupak 75WP	0.8-1.0 oz	
	Provado 1.6F	3-4 fl oz	
	Admire Pro	7-14 fl oz	
	Actara 25WG	1.5-3 oz	
	Platinum 2SC	8-17 fl oz	
	Assail 30SG	2.5 oz	
	Clutch 50WDG	2-3 oz	
	Venom 20SG	0.44-0.66 oz	
	Venom 70SG	1-3 oz	
	Applaud 70WP	9-12 oz	
	Baythroid 2E or XL	2.4-3.2 fl oz	Crawlers only.
	Renounce 20 WP	3-4 oz	Crawlers only.
Fujimite 5EC	2 pt		
Mites	Nexter 75WP	4.4-10.67 oz (1-3 bags)	Nexter controls European red mite at 4.4-5.2 oz/A, and twospotted spider mite at 8.8-10.67 oz/A.
	Acramite 50WS	0.75-1.0 lb	
	Agri-Mek 0.15EC	8-16 fl oz	With Agri-Mek, add a nonionic surfactant.
	Fujimite 5EC	2 pt	
	Kelthane 50WP	2.5 lb	
	Envidor 2SC	16-18 fl oz	
	Zeal WP	2-3 oz	

First Cover to Veraison (Berry coloring)

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

Pest/Problem	Material	Rate/Acre	Comments
Black rot, Downy mildew, Powdery mildew	Bayleton 50WP <i>or</i>	2-6 oz	
	Nova 40WP <i>or</i>	3-5 oz	
	Rubigan 1EC <i>or</i>	4-5 fl oz	
	Procure 50WS <i>or</i>	4-8 oz	
	Elite 45DF <i>or</i>	4 oz	
	Sulfur <i>or</i>	See comments.	Use sulfur with caution. See note on page 18.
	JMS Stylet Oil <i>or</i>	1-2% conc.	Do not use Captan or sulfur within 2 weeks of a stylet oil application, or stylet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe damage to the vine.
	Quintec 2.08F <i>or</i>	3 4 fl oz	
	Potassium salts plus	See comments.	See note on potassium salts, page 20.
	Mancozeb 75DF <i>or</i>	4 lb	Mancozeb cannot be applied within 66 days of harvest.
	Captan 50WP OR	3-4 lb	
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See note on Abound, Sovran, Pristine, and Flint, pages 18-19. Flint is not recommended for control of downy mildew.
	Sovran 50WG <i>or</i>	3.2-6.4 oz	
	Flint 50WG plus	1.5-4.0 oz	
	Sulfur <i>or</i>	See comments.	Use sulfur with caution. See note on page 18.
	JMS Stylet Oil <i>or</i>	1-2% conc.	Do not use Captan or sulfur within 2 weeks of a stylet oil application, or stylet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe damage to the vine.
	Quintec 2.08F <i>or</i>	3 4 fl oz	
	Endura 70WG <i>or</i>	4.5 oz	
	Potassium salts OR	See comments.	See note on potassium salts, page 20.
	Pristine 38WG	6-10.5 oz	Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur.

Pest/Problem	Material	Rate/Acre	Comments
Black rot, Downy mildew	Research in New York has shown that berries of most varieties are resistant to black rot infection by 4 weeks after bloom. Sprays for black rot should not be needed after this period.		
	Captan 50WP <i>or</i>	3-4 lb	
	Phosphorous acid <i>or</i>	See comments.	See note on phosphorous acid, page 18.
	Aliette 80WDG plus	3-5 lb	
	Ferbam 76WP OR	3 lb	No more than 3 applications of Ferbam may be made per season on grapes.
	Mancozeb 75DF OR	4 lb	Mancozeb cannot be applied within 66 days of harvest.
	Abound 2.08F OR	11-15.4 fl oz	See notes on Abound, Sovran, and Pristine, pages 18-19.
	Sovran 50WG OR	3.2-6.4 oz	
	Pristine 38WG	6-10.5 oz	
Downy mildew, Powdery mildew	Fungicide Resistance Alert: See note on page 20 on fungicide resistance development in powdery and downy mildew.		
	Captan 50WP <i>or</i>	3-4 lb	
	Ziram 76DF <i>or</i>	3-4 lb	
	Phosphorous acid <i>or</i>	See comments.	See note on phosphorous acid, page 18.
	Aliette 80WDG <i>or</i>	3-5 lb	
	Abound 2.08F plus	11-15.4 fl oz	See note on Abound, Sovran, and Pristine, pages 18-19.
	Sulfur <i>or</i>	See comments.	
	JMS Stylet Oil <i>or</i>	1-2%	Do not use Captan or sulfur within 2 weeks of a stylet oil application, or stylet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe damage to the vine.
	Quintec 2.08F <i>or</i>	3-4 fl oz	
	Endura 70WG <i>or</i>	4.5 oz	
	Potassium salts <i>or</i>	See comments.	See note on potassium salts, page 20.
	Pristine 38WG <i>or</i>	6-10.5 oz	Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur.
	Fixed copper	See comments.	Fixed copper fungicides provide excellent control of downy mildew, but only moderate to slight control of black rot and powdery mildew. There are many fixed copper fungicides labeled for use on grapes. The use of copper may result in damage to leaves and fruit, especially under cool temperatures and slow drying conditions. Some varieties are more sensitive to copper damage than others. See Table 4. Do not tank mix Nova, Bayleton, or Rubigan with copper fungicides. Read all product labels.

Pest/Problem	Material	Rate/Acre	Comments	
Downy mildew	Fungicide Resistance Alert: See note on page 20 on fungicide resistance development in powdery and downy mildew.			
	Ridomil Gold MZ <i>or</i>	2.5 lb	Do not apply Ridomil Gold Copper within 42 days of harvest, or Ridomil Gold MZ within 66 days of harvest. Other restrictions apply. Read the label for more information.	
	Ridomil Gold Copper <i>or</i>	2 lb		
	Phosphorous acid <i>or</i>	See comments.	See notes on phosphorous acid, page 18.	
	Aliette 80WDG <i>or</i>	3-5 lb		
	Mancozeb 75DF <i>or</i>	3-4 lb	Mancozeb cannot be applied within 66 days of harvest.	
	Captan 50WP <i>or</i>	3-4 lb		
	Ziram 76DF <i>or</i>	3-4 lb		
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See note on Abound, Sovran, and Pristine, pages 18-19.	
	Sovran 50WG <i>or</i>	3.2-6.4 oz		
	Pristine 38WG <i>or</i>	6-10.5 oz		
	Fixed copper	See comments.	Fixed copper fungicides provide excellent control of downy mildew, but only moderate to slight control of black rot and powdery mildew. There are many fixed copper fungicides labeled for use on grapes. The use of copper may result in damage to leaves and fruit, especially under cool temperatures and slow drying conditions. Some varieties are more sensitive to copper damage than others. See Table 4 on page 23. Do not tank mix Nova, Bayleton, or Rubigan with copper fungicides. Read the label.	
Powdery mildew	On varieties that are highly susceptible to powdery mildew, a fungicide for powdery mildew control should be included in these early sprays. Primary infections of powdery mildew can occur during this period.			
	Fungicide Resistance Alert: See note on page 20 on fungicide resistance development in powdery and downy mildew.			
	Nova 40WP <i>or</i>	3-5 oz		
	Rubigan 1EC <i>or</i>	3 fl oz	Refer to Rubigan label for further information on recommended rates.	
	Procure 50WS <i>or</i>	4-8 oz		
	Elite 45DF <i>or</i>	4 oz		
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See notes on Abound, Flint, Sovran, and Pristine, pages 18-19. Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur.	
	Sovran 50WG <i>or</i>	3.2-6.4 oz		
	Flint 50WG plus Sulfur <i>or</i>	1.5-4.0 oz See comments.	Use sulfur with caution. See note, page 18.	

Pest/Problem	Material	Rate/Acre	Comments
Powdery mildew (continued)	JMS Stylet Oil <i>or</i>	1-2% conc.	Do not use Captan or sulfur within 2 weeks of a stylet oil application, or stylet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe damage to the vine.
	Quintec 2.08F <i>or</i>	3-4 fl oz	
	Endura 70WG <i>or</i>	4.5 oz	
	Potassium salts OR	See comments.	See note on potassium salts, page 20.
	Pristine 38WG	6-10.5 oz	See notes on Abound, Flint, Sovran, and Pristine, pages 18-19. Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur.
Grape berry moth, Leafhoppers, Rose chafer, Grape rootworm (adults), Redbanded leafroller, Grape mealybug	Same as for shatter.		Infestations by rose chafer are usually finished by this time of the season.
Japanese beetle	The adult beetles usually begin emerging in late June (in central Midwest) and are abundant during July and August.		
	Sevin XLR (4 EC)	1-2 qt	Do not use Sevin with copper-lime. Other formulations may be available.
	Imidan 70WP	1.3-2.1 lb	
	Danitol 2.4EC	0.7 fl oz	
	Capture 2EC	3.2-6.4 oz	
	Brigade 2EC	3.2-6.4 oz	
	Brigade 10WP (WSB)	8-16 oz	
	Assail 30SG	2.5 oz	
	Actara 25WG	1.5-3 oz	
	Patinum 2SC	8-17 fl oz	
	Avaunt 30WG	5-6 oz	
	Neemix 4.5	7-16 fl oz	Neem acts as a repellent.
	Aza-Direct	1-2 pt	
	Pyganic 1.4% EC	16-64 fl oz	
Pyganic 5% EC	4.5-18 fl oz		
Mites	Same as for shatter.		

Veraison to Harvest			
Pest/Problem	Material	Rate/Acre	Comments
Botrytis bunch rot	Same as bloom.		See comments under Bloom relative to use of Topsin M, Rovral, Vanguard, and Elevate on page 5 and comments on Botrytis bunch rot control, page 17.
Powdery mildew	On varieties that are highly susceptible to powdery mildew, a fungicide for powdery mildew control should be included in these early sprays. Primary infections of powdery mildew can occur during this period. Fungicide Resistance Alert: See note on page 20 on fungicide resistance development in powdery and downy mildew.		
	Nova 40WP <i>or</i>	3-5 oz	
	Rubigan 1EC <i>or</i>	3 fl oz	Refer to Rubigan label for further information on recommended rates.
	Procure 50WS <i>or</i>	4-8 oz	
	Elite 45DF <i>or</i>	4 oz	
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See notes on Abound, Flint, Sovran, and Pristine, pages 18-19. Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur.
	Sovran 50WG <i>or</i>	3.2-6.4 oz	
	Flint 50WG plus	1.5-4.0 oz	
	Sulfur <i>or</i>	See comments.	Use sulfur with caution. See note, page 18.
	JMS Stylet Oil <i>or</i>	1-2% conc.	Do not use Captan or sulfur within 2 weeks of a stylet oil application, or stylet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe damage to the vine.
	Quintec 2.08F <i>or</i>	3-4 fl oz	
	Endura 70WG <i>or</i>	4.5 oz	
	Potassium salts OR	See comments.	See note on potassium salts, page 20.
Pristine 38WG	6-10.5 oz	See notes on Abound, Flint, Sovran, and Pristine, pages 18-19. Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur.	
Downy mildew	If downy mildew is a problem and wet weather persists at this time, a fungicide for downy mildew control may be required. Consult the label for days from last application to harvest. Fungicide Resistance Alert: See note on page 20 on fungicide resistance development in powdery and downy mildew.		
	Captan 50WP <i>or</i>	3-4 lb	
	Ziram 76DF <i>or</i>	3-4 lb	
	Phosphorous acid <i>or</i>	See comments (see label).	See note on phosphorous acid, page 18.
	Aliette 80WDG <i>or</i>	3-5 lb	
	Abound 2.08F <i>or</i>	11-15.4 fl oz	See notes on Abound and Pristine, pages 18-19.
	Pristine 38WG <i>or</i>	6-10.5 oz	
Fixed copper	See comments.	See comments on the use of copper fungicides, pages 19-20.	

Pest/Problem	Material	Rate/Acre	Comments
Downy mildew, Powdery mildew	Captan 50WP <i>or</i>	3-4 lb	
	Ziram 76DF <i>or</i>	3-4 lb	
	Phosphorous acid <i>or</i>	See comments.	See note on phosphorous acid, page 18.
	Aliette 80WDG <i>or</i>	3-5 lb	
	Abound 2.08F plus	11-15.4 fl oz	See notes on Abound, Sovran, and Pristine, pages 18-19.
	Sulfur <i>or</i>	See comments.	Do not use Captan or sulfur within 2 weeks of a stylet oil application, or stylet oil within 2 weeks of a Captan or sulfur application. Mixing Captan or sulfur with oil can result in severe damage to the vine.
	JMS Stylet Oil <i>or</i>	1-2%	
	Quintec 2.08F <i>or</i>	3-4 fl oz	
	Endura 70WG <i>or</i>	4.5 oz	
	Potassium salts OR	See comments.	See note on potassium salts, page 20.
	Pristine 38WG OR	6-10.5 oz	Do not apply Flint or Pristine to Concord or other American type grapes as injury may occur.
	Fixed copper	See comments.	See comments on the use of copper fungicides, pages 19-20.
Black rot	As berries reach full size and sugar content starts to increase, they become resistant to infection by the black rot fungus. Research in New York has demonstrated that berries of most varieties become resistant to black rot infection by 3-4 weeks after bloom. Sprays for black rot should not be needed at this time.		
Grape berry moth, Grape leafhopper, Grape rootworm, Japanese beetle, Redbanded leafroller	Same as first cover to veraison.		Continue to monitor for insect and mite pests, and apply insecticide as needed. Refer to product label for specific insects, rates, and harvest restrictions.
Green June Beetle	Sevin XLR (4 EC)	2 qt	In southern Midwest, apply in July when first beetles enter the vineyard. Repeat sprays as needed (weekly). Other formulations may be available. Several insecticides listed for Japanese beetle control on page 13 — including Imidan, Danitol, Capture, and Brigade — also provide at least some control of green June beetle.
Multicolored Asian lady beetle	Venom 70SG	1-3 oz	Illinois, Indiana, Kentucky, Ohio, and West Virginia only. See note on page 16.
Grape root borer	See control details, pages 16-17.		
Mites	Same as shatter.		
RESIDUE REMINDER: Wettable powder formulations may leave visible residues on fruit at harvest.			

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

Special Comments on Grape Schedule

Multicolored Asian Lady Beetle

Within the past few years, the multicolored Asian lady beetle has become problematic in several vineyards (and wineries) across the Midwest. The multicolored Asian lady beetle (MALB), a late-season inhabitant of vineyards, can significantly impair wine quality.

In vineyards, the lady beetles are attracted to the ripening grapes as a late-season source of sugars. They may congregate, often by the hundreds or thousands, in and among grape clusters during late August and September. Although the beetles may become primary pests of grapes (i.e., cause direct yield loss), they can have a devastating effect on wine quality when sufficient numbers become trapped in the harvested grapes, which then are crushed along with the grapes at the winery. The beetles excrete an orange-colored defense chemical when agitated or stressed. This chemical causes the wine to smell “dirty” (a musty, damp basement odor) that masks all varietal characteristics. Preliminary data from Ohio indicate that wine made from grapes that contained as few as two beetles per lug of harvested grapes is negatively noticeable to wine connoisseurs, and at least half of wine drinkers will notice a diminished flavor from wine made with grapes that contained 24 beetles per harvest lug. The problem of excessive numbers of beetles in vineyards at harvest time appears to occur predominately in late ripening varieties such as Cabernet Franc, Cabernet Sauvignon, Chambourcin, Riesling, Vidal, and Vignoles, but earlier ripening grapes that are prone to cracking due to their thin skins can also be heavily infested.

The beetle, a beneficial insect introduced some 25 years ago by the USDA, also has emerged as a significant late-summer nuisance for homeowners as they congregate within and around structures in preparation for overwintering.

What can be done? Scout vineyards several days prior to harvest to detect the presence and abundance of beetles. Try to cause the beetles to leave the grape clusters prior to harvesting by waiting until later in the day to begin harvest when the beetles are more active and by vigorously shaking the vines. Venom 70SG is labeled for control of multicolored Asian lady beetles in some states. Additional insecticides labeled for use on grapes have provided effective control in research trials.

Grape Root Borer

It is generally difficult to evaluate damage from the grape root borer. Injury is most often associated with a slow decline of vineyards, when it can be associated at all. If grape root borer is not a problem, there is no reason to risk destroying the natural control processes (predators, parasites, diseases). A pheromone lure is available that is very effective for attracting grape root borer males. Traps should be set out in early June. If moths are detected, then treatment is advised. If you believe that this insect is affecting your vineyard’s performance, you may wish to begin the following program. Sampling is critical for several reasons:

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

Immediately After Harvest

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

Examine — A circular site (3 feet in diameter) around the base of each plant, concentrating on the inner 1 foot,

looking for shed pupal skins of the grape root borer moth. If pupal skins are found beneath 5% of the vines examined, apply an insecticide next year.

35 Days Before Harvest the Next Season

If previous year's sample indicates a need to spray, apply Lorsban 4E or Lorsban 75WG. The directions on the Lorsban label are to use a rate of 4.5 pints of 4E or 3 pounds of 75 WG per 100 gallons of water. Apply 2 quarts of this diluted spray mix to the soil surface on a 15 square foot area around the base of each vine. Do not allow the spray to contact fruit or foliage. The pre-harvest restriction is 35 days.

Grape Berry Moth-Mating Disruption Strategy

A new use of pheromones is for insect control using the strategy of mating disruption; this expands the use of sex-attractant pheromones beyond their traditional role in insect monitoring.

The pheromone is imbedded in 8-inch long plastic twist-ties. The atmosphere of the vineyard is saturated with the scent of the pheromone by attaching twist-ties to vines, with 400 twist-ties per acre. The pheromone confuses the male moths so that they are unable to locate and mate with females. Females are unaffected by the pheromone and can lay unfertilized eggs, but these eggs are unable to develop. This strategy should be considered only for vineyards that are at least 5 acres in size. For grape berry moth, the product is called Isomate-GBM, manufactured by Shinetsu Chemical Company and distributed by Pacific Biocontrol of Davis, California. It is distributed in the Midwest by Great Lakes IPM, Vestaburg, Michigan — phone (989) 268-5693. A sprayable form of mating disruption pheromone that was introduced in 2001 is called "3M Sprayable Pheromone, Mating Disruption for Grape Berry Moth." It is made by 3M in Canada and distributed by Certis of Columbia, Maryland — phone (800) 847-5620. It is used at a rate of 2 fl oz/A. Application can be repeated at two- to three-week intervals. There is a limit of 12 applications per year.

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 resembling black rot develops on mature berries (8% sugar or above), the cause is probably not black rot. This late season rot is likely to be bitter rot. The new systemic fungicides (Nova, Bayleton, and Rubigan) are not effective against bitter rot (Table 1). If bitter rot is a problem, pre-harvest applications of Captan may be beneficial. Observe all pre-harvest restrictions.

Botrytis Bunch Rot

Use Rovral 50WP at the rate of 1.5-2 lb/A, Vanguard 75WG at 10 oz/A, or Elevate 50WG at 1 lb/A (see comments on page 5). Botrytis bunch rot is most commonly a problem on tight-clustered French hybrid and *Vitis vinifera* cultivars. Proper timing and thorough spray coverage are essential for good control. (See label directions on timing applications.) Direct the spray toward the fruit, and use a minimum of 100 gal/A of water. Include a spreader-sticker with Rovral, especially at the 1.5 lb rate.

NOTE: Growers in Europe and Canada have experienced loss of disease control due to the development of fungicide resistance when more than three applications per year of Rovral were made over a period of 3 to 5 years. Vanguard and Elevate are also at risk for fungicide resistance development. It is therefore strongly recommended that Rovral, Elevate, and Vanguard use be limited to a maximum of three applications per year to reduce the probability of developing strains of Botrytis that are resistant to these materials. In addition, growers should consider alternating applications of Rovral, Elevate, and Vanguard during the growing season.

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

Downy Mildew — Use of Ridomil Gold MZ and Ridomil Gold Copper

Ridomil is very effective for control of downy mildew on grapes. The current labels for Ridomil Gold MZ and Ridomil Gold Copper read as follows.

Ridomil Gold MZ: Apply 2.5 lb/A of Ridomil Gold MZ. Make up to four applications beginning before bloom; do not apply within 66 days of harvest. For late season downy mildew control, apply other registered fungicides.

NOTE: Other restrictions also apply. Always read the label.

Ridomil Gold Copper: Apply 2 lb/A of Ridomil Gold Copper. Make up to four applications beginning before bloom; do not make an application within 42 days of harvest.

For late season downy mildew control, apply other registered fungicides. NOTE: Always obtain and read the most current label.

Phosphorous Acid (ProPhyt, Phostrol, Agri-Fos)

Several products containing phosphorous acid (phosphonates, phosphites) are sold as nutritional supplements and “plant conditioners,” but a few products (ProPhyt, Phostrol, Agri-Fos) are registered for use as fungicides for downy mildew control on grape. In trials in New York, these products have provided excellent control of downy mildew but do not control other grape diseases. Phosphorous acid has been used successfully for many years in Australia for downy mildew control on grape. Australian experience suggests that these products provide most control on foliage when applied within a few days after the start of an infection period, providing only a few days of additional residual (protective) activity. Experience in New York suggests that spray timing is less critical for control of downy mildew on fruit, perhaps because this highly mobile chemical (which is exempt from residue tolerances) accumulates in these organs. Phosphorous acid is a promising new fungicide for control of downy mildew, but commercial experience in the United States is limited and questions pertaining to optimum spray timing still need to be answered. Usage rate recommendations vary among different products. Some recommend a specific number of pints per 100 gallons of water and some recommend a percent solution such as 0.3%. The products mentioned here have a 4-hour re-entry interval and a 0-day preharvest interval. Obtain and read the label of each product prior to use.

Anthraco

Especially in the more southern regions of the Midwest, anthracnose can be quite severe. Mancozeb, Captan, ziram, and copper fungicides are rated as only slightly or moderately effective for anthracnose control, but efficacy data is lacking. Pristine is registered for control of anthracnose on grapes. The dormant application of lime sulfur solution listed on page 1 is important for anthracnose control.

Sulfur

There are many formulations of sulfur labeled for use on grapes. Sulfur is available in dry flowable (DF) and flowable (F) formulations, as well as wettable powders (WP) and dusts (D). The dry flowable and flowable formulations greatly reduce the applicator’s exposure as compared to wettable powders and dusts. Use rates are different for different formulations. See the label for specific use rates. Some grape varieties, such as Concord and other Labrusca (American) types, are extremely sensitive to sulfur. See Table 4. Do not apply when the temperature during or immediately following application will exceed 85°F. Sulfur loses efficacy for powdery mildew control at temperatures below 65°F.

Abound Flowable (2.08F)

Abound is in the same general class of chemistry as Sovran and Flint (strobilurin) and is registered for control of black rot, downy mildew, powdery mildew, and Phomopsis cane and leaf spot. Abound is excellent for control of black rot and downy mildew, and provides good control of powdery mildew. None of the strobilurins (Abound, Flint, or Sovran) are highly effective for control of Phomopsis cane and leaf spot. Abound is recommended at the rate of 11-15.4 fl oz/A. In university tests, the rate of 11-12 fl oz provided good control of the mentioned diseases above. NOTE: Abound Flowable is very phytotoxic to apples of the variety McIntosh or varieties related to McIntosh. Do not use the same sprayer to apply Abound to grapes that will be used to apply other materials to apples. Do not allow spray to drift from grapes to apples.

Sovran 50WG

Sovran 50WG is in the same general class of chemistry as Abound and Flint (strobilurin). It is registered for control of black rot, powdery mildew, Phomopsis cane and leaf spot, and downy mildew. The Sovran label gives different use rates for control of different diseases. For black rot and Phomopsis cane and leaf spot the rate is 3.2-4.8 oz/A; for powdery mildew the rate is 3.2-4.8 oz/A and for downy mildew the rate is 4.0-6.4 oz/A. Sovran is excellent for control of black rot and powdery mildew, but is less effective than Abound for downy mildew control. Under heavy disease pressure, Sovran may not provide adequate control of downy mildew even at the higher rate.

Unlike Abound, Sovran is not phytotoxic on certain apple varieties. Sovran has a 14-day PHI. See label for further information and certain use restrictions.

Flint 50WG

Flint 50WG is in the same general class of chemistry as Abound and Sovran. It is registered for control of black rot and powdery mildew, and suppression of downy mildew. Phomopsis cane and leaf spot is not listed on the Flint label. The Flint label provides different use rates for control of different diseases. For powdery mildew the rate is 1.5-2.0 oz/A; for black rot the rate is 2.0 oz/A and for downy mildew the rate is 4.0 oz/A. Flint is excellent for control of black rot and powdery mildew, but is not highly effective against downy mildew, and is not recommended for control of downy mildew. Unlike Abound, Flint is not phytotoxic to certain apple varieties; however, Flint is very phytotoxic to Concord grapes. The label states, “Do not apply Flint to Concord grapes or crop injury may occur.” See label for further information and certain use restrictions.

Pristine 38WDG

Pristine 38WDG contains a combination of two active ingredients (pyraclostrobin, 12.8% and boscalid 25.2%). Pyraclostrobin is in the same general class of chemistry as Abound, Sovran, and Flint (strobilurin). Boscalid is a new class of chemistry with excellent activity against powdery mildew and good activity against Botrytis. With increasing resistance in powdery mildew to the sterol inhibiting fungicides (Nova, Rubigan, Procure, Elite) and the strobilurin fungicides (Abound, Sovran, and Flint), the addition of a new powdery mildew fungicide (boscalid) is timely. Pristine will probably be an important component in our resistance management programs for powdery mildew. Pristine is registered for control of anthracnose, black rot, downy mildew, powdery mildew, and Phomopsis cane and leaf spot, and “suppression only” of Botrytis gray mold. Pristine is registered for use at the rates of 6-10.5 oz/A. A maximum of six applications may be made per season. Pristine has a 14-day preharvest interval and 24-hour re-entry interval. The label also states, “Do not use on Concord, Worden, Fredonia, or related varieties due to possible foliar injury.”

Adament 50WG

Adament 50WG contains a combination of two active ingredients (tebuconazole 25% and trifloxystrobin 25%). Tebuconazole is the active ingredient in Elite 45DF and trifloxystrobin is the active ingredient in Flint 50WG. Tebuconazole is a sterol inhibiting fungicide and trifloxystrobin is a strobilurin. The combination should be very effective for control of powdery mildew and black rot, but is weak for control of downy mildew. As with Flint, Adament should not be applied to Concord grapes or injury may occur to the vines.

Resistance Management for Strobilurin Fungicides

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

Copper Fungicides for Grape Disease Control

When different formulations of copper are dissolved in water, copper ions are released into solution. These copper ions are toxic to fungi and bacteria because of their ability to destroy proteins in plant tissues. However, because copper can kill all types of plant tissues, the use of copper fungicides carries the risk of injuring foliage and fruit of most crops. Factors promoting this injury include: (1) the amount of actual copper applied, and (2) cold, wet weather (slow drying conditions) that apparently increases the availability of copper ions and, thus, increases the risk of plant injury. Because of the potential to injure plants and to accumulate in soil, the use of copper fungicides in conventional production systems has largely been replaced with conventional fungicides that are generally safer to plant tissues and often more effective.

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

Bordeaux Mixture

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

Fixed Copper Fungicides

Following the discovery and use of Bordeaux mixture, several relatively insoluble copper compounds or fixed coppers were developed. Fixed copper formulations release less copper ions and are generally less injurious to plant

Grape (continued)

tissues (safer to use) than Bordeaux mixture, but their 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.

Copper (Cupric) hydroxide: Agtrol Champion WP; Agtrol Champ flowable; Agtrol Champ 2F; Kocide 101; Kocide 404S; Kocide 606; Kocide LF; Kocide DF; Microflo BlueShield WP; and Microflo BlueShield DF.

There are many other formulations of fixed copper registered for use on grapes. Always read the label for use instructions.

Recommendations for Use of Copper Fungicides on Grapes

Copper fungicides are highly effective against downy mildew and are moderately effective against powdery mildew. Copper fungicides are weak for controlling black rot, Botrytis bunch rot and Phomopsis cane and leaf spot. A concern with the use of copper fungicides is the potential they have for phytotoxicity or “vine damage.”

The following summary of recommendations is intended to reduce the danger of phytotoxicity when using copper:

1. Do not make a complete seasonlong spray program with any copper fungicide.
2. Use fungicides other than copper whenever possible.
3. When using copper fungicides, delay their use as late into the growing season as possible.
4. When using copper fungicides, avoid the use of copper sulfate. Always use a “fixed” copper formulations.
5. Use the full recommended rate of lime. Never eliminate the use of lime completely, unless the pesticide label indicates that lime should not be used.
6. Remember that cool, wet weather enhances the risk of copper injury. Be especially certain to use adequate lime levels during such periods or switch to other fungicides.
7. Make sure that any material you tank mix with copper is compatible. Many materials are incompatible (cannot be tank-mixed) with copper.
8. Avoid copper and lime sprays on fruit destined for fresh market.

Important Note on Powdery Mildew and Downy Mildew Fungicide Resistance

Powdery Mildew

In some locations, the powdery mildew fungus has developed resistance to the sterol-inhibiting fungicides (Nova, Rubigan, Elite, and Procure) and the strobilurin fungicides (Abound, Sovran, and Flint). All of these materials were highly effective for control of powdery mildew when they were first introduced. In the vineyards where these materials have been used for several years, reduced sensitivity or resistance may be present. For this reason, it is recommended that these materials not be used alone when powdery mildew needs to be controlled. In order to provide adequate control of powdery mildew, they should be mixed with sulfur, JMS Stylet Oil, Quintec, Endura, or potassium salts. Pristine is a combination of a strobilurin fungicide plus Endura; therefore it can be used alone. Sulfur is an inexpensive and very effective fungicide for powdery mildew control. On sulfur tolerant varieties, the use of sulfur should be considered.

Downy Mildew

Strobilurin fungicides are locally systemic, and some have had good to excellent activity against downy mildew. Abound, Sovran, and Pristine have provided excellent activity against downy mildew in the past; however, reports from several areas in Europe and, most recently, from Virginia indicate that the downy mildew fungus has developed resistance, or is at least less sensitive to, these strobilurin fungicides. Growers should consider not using strobilurin fungicides alone for downy mildew control. If these products are used to control other diseases and downy mildew control is also required, tank-mix strobilurins with another fungicide with activity against downy mildew. See Table 1 for alternative fungicides for downy mildew control.

Potassium Salts for Powdery Mildew Control

Several potassium salt materials are currently registered for control of powdery mildew on grape. These include Nutrol (monopotassium phosphate), Kaligreen, and Armicarb 100 (potassium bicarbonate). Several other products may also be available. They provide moderate to good control of powdery mildew when applied to developing powdery mildew colonies. They do not provide protectant activity, and they are not effective against the other grape diseases caused by fungi. See label of each material for usage rates and other recommendations.

Table 1. Effectiveness of Fungicides for the Control of Grape Diseases

Fungicide	Phomopsis cane and leaf spot	Black rot	Downy mildew	Powdery mildew	Botrytis rot	Bitter rot
Abound ^{1,2}	+	+++	+++ (FRP)	+++ (FRP)	++	?
Adament	+	+++	+	+++	++	0
Bayleton ¹	0	+++	0	+++ (FRP)	0	0
Captan	+++	+	+++	0	+	++
Elevate	0	0	0	0	+++	0
Elite ¹	0	+++	0	+++ (FRP)	0	0
Endura	0	0	0	+++	++	0
Ferbam	+	+++	+	0	0	++
Fixed copper and lime	+	+	+++	++	+	+
Flint ^{1,2}	+	+++	+(FRP)	+++ (FRP)	++	0
JMS Stylet Oil	0	0	0	+++	0	0
Mancozeb	+++	+++	+++	0	0	++
Nova ¹	0	+++	0	+++ (FRP)	0	0
Potassium salts	0	0	0	++	0	0
Phosphorous acid	0	0	+++	0	0	0
Pristine ²	++	+++	+++ (FRP)	+++	++	?
Procure ¹	0	++	0	+++ (FRP)	0	0
Quintec	0	0	0	+++	0	0
Ridomil GoldMZ	+	++	+++	0	0	++
Ridomil Gold Copper	+	+	+++	++	+	+
Rovral	0	0	0	0	+++	0
Rubigan ¹	0	++	0	+++ (FRP)	0	0
Scala	0	0	0	0	+++	0
Sovran ^{1,2}	+	+++	++ (FRP)	+++ (FRP)	++	0
Sulfur	+	0	0	+++	0	0
Topsin M ³	++	+	0	+++	++	++
Vangard	0	0	0	0	+++	0
Ziram	++	+++	++	0	0	0

Key to ratings: +++=highly effective; ++=moderately effective; +=slightly effective; 0=not effective; ?=effectiveness unknown or not established; FRP=Fungicide Resistance Possible.

¹These fungicides are not recommended for powdery mildew control due to development of fungicide-resistant strains of the powdery mildew fungus.

²These fungicides are not recommended for downy mildew control due to development of fungicide resistant strains of the downy mildew fungus.

³Where Topsin M-resistant strains of the powdery mildew and Botrytis fungi have been detected, Topsin M will be ineffective and should not be used.

Note: The above ratings are intended to provide readers with an idea of relative effectiveness. They are based on published data and/or field observations from various locations. Ratings could change based on varietal susceptibility and environmental conditions for disease development.

Table 2. Leaf Wetness Duration-Temperature Combinations Necessary for Grape Foliar Infection by Black Rot

Temperature °F	Minimum Leaf Wetness Duration for Light Infection (hr)
50	24
55	12
60	9
65	8
70	7
75	7
80	6
85	9
90	12

Data represent a compilation from several experiments with the cultivars Concord, Catawba, Aurora, and Baco Noir.

Table 3. Effectiveness of Pesticides for Control of Grape Insects and Mites

	Grape berry moth	Eight spotted forester	Leafhoppers	Grape cane girdler Grape cane gallmaker	Grape flea beetle	Japanese beetle	Grape phylloxera (foliar)	Redbanded leafroller	Rose chafer	Spider mites	Climbing cutworm	Fruit flies	Grape root borer
Insecticides													
Applaud	-	-	++	-	-	-	-	-	-	-	-	-	-
Assail	-	-	+++	-	-	++	++	-	+++	-	-	-	-
Baythroid	+++	-	++	++	++	+++	++	-	+++	-	-	-	-
Brigade	++	-	++	-	++	++	++	-	++	-	-	-	-
Capture	++	-	++	-	++	++	++	-	++	-	-	-	-
Danitol	+++	-	++	-	-	+++	+++	-	-	++	-	-	-
Diazinon	++	-	++	-	-	-	-	-	-	-	-	+++	-
Dibrom	-	-	-	-	-	-	-	-	-	-	-	+++	-
Endosulfan	-	-	+	-	-	-	+++	-	++	-	-	-	-
Guthion	+++	+++	++	++	++	-	-	+++	-	-	-	-	-
Imidan	++	-	++	-	+	++	-	++	++	-	-	-	-
Intrepid	+++	-	-	-	-	-	-	++	-	-	-	-	-
Lannate	++	-	++	-	-	-	-	++	-	-	+++	-	-
Lorsban	-	-	-	-	-	-	-	-	-	-	-	-	++
Malathion	+	-	++	-	-	++	-	-	++	-	-	+++	-
Provado	-	-	+++	-	-	+	++	-	+	-	-	-	-
Renounce	+++	-	++	++	++	+++	++	-	+++	-	-	-	-
Sevin	++	+++	+++	-	+++	+++	-	++	+++	-	+++	-	-
SpinTor, Entrust	++	-	-	-	-	-	-	++	-	-	-	-	-
Venom	-	-	++	-	-	-	-	-	-	-	-	-	-
Miticides													
Acramite	-	-	-	-	-	-	-	-	-	+++	-	-	-
Agri-Mek	-	-	-	-	-	-	-	-	-	+++	-	-	-
Envidor	-	-	-	-	-	-	-	-	-	+++	-	-	-
Fujimite	-	-	-	-	-	-	-	-	-	+++	-	-	-
Kelthane	-	-	-	-	-	-	-	-	-	+	-	-	-
Nexter	-	-	++	-	-	-	-	-	-	+++	-	-	-
Vendex	-	-	-	-	-	-	-	-	-	+	-	-	-
Zeal	-	-	-	-	-	-	-	-	-	+++	-	-	-

Key to ratings: +++=highly effective; ++=moderately effective; +=slightly effective; -=ineffective or not sufficient data.

Table 4. Relative Disease Susceptibility and Chemical Sensitivity among Grape Cultivars.

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

Cultivar	Susceptible or Sensitive to									
	Black rot	Downy mildew	Powdery mildew	Botrytis	Phomopsis	Eutypa	Crown gall	Anthraxnose	Sulfur ¹	Copper ²
Aurore	+++	++	++	+++	+	+++	++	+	No	++
Baco Noir	+++	+	++	++	+	++	+++	+	No	?
Briana	?	+	?	+	?	?	?	?	?	?
Cabernet Franc	+++	+++	+++	+	?	?	+++	++	No	?
Cabernet Sauvignon	+++	+++	+++	+	+++	+++	+++	?	No	+
Canadice	+++	++	+	++	?	?	++	++	?	?
Catawba	+++	+++	++	+	+++	+	+	++	No	++
Cayuga White	+	++	+	+	++	+	++	+++	No	+
Chambourcin	+++	++	+	++	+	?	++	+	Yes	?
Chancellor	+	+++	+++	+	+++	+	+++	++	Yes	+++
Chardonel	++	++	++	++	+++	?	++	+	No	?
Chardonnay	++	+++	+++	+++	+++	++	+++	+++	No	+
Concord	+++	+	++	+	+++	+++	+	+	Yes	+
Corot noir	+	+++	+	+	+	+	+	+	No	?
Cynthiana/Norton	+	++	+	+	+	?	+	+	Yes	?
DeChaunac	+	++	++	+	+++	+++	++	++	Yes	+
Delaware	++	+++ ³	++	+	+++	+	+	++	No	+
Edelweiss	?	?	?	?	?	?	?	?	?	?
Einset Seedless	+++	++	+++	+	?	?	+	?	?	?
Foch (Marechal Foch)	++	+	++	+	+	+++	+	++	Yes	?
Fredonia	++	+++	++	+	+++	?	+	+++	No	?
Frontenac	++	+	++	++	+	?	?	+	No	?
Frontenac Gris	++	+	++	++	+	?	?	+	No	?
Geneva Red-7	+	++	++	++	+	+	+	+	No	?
Gewürztraminer	+++	+++	+++	+++	?	?	+++	+++	No	+
Himrod	++	+	++	+	+	?	?	+++	No	?
Jupiter	++	+++	+++	+	+	?	?	+	?	?
LaCrescent	++	+	++	+	+	+	+	+	?	?
LaCrosse	+++	++	++	+++	++	?	?	+	?	?
Leon Millot	+	++	+++	+	+	+	?	+	Yes	?
Limberger	+++	+++	+++	+	?	+++	+++	?	No	?
Marquette	+	+	+	+++	?	?	+	?	?	?
Marquis	+	+++	+	+	+++	?	?	+++	?	?
Mars	+	+	+	+	+	?	+	+	?	?
Melody	+++	++	+	+	+++	?	?	+	No	?
Merlot	++	+++	+++	++	+	+++	+++	++	No	++
Moore's Diamond	+++	+	+++	++	?	++	?	?	No	?
Muscat Ottonel	+++	+++	+++	++	?	+++	+++	++	No	?
Niagara	+++	+++	++	+	+++	+	++	++	No	+
Noiret	++	++	++	+	+	?	++	+	No	?
Pinot gris	+++	+++	+++	++	?	+++	+++	?	No	?
Pinot noir	+++	+++	+++	+++	?	?	+++	?	No	+
Reliance	+++	+++	++	+	++	?	?	+++	No	+
Riesling	+++	+++	+++	+++	++	++	+++	?	No	+
St. Croix	?	++	++	++	?	?	?	+	?	?
St. Vincent	+	++	+	+	+	+	+	+	No	?
Seyval	++	++	+++	+++	++	+	++	+	No	+
Steuben	++	+	+	+	?	?	+	+	No	?
Sunbelt	+	++	++	+	+	?	?	+	?	?
Traminette	+	++	+	+	+++	?	++	+	No	?
Valvin Muscat	++	+	++	+	+	?	+	?	No	?
Vanessa	+++	++	++	+	+	?	+	?	?	?
Ventura	++	++	++	+	+	?	+	+	No	?
Vidal blanc	+	++	+++	+	+	+	++	+++	No	?
Vignoles	+	++	+++	+++	++	++	++	+++	No	?

Key to ratings: +=slightly susceptible or sensitive; ++=moderately susceptible or sensitive; +++=highly susceptible or sensitive; No=not sensitive; Yes=sensitive; ?=relative susceptibility or sensitivity not established.

¹ Slight to moderate sulfur injury may occur even on tolerant cultivars when temperatures are 85°F or higher during, or immediately following, the application.

² Copper applied under cool, slow-drying conditions is likely to cause injury.

³ Berries not susceptible.

Blueberry Spray Schedule

Dormant			
Apply as buds begin to break.			
Pest/Problem	Material	Rate/Acre	Comments
Phomopsis cane and twig blight	Lime sulfur solution <i>or</i>	See comments for rate.	The lime sulfur label reads: Use 5-6 gal per 100-150 gal of spray per acre. Apply at delayed dormant stage after leaf buds begin to break. Do not use within 14 days of an oil spray or when temperature is above 75°F as burning of foliage may occur.
	Sulfurix	1-2 gal	
Phytophthora root rot	Ridomil Gold EC <i>or</i>	See comments on page 28.	
	Phosphorous acid <i>or</i>		
	Aliette 80WDG		

Green Tip			
Apply when leaf buds are showing 1/16-1/4 inch green tip.			
Pest/Problem	Material	Rate/Acre	Comments
Stem canker and stem blight	Captan 50WP <i>or</i>	5 lb	Captan is also available as 80% WDG and Captec 4L. Note: The re-entry interval (REI) for Captan on blueberry is 4 days. For the 80WDG formulation the REI is 3 days. Do not tank mix Captan with Diazinon.
	Ziram 76DF	3 lb	
Mummy berry (shoot blight phase)	Unless diseases (mummy berry, anthracnose, or stem canker) are or have been a problem, an intensive fungicide spray program may not be required.		
	Captan 50WP <i>or</i>	5 lb	Captan provides protective control of stem canker and stem blight, anthracnose, and Phomopsis canker.
	Ziram 76DF <i>or</i>	3 lb	
	Indar 75WSP	2 oz	Indar is also available in a flowable (2F) formulation.

Pink Bud Stage and 25% Bloom			
Apply when flower petals show pink and again at 25% bloom.			
Pest/Problem	Material	Rate/Acre	Comments
Mummy berry (blossom infection), Botrytis blight, Stem canker and stem blight, Anthracnose	Captan 50WP <i>or</i>	5 lb	Captan provides protective control of stem canker and stem blight, anthracnose, and Phomopsis canker.
	Ziram 76DF <i>or</i>	3 lb	
	Indar 75WSP <i>or</i>	2 oz	Indar is also available in a flowable (2F) formulation.
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	See note on Abound, Cabrio, and Pristine on page 28.
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	CaptEvate 68WDG	3.5-4.7 lb	

Pest/Problem	Material	Rate/Acre	Comments
Botrytis blight	Elevate 50WG <i>or</i>	1.5 lb	
	CaptEstate 68WDG <i>or</i>	3.5-4.7 lb	
	Switch 62.5WG	11-14 oz	See note on Switch on page 28.

Full Bloom to Early Petal Fall

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

Pest/Problem	Material	Rate/Acre	Comments
Mummy berry (blossom infection), Botrytis blight, Stem canker and stem blight, Anthracnose	Captan 50WP <i>or</i>	5 lb	
	Ziram 76DF <i>or</i>	3 lb	Do not apply Ziram more than 3 weeks after full bloom.
	Indar 75WSP <i>or</i>	2 oz	Indar is also available in a flowable (2F) formulation.
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	See note on Abound, Cabrio, and Pristine on page 28.
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
		CaptEstate 68WDG	3.5-4.7 lb
Botrytis blight	Elevate 50WG <i>or</i>	1.5 lb	
	CaptEstate 68WDG <i>or</i>	3.5-4.7 lb	
	Switch 62.5WG	11-14 oz	See note on Switch on page 29.
Cherry fruitworm	Confirm 2F	16 fl oz	Cherry fruitworm control by conventional insecticides starts at petal fall, but control by Confirm must begin earlier. First application is best at 400 degree days (base 50) after biofix (sustained catch of moths in pheromone trap). Second application at 100% petal fall.
	Esteem 35WP	5 oz	Apply Esteem when egg laying begins and again at petal fall.

Petal Fall

Apply when petals are falling.

Pest/Problem	Material	Rate/Acre	Comments
Cherry fruitworm	Control cherry fruitworm at petal fall and 10 days later. Insect pests of blueberry are rare in much of the region; scout before applying insecticides. Unneeded applications of insecticides can create problems where none existed.		
	Imidan 70WP	1.3 lb	
	Guthion 50WP	1-1.5 lb	For use in Arkansas and Indiana only.
	Asana XL (0.66 EC)	4.8-9.6 fl oz	
	Danitol 2.4EC	10.6-16 oz	
	Malathion 8EC	1.5-2.5 pt	
	Malathion 5EC	1.5 pt	
	Confirm 2F	16 fl oz	
	Diazinon AG600	25.5 fl oz	
	Sevin XLR (4EC)	1.5-2 qt	Other formulations may be available.
	Lannate LV	1.5-3 pt	
	Lannate SP	8-16 oz	
	Esteem 35WP	5 oz	
	SpinTor 2SC	4-6 fl oz	Target spray to coincide with egg laying.
Entrust 80WP	1.25-1.5 oz	Limit of 9 oz of Entrust per season.	

Blueberry

Petal Fall (continued)

Pest/Problem	Material	Rate/Acre	Comments
Cherry fruitworm (continued)	Bt (<i>Bacillus thuringiensis</i>)		See Table 10 on page 47 for a list of products that contain <i>Bacillus thuringiensis</i> ; see individual product labels for rates and application details.

First and Second Cover

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

Pest/Problem	Material	Rate/Acre	Comments
Anthracnose, Stem canker and stem blight	Captan 50WP <i>or</i>	5 lb	Apply only if anthracnose or canker is a problem.
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	See notes on Abound, Cabrio, and Pristine, and on Switch on page 28.
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Switch 62.5WG <i>or</i>	11-14 oz	
	CaptEvate 68WDG	3.5-4.7 lb	
Cherry fruitworm, Cranberry fruitworm	Same as at petal fall for cherry fruitworm.		Control cherry fruitworm at petal fall and 10 days later. Control cranberry fruitworm 10 days and 20 days after petal fall.
Plum curculio	Plum curculio adults and larvae have not been observed to damage blueberries in the most southern portions of the region.		
	Imidan 70WP	1.3 lb	
	Guthion 50WP	1-1.5 lb	For use in Arkansas and Indiana only.
	Malathion 8EC	1.5-2.5 pt	
	Malathion 5EC	1.5 pt	
	Danitol 2.4EC	10.6-16 oz	
	Surround 95WP	12.5-50 lb	Surround may leave noticeable residues on berries.
Blueberry tip borer	Not a common pest.		
	Malathion 8EC	1.5-2.5 pt	

Third and Additional Covers

Apply about 10 days after previous cover, repeat as needed.

Pest/Problem	Material	Rate/Acre	Comments
Anthracnose, Stem canker and stem blight	Captan 50WP <i>or</i>	5 lb	Apply only if these diseases are a problem. Observe harvest restrictions.
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	See notes on Abound, Cabrio, and Pristine, and on Switch on page 28.
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Switch 62.5WG	11-14 oz	

Pest/Problem	Material	Rate/Acre	Comments
Blueberry maggot	Monitor for first emergence of blueberry maggot flies with traps. Emergence usually begins around July 1 in northern areas. Insecticide applications to protect berries may be needed until harvest. See product labels for preharvest intervals and restrictions. Blueberry maggot is not a common pest in the southern portion of the region.		
	Imidan 70WP	1.3 lb	
	Guthion 50WP	1-1.5 lb	For use in Arkansas and Indiana only.
	Asana XL (0.66 EC)	9.6 fl oz	
	Malathion 8EC	1.9-2.5 pt	
	Malathion 95ULV	10 fl oz	
	Diazinon AG600	25.5 fl oz	
	Sevin XLR (4 EC)	1.5-2 qt	Other formulations may be available.
	Lannate LV	12-24 fl oz	
	Lannate SP	4-8 fl oz	
	Provado 1.6F	8 fl oz	
Danitol 2.4EC	10.67-16 fl oz		
Japanese beetle	See Tab 9 on page 46 for pre-harvest intervals for insecticides listed below. See page 49 for information on this pest.		
	Imidan 70WP	1.3 lb	Imidan is moderately effective and may be used until 3 days before harvest.
	Malathion 8EC	1.5-2.5 pt	
	Malathion 5EC	1.5 pt	
	Sevin XLR (4 EC)	1-2 qt	For control of Japanese beetles on fruit, Sevin is labeled and effective, but may not be used within 7 days of harvest. Other formulations may be available.
	Asana XL (0.66 EC)	4.8-9.6 fl oz	
	Pyganic 1.4%EC	16-64 fl oz	Pyganic, Pyronyl, and Neemix provide some short-term control and may be applied until the day of harvest.
	Pyganic 5%EC	4.5-18 fl oz	
	Pyronyl	12 fl oz	
	Neemix 4.5	7-16 fl oz	Neem acts as a repellent.
	Aza-Direct	1-2 pt	
	Surround 95WP	12.5-50 lb	Surround may leave noticeable residues on berries.
	Provado 1.6F	6-8 f. fl oz	
Actara 25WG	4 oz		
Danitol 2.4EC	10.67-16 fl oz		

Post Harvest			
Pest/Problem	Material	Rate/Acre	Comments
Stem canker and stem blight	Captan 50WP	5 lb	If canker is a problem, apply post-harvest sprays at 4-6 week intervals until leaf drop in the fall.

Special Comments on Blueberry Schedule

Phytophthora Root Rot

Ridomil Gold EC is labeled for control of *Phytophthora* root rot of blueberries. The label reads: “Established plantings: Apply 0.25 pt/1,000 linear feet of row (3.6 pt/A broadcast basis) in a 3-foot band over the row before the plants start growth in the spring. One additional application may be made to coincide with periods most favorable for root rot development. New plantings: Apply 3.6 pt/A broadcast at or after the time of planting. Use the formula in the General Information section of the label to calculate the amount needed per acre. Note: On new plantings, do not apply more than 0.9 gal/A broadcast during the 12 months before bearing harvestable fruit, or illegal residues may result.”

Phosphorous acid (Agri-Fos) and Aliette 80WDG are registered for control of *Phytophthora* root rot on blueberry. Both materials essentially have the same active ingredient. Aliette is a water dispersible granule and Agri-Fos is a liquid. Aliette is registered for use at 5 lb/A and Agri-Fos is used at 1.25 qt/A in 100 gallons of water to 2.5 qt/A in 185 gallons of water. Read the label for additional information on use and restrictions.

Abound, Cabrio, and Pristine

Abound 2.08F, Cabrio 20EG, and Pristine 38WG fungicides are registered for use on blueberry. All of these fungicides belong to the same group of fungicides called strobilurins, and are at risk for fungicide resistance development in pathogenic fungi. No more than four applications of each fungicide may be made per season, and no more than two sequential sprays of each fungicide should be made without switching to a different class of fungicide. Because they are in the same class of chemistry, they cannot be alternated with each other as a fungicide resistance management strategy. These are the materials of choice for control of anthracnose fruit rot on blueberry. Alternating Abound, Cabrio, or Pristine with Captan or Switch may aid in preventing fungicide resistance in the fungus that causes anthracnose.

Switch 62.5WG

Switch is a combination of two active ingredients (cyprodinil and fludioxonil). It is a different class of chemistry than the strobilurin fungicides (Abound, Cabrio, and Pristine). It has excellent activity against *Botrytis* fruit rot and is registered for control of mummy berry, *Alternaria* fruit rot, *Phomopsis*, and anthracnose. Its activity against anthracnose makes it a good material to alternate with a strobilurin fungicide in a resistance management program for anthracnose.

Raspberry and Blackberry Spray Schedule

Delayed Dormant			
Apply when tips of buds show green.			
Pest/Problem	Material	Rate/Acre	Comments
Anthracnose, Spur blight (reds only), Cane blight	Liquid lime-sulfur <i>or</i>	6-12 gal	This is a critical spray for good disease control. Be sure that all canes are completely covered by the fungicide. This spray may burn the leaves if applied after new shoots are 3/4-inch long.
	Sulfurix <i>or</i>	3-6 gal	
	Copper hydroxide 50WP	4 lb	Copper hydroxide is available as Blueshield 50WP or Kocide 50WP. Both products have a 48-hour re-entry interval.
Phytophthora root rot	Ridomil Gold EC <i>or</i>		See comments on page 33 for application information.
	Aliette 80WDG <i>or</i>		
	Phosphorous acid		
Raspberry crown borer	Apply insecticides after egg hatch in late October or early November or wait until late March. Apply Capture or Brigade as a soil drench directed at the crown of the plants in a minimum of 50 gal water per acre prior to a significant rainfall or irrigation.		
	Capture 2EC	6.4 fl oz	
	Brigade 2EC	6.4 fl oz	
Rednecked cane borer			See comments on page 32 about pruning to remove last year's galls.
Pre-Bloom			
Apply when flowers show white.			
Pest/Problem	Material	Rate/Acre	Comments
Anthracnose, Spur blight (reds only), Cane blight, *Raspberry leaf spot, *Septoria leaf spot	NOTE: Unless anthracnose, cane blight, or spur blight have been problems, fungicide applications prior to bloom are probably not required. This is especially true if the delayed-dormant application of lime-sulfur has been made. *See note on raspberry leaf spot and Septoria leaf spot on page 34.		
	Captan 80WDG <i>or</i>	2.5 lb	See note on Captan on page 35.
	Cabrio 20EG <i>or</i>	14 oz	See notes on Abound, Cabrio, and Pristine on page 34.
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Pristine 38WG	18.5-23 oz	
Rust diseases (orange rust and late leaf rust), Powdery mildew, *Raspberry leaf spot, *Septoria leaf spot	*See note on raspberry leaf spot and Septoria leaf spot on page 34.		
	Nova 40WP <i>or</i>	2.5 oz	For late leaf rust and powdery mildew, begin applications when disease first appears and repeat on a 10-14 day schedule. For orange rust, see comments on pages 33-34.
	Cabrio 20EG <i>or</i>	14 oz	See notes on Abound, Cabrio, and Pristine on page 34.
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Pristine 38WG	18.5-23 oz	
Raspberry fruitworm	Pyganic 1.4%EC	16-64 fl oz	Early fruit is more seriously attacked than later fruit. Check for feeding damage to spring leaves, buds, and early summer fruit.
	Pyganic 5%EC	4.5 18 fl oz	
	SpinTor 2SC	4-6 fl	
	Entrust 80WP	1.25-2 fl oz	

Raspberry & Blackberry (continued)

Pre-Bloom (continued)

Pest/Problem	Material	Rate/Acre	Comments
Strawberry clipper (bud weevil)	Malathion 50WP	4 lb	Begin checking for the first clipped buds when buds' first flowers show white. If clipped buds are found, apply insecticide and repeat spray 10 days later if bud clipping continues.
Leafrollers	Not common pests.		
	Sevin XLR (4 EC)	1-2 qt	Other formulations may be available.
	Capture 2EC	3.2-6.4 fl oz	
	Brigade 2EC	3.2-6.4 fl oz	
	Brigade 10WP (WSB)	8-16 oz	
	Asana XL	4.8-9.6 fl oz	
	Mustang Max 0.8EC	4 oz	
	Confirm 2F	16 fl oz	
	SpinTor 2SC	4-6 oz	SpinTor should target eggs at hatch or small larvae.
	Entrust 80WP	1.25-2 oz	
	Bt (<i>Bacillus thuringiensis</i>)		See Table 10 for a list of products that contain <i>Bacillus thuringiensis</i> ; see individual product labels for rates and application details.
	Neemix	0.5-2 gal	
	Aza-Direct	1-2 pt	
	Pyganic 1.4%EC	16-64 fl oz	
	Pyganic 5%EC	4.5-18 fl oz	
Surround 95WP	12.5-50 lb	Surround may leave noticeable residues on berries.	
Rose chafer	Not a common pest in most areas.		
	Sevin XLR (4 EC)	1-2 qt	Other formulations may be available.
	Pyganic 1.4%EC	16-64 fl oz	
	Pyganic 5%EC	4.5-18 fl oz	
	Pyronyl	12 fl oz	
	Surround 95WP	12.5-50 lb	Surround may leave noticeable residues on berries.
Raspberry sawfly	Not a common pest.		
	Sevin XLR (4 EC)	1-2 qt	Other formulations may be available.
	Entrust 80WP	1.25-2 fl oz	

First Bloom through Petal Fall

Apply when first flowers open through when petals fall.

Anthracnose, Botrytis fruit rot, Spur blight (reds only), Cane blight, *Raspberry leaf spot, *Septoria leaf spot	*See notes on raspberry leaf spot and Septoria leaf spot on page 34. Make 3 fungicide applications during this period: apply the first as blooms begin to open, not later than 5% bloom; make the second at full bloom; and follow with a third as petals begin to fall.		
	Captan 80WDG <i>or</i>	2.5 lb	
	Cabrio 20EG <i>or</i>	14 oz	
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Pristine 38WG	18.5-23 oz	
Rust diseases (orange rust and late leaf rust), Powdery mildew, *Raspberry leaf spot, *Septoria leaf spot	*See notes on raspberry leaf spot and Septoria leaf spot on page 34.		
	Nova 40WP <i>or</i>	2.5 oz	For late leaf rust and powdery mildew, begin applications when disease first appears and repeat at 10-14 day schedule. For orange rust, see comments on pages 33-34.
	Cabrio 20EG <i>or</i>	14 oz	
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Pristine 38WG	18.5-23 oz	

Pest/Problem	Material	Rate/Acre	Comments
Rosette (double blossom)			See comments on page 33.
Botrytis fruit rot (only)	Rovral 50WP <i>or</i>	1-2 lb	See note on fungicide resistance management on page 33.
	Elevate 50WG <i>or</i>	1.5 lb	
	CaptEstate 68WDG <i>or</i>	3.5 lb	
	Switch 62.5WG <i>or</i>	11-14 oz	
	Pristine 38WG	18.5-23 oz	

Post-Bloom through Harvest

Apply every 14 days after petal fall as needed.

Pest/Problem	Material	Rate/Acre	Comments
Anthracnose, Botrytis fruit rot, Spur blight, Cane blight, *Raspberry leaf spot, *Septoria leaf spot	*See note on raspberry leaf spot and Septoria leaf spot on page 34.		
	Captan 80WDG <i>or</i>	2.5 lb	See comments on Captan on page 33.
	CaptEstate 68WDG <i>or</i>	3.5 lb	CaptEstate has a preharvest interval (PHI) of 3 days.
	Cabrio 20EG <i>or</i>	14 oz	
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Pristine 38WG	18.5-23 oz	
Botrytis fruit rot (only)	Rovral 50WP <i>or</i>	1-2 lb	Rovral, CaptEstate, Elevate, Switch, and Pristine may be applied up to and including the day of harvest for Botrytis fruit rot control.
	CaptEstate 68WDG <i>or</i>	3.5 lb	
	Elevate 50WG <i>or</i>	1.5 lb	
	Switch 62.5WG <i>or</i>	11-14 oz	
	Pristine 38WG	18.5-23 oz	
Rust diseases (orange rust and late leaf rust), Powdery mildew	Nova 40WP <i>or</i>	2.5 oz	For late leaf rust and powdery mildew, begin applications when disease first appears and repeat on a 10-14 day schedule. For orange rust, see comments on pages 33-34.
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG	18.5-23 oz	
Rednecked cane borer	Admire Pro	10.5-14 fl oz	Do not apply pre-bloom, during bloom, or when bees are foraging. See comments on page 32.
Sap beetles	Bait buckets		Keep berries off the ground and ripe berries picked. Establish bait buckets containing overripe fruit between the berry planting and nearby wooded areas. Empty bait buckets on a regular basis. Few insecticides are registered for sap beetle control, and during picking harvest restrictions practically rule out their use.

Raspberry & Blackberry (continued)

Post-Bloom through Harvest (continued)

Pest/Problem	Material	Rate/Acre	Comments
Japanese beetle and/or Green June beetle	Check preharvest intervals in Table 9 on page 46.		
	Sevin XLR (4 EC)	1-2 qt	Other formulations may be available.
	Malathion 8F	2-4 pt	
	Actara 25WB	3 oz	
	Pyganic 1.4%EC	16-64 fl oz	
	Pyganic 5%EC	4.5-18 fl oz	
	Neemix 4.5	7-16 fl oz	Neem acts as a repellent.
	Aza-Direct	1-2 pt	
	Surround 95WP	12.5-50 lb	Surround may leave noticeable residues on berries.
Tarnished plant bug, stink bugs	Sevin XLR (4 EC)	1.5-2 qt	Other formulations may be available.
	Actara 25WB	3 oz	
	Pyganic 1.4%EC	16-64 fl oz	
	Pyganic 5%EC	4.5-18 fl oz	
Mites	Savey 50DF	3-6 oz	

Post Harvest

Pest/Problem	Material	Rate/Acre	Comments
Rust diseases (orange rust and late leaf rust), Powdery mildew, *Raspberry leaf spot, *Septoria leaf spot	*Post harvest sprays are probably the most important for control of the leaf spot diseases. When diseases are severe, most defoliation occurs post harvest.		
	Nova 40WP <i>or</i>	2.5 oz	For late leaf rust and powdery mildew, begin applications when disease first appears and repeat on a 10-14 day schedule. For orange rust, see comments on pages 33-34.
	Cabrio 20EG <i>or</i>	14 oz	
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Pristine 38WG	18.5-23 oz	
Raspberry crown borer	Apply insecticides after eggs hatch in late October or early November or wait until March. Apply Capture or Brigade as a soil drench directed at the crown of plants in a minimum of 50 gal water per acre prior to a significant rainfall or irrigation.		
	Capture 2EC	6.4 fl oz	
	Brigade 2EC	6.4 fl oz	

In exceptionally wet seasons, post-harvest fungicide applications may be required to protect first year canes from anthracnose, spur blight, cane blight, and powdery mildew. A good spray program early in the season should help minimize development of these diseases later in the season.

Special Comments on the Raspberry and Blackberry Schedule**Tree Crickets and Periodical Cicadas**

See notes on pages 48-49.

Raspberry Cane Maggot

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

Rednecked Cane Borer

Scout for galls before or during the delayed dormant period. Prune out galled canes and burn, bury, or otherwise destroy them to kill overwintered larvae. If more than 5 percent of all canes have galls, an insecticide application immediately after bloom may be necessary. Adult emergence begins in May or June. Begin scouting plantings during bloom by looking for adult beetles active during daylight hours. Begin insecticide application(s) after bloom has ended and bees are no longer present. Apply Admire Pro via drip or trickle chemigation or in a soil drench in a minimum of 500 gallons of water per acre. Do not apply pre-bloom or during bloom or when bees are actively foraging.

Phytophthora Root Rot

Ridomil Gold EC is labeled for control of *Phytophthora* root rot on raspberries. The label reads: “Apply 1/4 pt per 1,000 linear feet of row to the soil surface in a 3-foot band over the row. Make one application in the spring and another in the fall after harvest. Use the formula in the General Information section of this label to calculate the amount of Ridomil Gold EC needed per acre. Note: Do not apply Ridomil within 45 days before harvest or illegal residues may result.” See the label for more detailed information.

Aliette 80WDG is registered for control of *Phytophthora* root rot on caneberries (raspberry and blackberry). The label recommendation reads: “Begin foliar sprays (5 lb/acre) in the spring after bud break (1-3 inches new growth) and continue spraying on a 45-60 day schedule, up to a maximum of four (4) sprays during the growing season. Do not apply Aliette within 60 days of harvest.”

Phosphorous acid (Agri-Fos) is registered for control of root rot on brambles. It has essentially the same active ingredient as Aliette. See label for use recommendations.

Rosette or Double Blossom

Rosette is caused by the fungus, *Cercospora rubi*. It is a serious disease of blackberry in the southern regions of the Midwest (Kentucky, Missouri, and Arkansas). At present, Abound is the only fungicide currently labeled for control of this disease on blackberry. It is probable that the other strobilurin fungicides (Cabrio and Pristine) will also provide some level of control. In the past, chemical control of this disease under conditions of heavy pressure has not been highly successful. One possible cultural practice for an infected site is to mow the planting down before flowering to eliminate spore release and infection of emerging primocanes. Though sacrificing one year of production, the practice may provide short-term control. Evidence indicates that only the cultivars Navaho and Arapaho appear to have resistance/tolerance to this fungus. Other cultivars differ in susceptibility, but all will become infected over time. For additional information on Rosette, contact your local Extension office.

Captan Use on Brambles

Federal registration for use of Captan fungicide on caneberries (raspberry and blackberry) was suspended in 1989. In 2003, the Captan 80WDG formulation received federal registration for use on brambles, and the re-entry interval (REI) on the new label was reduced from four days to three days (72 hours). The pre-harvest interval (PHI) for Captan on caneberries is three days. Recently, the registration for several other formulations of Captan (Captan 50W, Captan 80W, Captan 4L, and Captec 4L) have also changed. Caneberries have been added to the label and the REI is reduced from four to three days. The PHI on all Captan formulations on caneberries is still three days.

Growers need to be aware that some companies have received federal registration for their specific formulations of Captan, while others have not. All 80WDG products should have the new registration. Formulations of Captan 50W, Captan 80W, and Captan 4L from the Drexel company all have the new registration. MICROFLO'S Captec 4L formulation has the new registration, but its Captan 50W and Captan 80W do not.

The bottom line is that growers who wish to use Captan on caneberries need to read the label of the material they plan to purchase to make sure it is registered on caneberries. Old products may not have caneberries on the label. Ohio has a 24(c) Special Local Needs registration for use of MICROFLO'S formulation of Captan 50W and Captan 80W. The registration is only for Ohio, and the 24(c) label must be in the user's hand at the time of application. These 24(c) labels may be useful to Ohio growers who have old products they need to use. For information on how to obtain a label in Ohio, contact Mike Ellis at (330) 263-3849 or ellis.7@osu.edu.

Fungicide Resistance Management

Elevate, Rovral, Switch, and Pristine should not be used alone for seasonlong control of *Botrytis* fruit rot because of the potential for pathogen strains to develop resistance to each fungicide. The addition (tank mix) of Captan to Elevate, Rovral, Switch, or Pristine should provide a higher level of disease control and aid in preventing fungicide resistance development. Rotating the use of these fungicides in one-two-spray blocks is a good resistance management strategy.

Nova, Cabrio, and Pristine for Control of Orange Rust

Based on information currently available on the disease cycle of orange rust, there appear to be two main periods during the growing season when fungicides should be effective to control the disease. Growers should review the

orange rust section in the *Midwest Small Fruit Pest Management Handbook* to become familiar with the disease cycle and cultural practices for disease control.

The first period is during the spring when aeciospores (bright orange spores) are being produced. Sprays at this time would control “localized” leaf infections and, therefore, teliospores would not be produced later in the growing season. The timing for these sprays would be from just before the aeciospores are released in the spring (generally early to mid-May) until the infected leaves die and dry up, and spores are no longer present (mid-June through mid-July). It is important to note that as temperatures get above 77°F, aeciospore germination is very slow, and disease development greatly reduced. In short, during the hot days of summer, infections should not be occurring.

The second period is during late summer or fall as temperatures decrease and the threat of “systemic” (teliospore) infections occurs. Even if complete control of early season aeciospore infections is achieved, some teliospores could still be blown into the planting from infected wild hosts. Nova, Abound, Cabrio, or Pristine applied on a 10-14 day schedule during these periods should be beneficial for control. In wet weather the shorter interval should be used. Nova should be alternated with either Cabrio or Pristine in the spray program in order to prevent fungicide resistance development. A good approach would be to alternate them in two-spray blocks. Do not apply more than two sprays without alternating to another class of fungicide. For the most current suggestions for timing fungicide applications for orange rust control, contact Mike Ellis at (330) 263-3849 or ellis.7@osu.edu.

Abound 2.08F

Abound 2.08F fungicide is registered for use on all brambles (blackberry and raspberry) for control of Botryosphaeria canker, anthracnose, powdery mildew, raspberry leaf spot, Septoria leaf spot on blackberry, Colletotrichum rot, spur blight, and rosette or double blossom of blackberries. Abound or any other strobilurin fungicide (Cabrio or Pristine) cannot be applied more than three times per season. It cannot be applied in more than two sequential sprays without alternating to another fungicide with a different class of chemistry. It has a 12-hour re-entry interval and can be applied on the day of harvest.

Cabrio 20EG

Cabrio 20EG fungicide is registered for use on all brambles (blackberry and raspberry) for control of anthracnose, leaf spot and blotch, powdery mildew, rusts, and spur blight. It is a strobilurin fungicide and has good activity against these diseases. It cannot be applied more than four times per season and cannot be applied in more than two sequential sprays without alternating to another fungicide with a different class of chemistry. It has a 24-hour re-entry interval and a 0-day pre-harvest interval.

Pristine 38WG

Pristine 38WG fungicide is registered for use on all brambles (blackberries and raspberries) for control of anthracnose, Botrytis gray mold, leaf spots, powdery mildew, rust diseases, and spur blight. Pristine is a combination of two active ingredients (pyraclostrobin and boscalid). It cannot be applied more than four times per season and has a 0-day pre-harvest interval. Pyraclostrobin is the same class of chemistry as Cabrio (strobilurin) so Cabrio and Pristine should not be alternated with each other in a resistance management program. For control of rust diseases, Cabrio or Pristine should be alternated with Nova to prevent fungicide resistance development.

Raspberry Leaf Spot and Septoria Leaf Spot of Blackberry and Raspberry

The incidence of raspberry leaf spot and Septoria leaf spot appears to be increasing across the Midwest. If not controlled, they can result in severe defoliation of the plant. The strobilurin fungicides (Abound, Cabrio, Pristine) provide good control of both diseases. Abound is registered for control of raspberry leaf spot and Septoria leaf spot. Some fungicide trials have shown that Captan and Nova also provide some level of control. Post harvest (late season) applications are important for controlling these leaf diseases. Most defoliation resulting from these diseases occurs later in the season (post harvest).

Strawberry Spray Schedule

Early Spring (Pre-Bloom)			
Apply when new leaves are expanding and blossom buds are visible.			
Pest/Problem	Material	Rate/Acre	Comments
Leaf spot, Leaf scorch, Leaf blight, Powdery mildew, Anthracnose	Captan 50WP <i>or</i>	6 lb	The re-entry interval for Captan on strawberry is 24 hours. Always read the label. Captan has good activity against anthracnose and most leaf diseases, but will not control powdery mildew. Captan is also available as 80WDG and Captec 4L.
	Thiram 65WP <i>or</i>	5 lb	Thiram will not control powdery mildew.
	Nova 40WP <i>or</i>	2.5-5 oz	Nova is highly effective for control of powdery mildew and leaf blight.
	Procure 50WS <i>or</i>	4-8 oz	Procure is highly effective for control of powdery mildew only.
	Cabrio 20EG <i>or</i>	14 oz	Cabrio, Pristine, and Abound are registered for control of leaf spot, powdery mildew and anthracnose.
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Quintec 2.08F	10-14 fl oz	Quintec will control powdery mildew only and must be used in a protectant program.
Red stele			See comments on page 40.
Strawberry clipper (bud weevil)	Watch for clipper when flower buds start coming out of the crown and when temperatures approach 65°F. Treat if the number of clipped buds per meter of row is 3 or more primary buds or 30 or more secondary or tertiary buds. Infestations begin at field edge so border spray is often sufficient.		
	Lorsban 4EC	2 pt	
	Lorsban 75WG	1.33 lb	
	Brigade 10WP (WSB)	6.4-32 oz	
	Danitol 2.4EC	16-21.3 fl oz	
Spittlebug, Tarnished plant bug (adults)	If a problem, apply when buds first become visible, and make a second application just before the first bloom opens.		
	Endosulfan 50WP	2 lb	
	Endosulfan 3EC	2.6 pt	
	Sevin XLR (4EC)	1.5-2 qt	Other formulations may be available.
	Danitol 2.4EC	10.67 fl oz	
	Brigade 10WP (WSB)	6.4-32 oz	
Spider mites	Agri-mek 0.15EC	16 fl oz	
	Savey 50DF	4-6 oz	Savey kills eggs and young nymphs, not adults.
	Acramite 50WS	0.75-1.0 lb	
	Danitol 2.4EC	16-21.3 fl oz	
	Zeal 72WP	2-3 oz	Zeal is primarily an ovicide/larvicide and, if needed, should be used early in the season.
	Kelthane 50WP	1-2 lb	
	Kanemite 15SC	21-31 fl oz	
	Oberon 2SC	12-16 fl oz	

Early Bloom through Bloom			
Apply from 5-10% bloom until flowers have finished blooming.			
Pest/Problem	Material	Rate/Acre	Comments
Botrytis blossom blight and fruit rot	NOTE: The most critical period for control of Botrytis fruit rot with fungicides is during bloom.		
	Topsin M 70WSB <i>or</i>	1 lb	Never use Switch, Elevate, or Topsin M alone for seasonlong control of Botrytis because of the potential for pathogen strains to develop resistance. Switch provides excellent control of Botrytis fruit rot (gray mold) and has been reported to have good activity against anthracnose fruit rot.
	Elevate 50WG <i>or</i>	1.5 lb	
	Switch 62.5WG <i>or</i>	11-14 oz	
	Scala 5SC plus	18 fl oz	
	Captan 50WP <i>or</i>	4 lb	
	Thiram 65WP OR	4 lb	
	Captan 50WP <i>or</i>	6 lb	
	Thiram 65WP <i>or</i>	5 lb	
	CaptEvate 68WG <i>or</i>	3.5-5.25 lb	CaptEvate is a combination of Captan plus Elevate. At the high rate of CaptEvate, the amount of active ingredient of Captan and Elevate are equal to each product used alone.
Pristine 38WG	18.5-23 oz		
Powdery mildew, Leaf spot, Leaf blight, Leaf scorch	Nova 40WP <i>or</i>	2.5-5 oz	Nova is very effective for control of powdery mildew and Phomopsis leaf blight. Leaf spot is also listed on the label. Nova is not effective for control of Botrytis fruit rot (gray mold).
	Procure 50WS <i>or</i>	4-8 oz	Procure controls powdery mildew only.
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	Abound is registered for control of powdery mildew and anthracnose.
	Cabrio 20EG <i>or</i>	14 oz	Cabrio is registered for control of leaf spot, powdery mildew, and anthracnose.
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Quintec 2.08F	10-14 fl oz	Quintec will control powdery mildew only and must be used in a protectant program.
Anthracnose	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Switch 62.5WG <i>or</i>	11-14 oz	
	Captan 50WP OR	6 lb	
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	

Pest/Problem	Material	Rate/Acre	Comments
Anthracnose (continued)	Switch 62.5WG plus	11-14 oz	
	Captan 50WP	6 lb	Under heavy disease pressure for anthracnose all fungicides should be combined with Captan. The use of Captan close to harvest may result in visible fungicide residues on the fruit and should be avoided.
Insects	Save the bees! Do not apply insecticides during bloom.		

Post-Bloom to Harvest

Apply every 7-10 days as needed.

Pest/Problem	Material	Rate/Acre	Comments
Botrytis fruit rot	Same as early bloom through bloom. See note on visible fungicide residue on fruit.		A good layer of straw mulch will reduce berry contact with soil and lessen fruit rot problems, especially leather rot. The wetter the season, the more necessary it is to maintain a thorough spray program. The use of Captan, Thiram or CaptEstate close to harvest may result in visible fungicide residues on the fruit. Close to, or during, harvest when visible residues are a concern, use Topsin M, Elevate, Switch, or Pristine alone. This should result in little or no visible residues.
Anthracnose	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Switch 62.5WG <i>or</i>	11-14 oz	
	Captan 50WP OR	6 lb	
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Switch 62.5WG plus	11-14 oz	
	Captan 50WP	6 lb	Under heavy disease pressure for anthracnose all fungicides should be combined with Captan.
Leather rot	Ridomil Gold EC <i>or</i>		
	Aliette 80WDG <i>or</i>		See note on page 40 for rates and timing.
	Phosphorous acid <i>or</i>		
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG	18.5-23 oz	

Strawberry (continued)
Post-Bloom to Harvest (continued)

Pest/Problem	Material	Rate/Acre	Comments
Leaf spot, Leaf blight, Leaf scorch, Powdery mildew	Nova 40WP <i>or</i>	2.5-5 oz	Nova is very effective for control of powdery mildew and Phomopsis leaf blight. Leaf spot is also listed on the label. Nova is not effective for control of Botrytis fruit rot (gray mold).
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Quintec 2.08F	10-14 fl oz	Quintec will control powdery mildew only and must be used in a protectant program.
Anthracnose fruit rot			See comments on page 41.
Spittlebug, Tarnished plant bug (nymphs)	Make every effort to protect bees by spraying when bees are not active. Follow all harvest restrictions.		
	Endosulfan 50WP	2 lb	
	Endosulfan 3EC	2.6 pt	
	Danitol 2.4EC	10.67 fl oz	
	Brigade 10WP (WSB)	6.4-32 oz	
	Provado 1.6F	3.75 fl oz	Provado is for spittlebug control only.
	Sevin XLR (4EC)	1.5-2 qt	Other formulations may be available.
Leafroller	Brigade 10WP (WSB)	6.4-32 oz	
	SpinTor 2SC	4-6 fl oz	
	Entrust 80WP	1.25-1.5 oz	
	Bt (<i>Bacillus thuringiensis</i>)		See Table 10 on page 47 for a list of products that contain <i>Bacillus thuringiensis</i> ; see individual product labels for rates and application details.
Strawberry sap beetle	As an alternative to insecticides, to control sap beetle during harvest, use bait buckets containing over-ripe fruit placed in field between berry patch and wooded area.		
	Brigade 10WP (WSB)	6.4-32 oz	Brigade has a 0-day pre-harvest interval.
	Danitol 2.4EC	16-21.3 fl oz	Danitol has a 2-day pre-harvest interval.
Slugs	Broadcast baits before berries form, or apply to soil surface in band between rows after berries form. Best if applied in the evening after rain or irrigation.		
	Deadline MP's (4% bait)	10-40 lb	
	Prozap Snail and Slug AG (3.5% bait)	12-39 lb	
	Sluggo	24-44 lb	
Strawberry rootworm (adult beetles)			No insecticides are labeled for this pest. Insecticides used for control of other strawberry pests are likely to control this pest as well. This pest builds up in perennially grown strawberries, not those replanted yearly and grown on plastic mulch.

Harvest

Apply during fruit harvest season.

Pest/Problem	Material	Rate/Acre	Comments
Botrytis fruit rot	If wet weather persists and fungicide is required for control of Botrytis fruit rot, these fungicides should be effective. NOTE: If Botrytis is controlled effectively during bloom, the need for additional fungicide applications during harvest is greatly reduced or eliminated. Due to the relatively high application rates, the use of Captan and Thiram immediately prior to or during harvest may result in unsightly residues on fruit. Thus, their use at this time is discouraged. In addition, other use restrictions apply. Always read the label.		
	Topsin M 70WSB <i>or</i>	0.75-1 lb	Topsin M has a 1-day PHI.

Pest/Problem	Material	Rate/Acre	Comments
Botrytis fruit rot (continued)	Elevate 50WG <i>or</i>	1.5 lb	Elevate has a 0-day PHI.
	Switch 62.5WG <i>or</i>	11-14 oz	Switch has a 0-day PHI.
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Scala 5SC OR	18 fl oz	
	Topsin M 70WSB <i>or</i>	0.75-1 lb	Topsin M, Elevate, or Switch should not be used alone in repeated sprays due to the potential for fungicide resistance development.
	Elevate 50WG <i>or</i>	1.5 lb	
	Switch 62.5WG <i>or</i>	11-14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Scala 5SC plus	18 fl oz	
	Captan 50WP	2-4 lb	The addition of Captan should result in a higher level of disease control; however, Captan used at higher rates and closer to harvest may leave visible residues on fruit.
Anthracnose	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Switch 62.5WG <i>or</i>	11-14 oz	
	Captan 50WP OR	6 lb	
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Cabrio 20EG <i>or</i>	14 oz	
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Switch 62.5WG plus	11-14 oz	
	Captan 50WP	6 lb	The addition of Captan should result in a higher level of disease control; however, Captan used at higher rates and closer to harvest may leave visible residues on fruit.
Leather rot			See comments on page 40.

Post Harvest and New Plantings

Apply every 10-14 days as needed.

Pest/Problem	Material	Rate/Acre	Comments
Leaf spot, Leaf scorch, Leaf blight	It is important to maintain good functional foliage on the plants until late fall. Especially during wet seasons, leaf diseases can increase, resulting in weak plants and increased primary inoculum for the next season. Extra fungicide sprays after harvest may be required.		
	Captan 50WP <i>or</i>	6 lb	
	Thiram 65WP <i>or</i>	5 lb	
	Topsin M 70WSB	0.75-1 lb	

Pest/Problem	Material	Rate/Acre	Comments
Leaf blight, Leaf spot, Leaf scorch, Powdery mildew	Nova 40WP <i>or</i>	2.5-5 oz	Nova is very effective for control of powdery mildew and Phomopsis leaf blight. Leaf spot is also listed on the label.
	Pristine 38WG <i>or</i>	18.5-23 oz	
	Abound 2.08F <i>or</i>	6.2-15.4 fl oz	
	Cabrio 20EG <i>or</i>	14 oz	
	Quintec 2.08F	10-14 fl oz	Quintec will control powdery mildew only and must be used in a protectant program.
White grubs	Admire 2F	16-24 fl oz	Admire and Platinum are for post harvest soil application on perennial strawberries during renovation.
	Admire Pro	7-10.5 fl oz	
	Platinum 2SC	5-12 oz	
Insects in new plantings, including strawberry root weevils			See comments on page 41.
Leather rot, Red stele			See comments on page 40.

Special Comments on the Strawberry Schedule

Leather Rot and Red Stele Control

Ridomil is labeled for control of red stele (caused by *Phytophthora fragariae*) and leather rot (caused by *Phytophthora cactorum*). The label for perennial strawberries reads: “Established Plantings: Apply Ridomil Gold EC at 1 pt per treated acre in sufficient water to move the fungicide into the root zone of the plants. Make one application in the spring after the ground thaws and before first bloom. A second application may be applied after harvest in the fall. For supplemental control of leather rot, an application may be made during the growing season at fruit set. Use sufficient water to move the Ridomil into the root zone. For banded applications, a 12-inch band is recommended. Use the formula in the General Information section of this label to determine the amount of Ridomil needed per acre. Note: To avoid possible illegal residues, do not use more than a total of 1 1/2 qt Ridomil Gold EC per acre on strawberries per year.”

Aliette is labeled for control of red stele and leather rot. For red stele it is labeled for use as a dip (before planting) or as a foliar spray. Dip: Use 2.5 lb per 100 gallons of water. Apply as a pre-plant dip to strawberry roots and crowns for 15 to 30 minutes. Plant within 24 hours after dipping. Foliar: Apply 2.5-5 lb/A. Apply as a foliar spray in the spring when plants start active growth. If disease conditions persist or reoccur, make additional applications at 30 to 60 day intervals. For leather rot, apply 2.5-5 lb/A, as a foliar spray between 10% bloom and early fruit set, and continue on a seven- to 14-day interval as long as conditions are favorable for disease development. Applications can be made the same day as harvest (PHI=0 days). Do not exceed 30 lb of product per acre per season.

Phosphorous acid (Agri-Fos) is labeled for control of red stele and leather rot on strawberries. This material has essentially the same active ingredient as Aliette and the use recommendations for red stele and leather rot are very similar to those of Aliette; however, Aliette is a wettable powder and Agri-Fos is a liquid. Agri-Fos is recommended at the rate of 1.25 qt/A in 90 gallons of water or 2.5 qts/A in 200 gallons of water. For red stele, first treatment is made during spring growth flush, and treatment is repeated at one- to two-month intervals as needed. For leather rot, apply at 10% bloom and early fruit set, then at one-to two-week intervals as required for disease control. Several phosphorous acid fungicides are currently being registered for use on several crops in the United States, and others will probably be registered for use on strawberry.

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

Anthracnose Fruit Rot Control

Anthracnose can be a severe disease attacking both green and ripe (red) strawberry fruit. The disease is favored by high temperatures accompanied by rainfall prior to, and during harvest. If anthracnose was a problem in the planting during the previous growing season or is detected in the planting during the current growing season, growers may want to consider an intensified fungicide spray program. Abound 2.08F, Cabrio 20EG, and Pristine 38WG fungicides are registered for control of anthracnose and powdery mildew. All of these fungicides are reported to have good to excellent activity against anthracnose and are the fungicides of choice for anthracnose control. All fungicides are at risk for fungicide resistance development in the fungi that cause powdery mildew and anthracnose. In order to prevent or delay the development of fungicide resistance, none of these fungicides should be applied more than four times per season or in more than two sequential sprays without alternating to a fungicide in a different class of chemistry. Abound, Cabrio, and Pristine are all in the same class of chemistry (strobilurins) and cannot be alternated with each other as a fungicide resistance management strategy. Captan is the old standard material for anthracnose control, but is not as effective as Abound, Cabrio, or Pristine. Switch fungicide is also reported to have some activity against anthracnose. Therefore, Captan or Switch should be alternated with Abound, Cabrio, or Pristine. Under heavy disease pressure, growers should consider using a combination (tank mix) of Abound, Cabrio, or Pristine plus Captan for control of anthracnose fruit rot. These materials must be used in a protectant program. Once the disease is present in the field it is difficult to control with fungicides.

Strawberry Root Weevil or Black Vine Weevil

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

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

Ohio has a 24(c) special local needs label for carbofuran (Furadan 4F) on strawberries. In younger plants, Furadan can be applied after harvest but before September 1. One application per season is allowed, at a rate of 4 pt/A. Furadan kills the adults before eggs are laid and kills any larvae. It is most effective at reaching larvae if irrigated (or rained in) after application. No berries should be present at the time of treatment; the plants may be mowed before application to remove remaining berries.

Potato Leafhopper

Strawberry foliage can be damaged by adult potato leafhoppers that feed in the crop for a short time, then leave. Damaged leaves become crinkled and turn yellow to brown at the margins. Damage is often detected after leafhoppers have left the field. If infestations are detected, carbaryl (Sevin) is labeled for control of this pest. Brigade, Danitol, Diazinon, Lannate, and Endosulfan do not list leafhoppers on their labels but should also provide control.

Eastern Flower Thrips

Eastern flower thrips cause small, seedy fruit with a rubbery texture and poor color. We recommend that growers inspect the early blossoms on early varieties for the presence of thrips. Although an exact threshold is unknown for Midwest conditions, data from elsewhere suggest that control is warranted if thrip counts exceed 2 to 10 per blossom. This is a wide range, but more precise information is not available. Endosulfan, Lorsban, Brigade, Danitol, Entrust, or SpinTor are likely to work well. Growers may also want to consider using insecticides containing neem extracts (Aza-Direct or Neemix) that are less toxic to bees.

Cyclamen Mites

Use Endosulfan one to two days before bloom and again 10 to 14 days later. Apply 4 lb of Endosulfan 50W or 2.7 qts of Endosulfan 3EC in the first application and 2 lb of 50W or 1.3 qts. 3EC in the second. It is not effective if delayed until midsummer.

Another option is Kelthane 50WP used at 3-4 lb/A.

Table 5. Disease Resistance of Strawberry Cultivars Commonly Grown in the Midwest

Cultivar	Verticillium wilt	Red stele	Leaf disease ¹	Powdery mildew	Sinbar sensitivity ²
Junebearing					
Allstar	R-T ³	R	T	T	NS
Annapolis	I	R	S	S	VS
Brunswick	U	U	U	U	U
Cabot	U	R	T	U	U
Cavendish	I	R	PR	S	S
DarSelect	U	U	T	U	U
DelMarvel ⁴	R	R	R	U	U
Earliglow	R	R ⁵	R	PR	NS
Eros	S	R	U	U	U
Evangeline	U	S	U	R	U
Guardian	R	R ⁵	R	S	VS
Honeoye	S	S	PR	T	MS
Jewel	S	S	PR	R	U
Kent	S	S	S	T	VS
Latestar	R	R	R	U	U
Lester	S	R	R	T	U
Mesabi	R	R	R	R	U
Mira	U	R	S	R	U
Noreaster	R	R	I	S	U
Ovation	U	U	U	U	U
Primetime	R	R	R	U	U
Redchief	PR	R ⁵	R	R	U
Seneca	S	S	U	U	U
Surecrop	R	R ⁵	R	U	U
Wendy	U	U	U	U	U
Winona	T	R	R	U	U
Day Neutral					
Tribute	PR	R	T	R	VS
Tristar	R	R	T	R	VS
Seascape	U	U	U	U	U
Plasticulture System⁶					
Camarosa	U	U	S	S	U
Chandler	U	S	S	S	U
Sweet Charlie ⁴	U	U	U	U	U

Rating: I=intermediate; PR=partially resistant; R=resistant; S=susceptible; T=tolerant; U=unknown.

¹Includes leaf spot and leaf scorch.

²Cultivar sensitivity to Sinbar herbicide. Rating: VS=very sensitive, S=sensitive, MS=moderately sensitive, SS=slightly sensitive, NS=not very sensitive.

³Resistant characteristics of the cultivar usually preclude the need for other controls.

⁴Del Marvel and Sweet Charlie have been reported to have good field resistance to anthracnose fruit rot.

⁵Resistant to several races of the red stele fungus.

⁶Plasticulture production is primarily for southern areas of the Midwest.

Ratings according to the Penn State *Commercial Berry Production and Pest Management Guide*, 2002-2004.

See expanded table in the *Midwest Small Fruit Pest Management Handbook*.

Table 6. Fungicide Effectiveness for Strawberry Disease Control

Fungicide	Phomopsis leaf blight	Leaf spot	Powdery mildew	Gray mold	Leather rot	Anthracnose fruit rot
Abound	?	?	+++	++	+++	+++
Aliette	0	0	0	0	+++	0
Cabrio	?	++	+++	++	+++	+++
Captan	++	++	0	++	+	++
CaptEbate	++	++	0	+++	+	++
Elevate	0	0	0	+++	0	0
Nova	+++	++	+++	0	0	0
Phosphorous acid	0	0	0	0	+++	0
Pristine	?	++	+++	++	+++	+++
Procure	?	?	+++	0	0	0
Quintec	0	0	+++	0	0	0
Ridomil	0	0	0	0	+++	0
Scala	0	0	0	+++	0	0
Switch	0	0	0	+++	0	++
Topsin M ¹	++	++	+++	+++	0	0
Thiram	++	++	0	++	+	+

Efficacy rating system: +++=highly effective; ++=moderately effective; +=slightly effective; 0=not effective; ?=activity unknown.

¹Never apply Topsin M alone. Always apply in combination with an unrelated fungicide such as Captan or Thiram.

Table 7. Effectiveness of Pesticides for Control of Strawberry Insects and Mites

CHEMICAL	Clipper	Cyclamen mite	Leafhoppers	Leafrollers	Root weevils	Rootworms	Slugs	Sap beetles	Spider mites	Spittlebug	Tarnished plant bug	White grubs
Acramite	-	-	-	-	-	-	-	-	+++	-	-	-
Admire	-	-	-	-	-	-	-	-	-	-	-	+++
Agri-mek	-	-	-	-	-	-	-	-	+++	-	-	-
Brigade	+++	-	++	-	-	-	-	+++	+	+++	+++	-
Danitol	-	-	++	-	-	-	-	++	+	+++	+++	-
Diazinon	-	-	+	++	+	-	-	++	-	++	+	++
Dibrom	-	-	-	-	-	-	-	++	-	-	-	-
Endosulfan (Thiodan)	-	+++	+	-	-	-	-	+	-	+++	+++	-
Intrepid	-	-	-	++	-	-	-	-	-	-	-	-
Kanemite	-	-	-	-	-	-	-	-	++	-	-	-
Kelthane	-	++	-	-	-	-	-	-	+	-	-	-
Lannate	-	-	+	-	-	-	-	-	-	++	-	-
Lorsban	+++	-	-	-	-	-	-	-	-	-	-	-
Malathion	-	-	-	-	-	-	-	+	-	-	++	-
Metaldehyde	-	-	-	-	-	-	++	-	-	-	-	-
Oberon	-	-	-	-	-	-	-	-	++	-	-	-
Provado	-	-	++	-	-	-	-	-	-	-	-	-
Savey	-	-	-	-	-	-	-	-	+++	-	-	-
Sevin	-	-	++	+	-	-	-	-	-	++	-	-
Sluggo	-	-	-	-	-	-	+++	-	-	-	-	-
Spin Tor	-	-	-	++	-	-	-	-	-	-	-	-
Vendex	-	-	-	-	-	-	-	-	+	-	-	-
Zeal	-	-	-	-	-	-	-	-	+++	-	-	-

Efficacy rating system: +++=Highly effective; ++=moderately effective; +=slightly effective; -= ineffective or not sufficient data.

Table 8. Fungicide Harvest Restrictions and Restricted-Entry Intervals (REI)

Trade Name	Common Name	Harvest Restrictions Days before harvest and limitations (Maximum amount/acre/season) ^a				REI ^b	FRAC ^c Code
		Grape	Blueberry	Brambles	Strawberry		
Abound	azoxystrobin	14*	0	0	0	12 hr	11
Adament	tebuconazole + trifloxystrobin	14*	-	-	-	24hr	11 3
Aliette	fosetyl-AL	15*	0*	60	0 (30 lb)	12 hr	33
Basic copper sulfate	copper sulfate	0	-	0	0	24 hr	M
Bayleton	triadimefon	14 (18 oz)	-	-	-	12 hr	3
Cabrio	pyraclostrobin	-	0 (56 oz)	0 (56 oz)	0 (56 oz)	24 hr	11
Captan	captan	0 (24 lb)	0 (70 lb)	3 ^d	0 (48 lb)	See note ^e	M
CaptEvate	captan plus fenhexamid	-	0 (21 lb)	0 (21 lb)	0 (21 lb)	24/72 hr ^e	M 17
Dithane M-45, others	mancozeb	66*	-	-	-	24 hr	M
Elevate	fenhexamid	0*	0	0	0*	12 hr	17
Elite	tebuconazole	14	-	-	-	12 hr	3
Endura	boscalid	14*	-	-	-	12 hr	7
Ferbam	carbamate	7	-	-	-	24 hr	M
Flint	trifloxystrobin	14*	-	-	-	12 hr	11
Indar	fenbuconazole	-	30	-	-	12 hr	3
JMS Stylet Oil	oil	0	-	-	0	12 hr	-
Nova	myclobutanil	14 (1.5 lb)	-	1 (10 oz)	1 (10 oz)	24 hr	3
Pristine	pyraclostrobin plus boscalid	14*	0*	0*	0*	24 hr	117
Procure	triflumizole	7 (32 oz)	-	-	-	24 hr	3
ProPhyt, Phostrol, Agri-Fos	phosphorous acid	0	0	0*	0	4 hr	33
Quintec	quinoxifen	14*	-	-	1*	12 hr	13
Ridomil	metalaxyl	-	-	45	*	12 hr	4
Ridomil Gold MZ	metalaxyl plus mancozeb	66	-	-	-	24 hr	4 M
Ridomil Gold Copper	matalaxyl plus copper	42	-	-	-	48 hr	4 M
Rovral	iprodione	7*	0*	0*	-	24 hr ^f	2
Rubigan	fenarimol	21 (19 oz)	-	-	-	12 hr	3
Scala	pyrimethanil	7	-	-	1	see note ^g	9
Sovran	kresoxim-methyl	14*	-	-	-	12 hr	11
Sulfur	sulfur	0	0	0	0	24 hr	M
Switch	cyprodinil plus fludioxonil	-	0 (56 oz)	0 (56 oz)	0 (56 oz)	12 hr	9 12
Topsin M	thiophanate	14 (4 lb)	-	-	1	see note ^h	1
Thiram	thiram	-	-	-	3	24 hr	M
Vanguard	cyprodinil	7*	-	-	-	12 hr	9

^aLimited number of applications allowed, or other restrictions apply. REFER TO LABEL DIRECTIONS.

- Not registered or recommended for the crop listed.

^aAmounts shown in parenthesis are the maximum amounts of the fungicide permitted per season.

^bAll fungicides have a Restricted-Entry Interval (REI). The restricted-entry interval is the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REI. Restrictions in REI may prohibit the use of certain pesticides during harvest.

^cFRAC code represents the mode of action of the fungicide.

^dSee comments on captan formulations and registrations on page 33.

^eCaptan 80WDG has a 3-day REI on grapes, raspberries, blackberries and blueberries. All captan formulations have a 24-hour REI on strawberries. CaptEvate has a 72-hour REI on blueberries and raspberries, and a 24-hour REI on strawberries.

^fREI for Rovral is 48 hours on grapes.

^gREI for Scala is 24 hours on grapes, 12 hours on strawberries.

^hREI for Topsin M is 7 days on grapes.

Note on Fungicide Resistance Management

Plant pathogenic fungi have been known to develop resistance to fungicides after repeated exposure. For fungicide resistance management, avoid successive applications of fungicides within the same group or type of chemistry. The Fungicide Resistance Action Committee codes (FRAC codes) listed in Table 8 identify the various fungicide mode of action groups. Rotating to fungicides with a different FRAC code should help avoid development of fungicide resistance in pathogenic fungi.

Strobilurin Fungicides include: azoxystrobin (Abound); pyraclostrobin (Cabrio, Pristine); trifloxystrobin (Flint); and kresoxim-methyl (Sovran).

Sterol Inhibiting Fungicides include: triadimefon (Bayleton); tebuconazole (Elite); myclobutanil (Nova); triflumizole (Procure); and fenarimol (Rubigan).

Benzimidazole Fungicides include: thiophanate-methyl (Topsin M, T methyl).

The following fungicides are also at risk for resistance development: fenhexamide (Elevate); boscalid (Endura); metalaxyl (Ridomil); iprodione (Rovral); cyprodinil (Vangard, Switch); and pyrimethanil (Scala).

The following materials are broad spectrum protectant fungicides and are not considered to be at risk for resistance development: captan (Captan); mancozeb (Dithane, Manzate, Penncozeb); carbamate (Ferbam); thiram (Thiram); ziram (Ziram); fixed copper (several trade names); and sulfur.

Table 9. Insecticide and Miticide Harvest Restrictions and Restricted-Entry Intervals

Consult product label for complete restrictions and limitations.

Trade Name	Common Name	Harvest Restrictions Days before harvest and limitations				REI ^a	FRAC ^b Code
		Grape	Blueberry	Brambles	Strawberry		
Acramite	bifenazate	14	-	-	1	12hr/5days	25
Actara	thiamethoxam	-	3	-	3	12 hr	4A
Admire	imidacloprid	30	7	7	14	12 hr	4A
Agri-mek (RUP)	abamectin	28	-	-	3	12 hr	6
Applaud	buprofezin	30	-	-	-	12 hr	16
Asana (RUP)	esfenvalerate	-	14	7	-	12 hr	3
Assail	acetamiprid	7	-	-	-	12 hr	4A
Avaunt	indoxacarb	7	-	-	-	12 hr	22
Baythroid	cyfluthrin	3	-	-	-	12 hr	3
Brigade (RUP)	bifenthrin	-	-	3	0	12 hr	3
Capture (RUP)	bifenthrin	30	-	3	-	12 hr	3
Clutch	clothianidin	0	-	-	-	12 hr	4A
Confirm	tebufenozide	-	14	14	-	4 hr	18A
Danitol (RUP)	fenpropathrin	21	3	-	2	24 hr	3
Deadline	metaldehyde	0	0	0	0	12 hr	-
Delegate	Spinetoram	7	3	1	-	12hr	5
Diazinon (RUP)	diazinon	28	7	-	5*	24 hr	1B
Dibrom	naled	3	-	-	1	48/72 hr	1B
Discipline (RUP)	bifenthrin	-	-	3	-	12 hr	3
DiPel ^c	<i>B. thuringiensis</i> ^c	0	0	0	0	4 hr	11 B2
Endosulfan	endosulfan	7	*	-	4*	24-48 hr	2A
Entrust	spinosad	7	3	1	1	4 hr	5
Envidor	spiroticlofen	14	-	-	-	12 hr	23
Esteem	pyriproxyfen	-	7	-	-	12 hr	7C
Fujimite	fenpyroximate	14	-	-	-	12 hr	21
Guthion (RUP)	azinphosmethyl	-	7	-	-	7 days*	1B
Imidan	phosmet	7/14	3	-	-	24 hr/14 days	1B
Intrepid	methoxyfenozide	30	-	-	-	4 hr	18A
Kanemite	acequinocyl	-	-	-	1	12 hr	20B
Kelthane	dicofol	7	-	-	3	48 hr	UN
Lannate* (RUP)	methomyl	1/14*	3	-	3/10*	48 hr/7 days*	1A
Lorsban (RUP)	chlorpyrifos	35*	-	-	21*	24 hr	1B
Malathion	malathion	3*	1*	1	3	12-24 hr	1B
Mustang Max (RUP)	<i>zeta-cypermethrin</i>	1	1	1	-	12 hr	3
Mycotrol	<i>Beauveria</i>	0	0	0	0	12 hr	-
Neemix, Aza-Direct	azadirachtin	0	0	0	0	4 hr	18B
Oberon	spiromesifen	-	-	-	3	12 hr	23
Nexter, Pyramite	pyridaben	7	-	-	-	12 hr	21
Platinum	thiamethoxam	60	75	-	50	12 hr	4A
Provado	imidacloprid	0	3	-	7	12 hr	4A
Pyganic	pyrethrins	0	0	0	0	12 hr	3
Pyronyl, Pyreth-It	pyrethrins plus piperonyl butoxide	0	0	0	0	12 hr	3 27A
Radiant	thiamethoxam	-	-	-	1	4 hr	5
Renounce	cyfluthrin	3	-	-	-	12 hr	3

(Table 9 continued)

Rotenone	rotenone	1	1	1	1	12 hr	21
Savey	hexythiazox	-	-	3	3	12 hr	10A
Sevin	carbaryl	7 ^d	7 ^d	7 ^d	7 ^d	12 hr	1A
Sluggo	iron phosphate	0	0	0	0	0 hr	-
SpinTor	spinosad	7	3	1	1	4 hr	5
Surround	kaolin	0	0	0	-	4 hr	-
Vendex (RUP)	fenbutatin-oxide (hexakis)	28*	-	-	1*	48 hr	12B
Venom	dinotefuran	1/28	-	-	-	12 hr	4A
Zeal	etoxazole	14	-	-	1	12 hr	10B

- Not registered or recommended for the crop.

*Harvest restrictions, use limitations or restricted entry intervals vary by crop, crop use, rate, or formulation. See product label for details. RUP=Restricted Use Pesticide. A license is required to purchase and apply. Record keeping is mandatory. Check with your state regulatory agency for details.

^aAll insecticides have a Restricted-Entry Interval (REI). The restricted-entry interval is the time immediately after a pesticide application when entry into the treated area is limited. Check labels for REI and Personal Protection Equipment (PPE) required for early re-entry. Restrictions in REI may prohibit the use of certain pesticides during harvest.

^bIRAC code represents the mode of action of the insecticide.

^cProducts that contain *Bacillus thuringiensis* for the control of caterpillars include Agree, Biobit, CryMax, DiPel, Javelin, Lepinox, and XenTari.

^dNo more than 5 sprays of Sevin per season, no closer than 7 days apart.

Note on Insecticide Resistance Management

Insects have been known to develop resistance to insecticides after repeated exposure. For insecticide resistance management, avoid successive applications of insecticides within the same group or type of chemistry. The Insecticide Resistance Action Committee codes (IRAC codes) listed in Table 9 identify the various insecticide mode of action groups. Rotating to insecticides with a different IRAC code should help avoid development of insecticide resistance.

Table 10. Generic Insecticides

Common name	Original brand name (and manufacturer)	Other brand names (and manufacturers)
abamectin	Agri-Mek 0.15EC (Syngenta)	Abba 0.15EC (Makhteshim) Epi-Mek 0.15EC (Syngenta) Reaper 0.15EC (UAP) Zoro (Cheminova)
<i>Bacillus thuringiensis</i>	Dipel (Abbott / Advan)	Agree (Advan) Biobit (Valent) CryMax (Advan) Deliver (Advan) Javelin (Advan) Lepinox (Advan) Xentari (Valent)
bifenthrin	Brigade 2EC and 10 WP (WSB) Capture 2EC (FMC)	Befenthrin 2EC Discipline 2EC (Amvac) Fanfare 2EC (Makhteshim) Sniper 2EC (UAP/Loveland) Tundra 2EC (Agrilience)
carbaryl	Sevin XLR 4EC (Bayer) Sevin 80S (Bayer)	Carbaryl 4L (UAP/Loveland; Drexel)
chlorpyrifos	Lorsban 4EC (Dow) Lorsban 50W (Dow)	Govern 4E (Tenkoz) Nufos 4E (Cheminova) Warhawk 4E ((UAP/Loveland) Whirlwind (Helena) Yuma 4E (Agrilience)
cyfluthrin	Baythroid and Renounce (Bayer)	Tombstone (UAP)
endosulfan	Thiodan 3EC (no longer made) Thiodan 50WP (no longer made)	Endosulfan 3EC (Drexel) Thionex 3EC (Makhteshim) Thionex 50W (Makhteshim)
esfenvalerate	Asana 0.66EC (DuPont)	Adjourn 0.66EC (Makhteshim)
imidacloprid	Provado 1.6F and 75W Solupak (Bayer) Admire 2F and Admire Pro (Bayer)	Couraze 1.6F, 75WP, 2F (Cheminova) Emida E-AG, 1.6F, 2F (Etigra) Impulse 1/6F (Albaugh) Macho 2F (Albaugh) Nuprid 1.6F, 2F (NUFARM) Pasada 1.6F (Makhteshim) Prey 1.6F (UAP/Loveland) Torrent 2F (Sipcam Agro) Widow (UAP)

Special Insect Pest Problems

Wasps in Fruit Plantings

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

Wasps are generally attracted to the juice and soft fruit. By far, the best key to prevention, or at least to reducing problems with wasps, is sanitation. Regular and thorough picking of all ripe fruit and fruit debris will aid in solving this problem. In addition, any item brought in by pickers that has food value (e.g., soft drinks, lunches, etc.) should be removed.

Periodical Cicadas

Periodical cicadas are orange to black, about 1 1/2 inches long, with black transparent wings, and appear from May to July. Annual or dog-day cicadas are larger, green to black, and appear each year from July to September. Ordinarily, annual cicadas do not cause much damage. Cicada males announce their presence to the voiceless females by making a continuous, high-pitched shrill sound. Vibrating membranes on the underside of the first abdominal segment produce the sound.

The total life cycle of the periodical cicada takes either 13 or 17 years. Otherwise, the two types have similar habits. The adult females lay eggs in rows in pockets that they cut in small branches and twigs of trees with their long, knife-like egg layer. Each female will make five to 20 of these pockets, laying 24 to 28 eggs in two rows in each pocket. The eggs hatch in six or seven weeks; the newly hatched nymphs fall to the ground and burrow until they find suitable roots, usually 1 1/2 to 2 feet beneath the soil. With their sucking mouth parts, they immediately begin to suck juices from the roots.

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

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

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

You can prevent egg-laying damage by cicadas on young fruit and ornamental trees by covering the tree with a protective netting such as cheesecloth. Cover the tree, and tie the netting to the trunk below the lower branches. Remove the covering when egg-laying is over. If netting is not an option, you may apply insecticides when egg-laying begins and repeat seven to 10 days later. Sevin is labeled for control of these insects.

Tree Crickets

Tree crickets are pests of caneberries, grapes, and blueberries. The important damage is caused by egg-laying in the canes or beneath the bark; nymphs and adults may also feed on foliage and ripening fruit. Egg-laying punctures weaken the plant. These pests are controlled by pruning and destroying damaged canes, or by spraying with carbaryl (Sevin).

Japanese Beetles

The Japanese beetle is an imported pest well known for its voracious appetite, extremely wide host range, and seemingly endless reproductive potential.

The life cycle of this insect is relatively simple. Beetles emerge from the ground in late spring, mate, lay eggs in grassy areas, and eat through midsummer. The eggs hatch into white grubs in mid- to late-summer. During the winter, the grubs burrow to below the frost line. The following spring, mature grubs burrow back to the surface, pupate, and emerge as adults.

These insects are not hard to kill, but control is often difficult because beetles continue to invade plantings for extended periods. Often, adults will be so plentiful that they fall in piles after a spray.

Expect to use as many as two to four additional insecticide applications the first two to three years your planting is attacked. In later years, after local predators and parasites have recognized the Japanese beetle as a food source, populations will decline. Of course, it is possible that this insect will never get to your area, or if it does get there it may not do well. However, if it does, you had best learn how to manage these insects because you will not kill all of them!

Chemical Weed Control in Small Fruit Crops

Controlling weeds in small fruit plantings is extremely important. Herbicides are very useful in small fruit plantings and substantially reduce labor costs. When herbicides are used properly, plant growth may be superior, and control over insects and diseases is facilitated as well. With the continued loss of herbicide registrations for the minor crops, which includes all small fruits, closer management of the planting must be maintained. Greater care with herbicide use and cultural procedures will be required.

Proper Application

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

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

Herbicides can injure fruit plants if used improperly. Therefore, sprayer adjustment and calibration should be as precise as possible to assure accurate and uniform applications. Use nozzles appropriate for herbicide application at low pressures (20-40 psi) on a fixed boom-type applicator. This type of sprayer is calibrated easily and, when designed properly, will deposit herbicide uniformly. Consider using one of the recently introduced low-drift nozzles such as the Turbo TeeJet Nozzle or the TurboDrop Nozzle. They have been designed to provide similar performance to traditional flat fan nozzles while reducing the number of very small droplets that are highly subject to drift. It is difficult to achieve a proper application of preemergent herbicides using backpack or hand sprayers.

Calibrate the sprayer carefully, and apply herbicides according to the suggested rates. Note that with many preemergent herbicides, rates should be adjusted according to soil characteristics. Generally, lower rates should be lower on sandy soils with low organic matter and higher rates on heavier textured soils and those high in organic matter. With some herbicides, no rate changes are suggested. If you are unsure about an herbicide's effectiveness or possible crop damage, test it on a small portion of the planting before using extensively. Continued use of the same herbicide can lead to resistance development in weeds, or the establishment of tolerant weeds. It is recommended that you do not use the same herbicide for more than two consecutive years to avoid resistance problems and improve weed control spectrum.

Site Preparation before Planting

Most perennial weeds cannot be controlled effectively in the spring before planting or once the crop is planted. Growers should strive to eradicate established perennials during site preparation in the previous season. Glyphosate (a nonselective systemic herbicide) products such as Roundup, Touchdown, and many other formulations, should be applied in the summer prior to planting when weeds are actively growing. Applying glyphosate just before harvesting winter wheat or rye (this is known as a pre-harvest treatment) is an excellent way to control creeping perennials such as Canada thistle and goldenrods. Treatments applied to stubble can also be highly effective. Fields that are in hay or pasture should be allowed to grow in the spring or fall until the grass is at least 8 inches tall. Ideally, perennial broadleaf weeds should be approximately at the bud to early flowering stage at the time of treatment. Summer and early fall applications of glyphosate may be more effective against perennial broadleaf weeds than spring applications. Allow five to seven days for glyphosate to translocate throughout the root system before plowing under. This should be followed by repeated shallow cultivations as green "flushes" of weed seedlings appear. An alternative is application of paraquat (Gramoxone) for contact nonselective weed control as flushes of weed seedlings appear.

Tank Mixes

Certain herbicides may be combined in suitable tank-mixes. Consult product labels for approved combinations and recommended rates. Do not use tank mixes that are not listed on the label. By using tank mixes, a preemergence herbicide can be applied together with a postemergence herbicide to provide improved weed control, or two preemergence herbicides may be applied at reduced rates, each to gain better weed control and reduce the risks of crop damage. **Always follow label recommendations.**

Active Ingredient (ai)

Herbicide labels list the chemical names of the active ingredients and the percentage or amount of the active ingredients as “ai.” Herbicides come in various formulations and under various trade names. For the sake of brevity, only one trade name is listed in this guide. Check if other trade names are available and compare costs per acre. Always read each label carefully as rates and labeled crops may differ between labels with similar active ingredients. Be sure to follow the recommended rates as they are listed on the label of the product you plan to use.

Use Restrictions

Herbicide use is controlled by federal regulations which prescribe the crops upon which the herbicides can be used and the timing and rates for which these materials are registered. Be sure to use only registered materials at the rates recommended. Herbicides are covered by Worker Protection Standards where they apply. Restricted-entry intervals (REI) and Personal Protective Equipment (PPE) information are included on product labels. *The product label is the final authority. Follow it carefully.*

Good Rules to Remember

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

Herbicide Recommendations for Grape

Weed Problem	Material & Rate/A	Comments and Limitations
Preemergence		
Annual and perennial grasses and broadleaves	Casoron 4G (granular) (dichlobenil 4% ai) at 100-150 lb	<p>Perennial weeds: Apply from Nov. 15 to Feb. 15 as a soil surface application at 150 lb. No need to remove old weed growth before application. Can also be applied in late fall or early spring before May 1 and incorporated immediately.</p> <p>Annual weeds: Apply in early spring after cultivation before weeds emerge. Rain or irrigation is needed for activation. A shallow incorporation is recommended. Apply 4 weeks after transplanting after soil has completely settled.</p>
Annual broadleaves and suppression of grasses	Chateau 51WDG (flumioxazin 51% ai) at 6-12 oz in 10-30 gal of water	<p>Do not apply after bloom unless with a hooded or shielded application. Apply alone preemergence or tank mix with Roundup or Gramoxone postemergence. Do not incorporate. Do not allow drift to contact foliage or green bark. Always add a crop oil at 1% v/v or nonionic surfactant at 0.25% v/v. Max. rate is 24 oz per season. Min. 30 days between applications. Chateau also has postemergence activity. PHI=60 days.</p> <p>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.</p>
Annual grasses and broadleaves	Devrinol 50DF (napropamide 50% ai) at 8 lb in min. 20 gal of water	<p>Apply from late fall prior to soil freeze-up, to early spring prior to weed emergence. If no rainfall of 1 inch or more occurs within 24 hours after treatment, cultivate or irrigate to activate. Apply alone to weed-free soil or in tank mix with Roundup or Gramoxone. Do not allow spray to contact fruit or foliage. PHI=35 days.</p>
Most broadleaves	Gallery 75DF (isoxaben 75% ai) at 0.66-1.33 lb in min. 10 gal of water	<p>Non-bearing only: May only be used on crops that will not be harvested within one year of application. Apply in late summer to early fall; or in early spring prior to weed germination or anytime immediately after cultivation. Do not apply to new transplants until soil has settled with no cracks present. Rainfall or irrigation of 0.5 inch is needed within 21 days of application. Not effective on germinated weeds. Min. 60 days between applications. Max. rate is 4 lb/A.</p>
Annual broadleaves and suppression of grasses	Goal 2XL (oxyfluorfen 2 lb ai/gal) at 5-8 pt in min. 10 gal of water Other names: Galigan, Goaltender, Oxiflo, others	<p>Dormant application only: Effective both preemergence (5-8 pt) and postemergence (2-8 pt) as a directed spray on weeds less than 4 inches. Do not apply from bud swell to harvest. Can be mixed with other preemergence herbicides, or with Roundup or Gramoxone. Max. rate is 8 pt per year.</p> <p>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.</p>
Annual grasses and broadleaves	Karmex 80DF (diuron 80% ai) at 2-6 lb in 25-40 gal of water Other names: Direx, Diuron	<p>Age restriction: Use on vineyards established at least 3 years and trunks at least 1.5 inches diameter. Apply as a directed spray to soil under trellis in early spring prior to weed germination. Max. 1 application per year. On soils low in organic matter (1-2%), severe injury may result if heavy rainfall occurs soon after treatment.</p>
Annual and perennial grasses and certain broadleaves	Kerb 50WP (pronamide 50% ai) at 2-8 lb in 40-50 gal of water	<p>Apply as a directed spray in the fall after harvest prior to soil freeze-up, or early winter when temperatures are below 55°F. Rainfall or irrigation are required to activate. Max. 1 application per year and 8 lb/A per year. Kerb also has early postemergence activity. Rate depends on soil texture.</p> <p>Restricted use pesticide.</p>

Weed Problem	Material & Rate/A	Comments and Limitations
Annual grasses and broadleaves	Princep 4L (simazine 4 lb ai/gal) at 2-4.8 qt in 25-40 gal of water Other names: Sim-Trol, Simazine	Age restriction: Apply to soil under trellis between harvest and early spring before weeds emerge. Use on vineyards established at least 3 years. Apply alone to weed-free soil or tank mix with Roundup or Gramoxone. Max. 1 application per year.
Annual grasses and certain broadleaves	Prowl 3.3EC, Prowl H ₂ O (pendimethalin 3.3 lb ai/gal) at 2.4 qt for short-term and 4.8 qt for long-term weed control in min. 20 gal of water Other names: Acumen, Helena Pendimethalin, others	Non-bearing only: May only be used on crops that will not be harvested within one year of application. Do not apply if buds have started to swell. May be applied preplant incorporated, preplant surface, or preemergence. For best results, rain or irrigation is needed within 21 days of application. Not effective on germinated weeds. Do not allow spray to contact leaves, shoots, or buds. For new plantings, do not apply until soil has settled and no cracks are present.
Annual grasses and certain broadleaves	Snapshot 2.5TG (isoxaben+trifluralin 2.5% ai) at 100-200 lb	Non-bearing only: May only be used on crops that will not be harvested within one year of application. Rainfall or irrigation of 0.5 inch is needed within 3 days of application. Not effective on germinated weeds. Min. 60 days between applications. Max. rate is 600 lb per year.
Annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (norflurazon 78.6% ai) at 1.25-5 lb in min. 20 gal of water	Apply as a directed spray to settled and firm soil from fall to early spring before weeds emerge. Rainfall or irrigation is needed within 4 weeks of application. Do not contact fruit or foliage. Do not apply after bud break on sandy loam soils. Check label for maximum amount allowed per year depending on soil type. Age restriction: Allow a minimum of 24 months after planting before first application. PHI=60 days.
Annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lb ai/gal) at 2-6 qt in 20-40 gal of water Other names: Oryzalin	Make a single band or broadcast application to the ground beneath vines before weeds emerge. Apply alone to weed-free soil or postemergence mixed with Roundup or Gramoxone. Min. 0.5 inch of rainfall or irrigation is required for activation. Min 2.5 months between applications. Max. rate is 12 qt per year.
Annual grasses and broadleaves	Treflan HFP 4EC (trifluralin 4 lb ai/gal) at 1-4 pt in 5-40 gal of water Other names: Trifluralin, Bayonet, others	In a new planting, apply 1-4 pt and incorporate within 24 hr. 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 hr. PHI=60 days.
Postemergence		
Annual broadleaves	Aim 2EC or Aim 2EW (carfentrazone 2 lb ai/gal) at 1-2 fl oz in 20 gal of water	Apply any time during the season. Always add nonionic surfactant at 0.5% v/v or crop oil at 1% v/v. Mix with Roundup or Gramoxone or labeled preemergence herbicides for broader weed control. Max. 7.9 fl oz per year. Min. 14 days between applications. PHI=3 days. Sucker management: Apply when suckers are green. Do not allow spray to contact desirable fruit, foliage, or green bark.
Annual broadleaves and yellow nutsedge	Basagran 4L (bentazon 4 lb ai/gal) at 1.5-2 pt in min. 20 gal of water	Non-bearing only: May only be used on crops that will not be harvested within one year of application. Apply as a directed postemergence spray. Include crop oil at 0.5% v/v. Avoid spraying stems, bark, or foliage. Max. 2 pt per application and 4 pt per season.

Herbicide Recommendations for Grape (continued)

Weed Problem	Material & Rate/A	Comments and Limitations
Most annual and perennial grasses	Fusilade DX 2EC (fluazifop-p 2 lb ai/gal) at 16-24 fl oz in 25 gal of water	Non-bearing only: May only be used on crops that will not be harvested within one year of application. Apply as a directed spray to actively growing grasses before tillering. Always add crop oil at 1% v/v or nonionic surfactant at 0.25% v/v. Avoid contact with foliage. Rainfast in 1 hour. Max. rate is 72 fl oz per year. Min. 5 days between applications. PHI=1 year.
Annual broadleaves	Goal 2XL	See "Preemergence" section above for details.
Most annual grasses and broadleaves and top kill of perennial weeds	Gramoxone Inteon 2L (paraquat 2 lb ai/gal) at 2.5-4 pt in min. 10 gal of water Other names: Firestorm	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 nonionic surfactant at 0.25% v/v or crop oil at 1% v/v. Best results with flat fan nozzles. Max. 5 applications per year. Sucker management: Apply when suckers are less than 8 inches tall. Do not allow spray to contact desirable fruit, foliage, or green bark. Restricted use pesticide.
Annual and perennial grasses	Poast 1.5EC (sethoxydim 1.5 lb ai/gal) at 1.5-2.5 pt in min. 5 gal of water	Apply as a directed spray to actively growing grasses before tillering. Always add crop oil at 1% v/v. Max. 2.5 pt per application and 5 pt per season. PHI=50 days.
Annual grasses and broadleaves	Reglone 2L (diquat 2 lb ai/gal) at 1.5-2 pt in min. 15 gal of water	Non-bearing only: May only be used on crops that will not be harvested within one year of application. Apply as a directed spray using a shield for contact burn of weeds. Complete coverage is essential for good control. Always use a nonionic surfactant at 0.5% v/v. Can be used during site preparation and up to 1 year of harvest. Do not allow contact with green stems, foliage or fruits. PHI=1 year.
Annual and perennial grasses and broadleaves	Rely 1L (glufosinate 1 lb ai/gal) at 3-6 qt in min. 20 gal of water	Age restriction: Do not apply within 1 year of transplanting. Apply as a directed spray to actively growing weeds. Do not apply on desirable foliage or drift on foliage, green, or uncalled bark of vines. Max. 18 qt per year for bearing and 12 qt per year for non-bearing grape. For spot application, mix 1.5-4 oz/gal. PHI=14 days. Sucker control: a split application approximately 4 weeks apart at 4 qt/acre is recommended or spot spray with 3 oz/gal of water. Suckers should not exceed 12 inches long.
Annuals and some perennial grasses and broadleaves	Roundup WeatherMax 5.5EC (glyphosate 5.5 lb ai/gal) at 0.5-5.3 qt in 10-40 gal of water Other names: Touchdown, Honcho, Rattler, others	Rate depends on weed species and stage of growth. See label for details. Apply as preplant broadcast application or in fall for control of roots and rhizomes of perennial weeds or as a directed spray or wiper application (20-100% solution) to actively growing weeds in established plantings. Always add ammonium sulfate 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. Does not provide residual control; can be mixed with labeled preemergence herbicides. PHI=14 days.
Annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lb ai/gal) at 3-10% spray 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 2EC (clethodim 2 lb ai/gal) at 6-8 fl oz Other names: Clethodim, Envoy	Non-bearing only: May only be used on crops that will not be harvested within one 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 nonionic surfactant at 0.25% v/v. Do not use crop oil. May be applied as a spot treatment at 0.32-0.64 fl oz per gal. Max. rate is 32 fl oz per year.

Herbicide Recommendations for Blueberry

Weed Problem	Material & Rate/A	Comments and Limitations
Preemergence		
Annual and perennial grasses and broadleaves	Casoron 4G (granular) (dichlobenil 4% ai) at 100-150 lb	Perennial weeds: Apply from Nov. 15 to Feb. 15 as a soil surface application at 150 lb. No need to remove old weed growth before application. Can also be applied in late fall or early spring before May 1 and incorporated immediately. Annual weeds: Apply in early spring after cultivation before weeds emerge. Rain or irrigation is needed for activation. A shallow incorporation is recommended. Apply 4 weeks after transplanting after soil has completely settled.
Annual grasses and broadleaves	Devrinol 50DF (napropamide 50% ai) at 8 lb in min. 20 gal of water	Apply from late fall prior to soil freeze-up to early spring prior to weed emergence. If no rainfall or 1 inch or more occurs within 24 hours after treatment, cultivate or irrigate to activate. Apply alone to weed-free soil or in tank mix with Roundup or Gramoxone. Do not allow spray to contact fruit or foliage. PHI=35 days.
Most broadleaves	Gallery 75DF (isoxaben 75% ai) at 0.66-1.33 lb in min. 10 gal of water	Non-bearing only: May only be used on crops that will not be harvested within 1 year of application. Apply in late summer to early fall; or in early spring prior to weed germination or anytime immediately after cultivation. Do not apply to new transplants until soil has settled with no cracks present. Rainfall or irrigation of 0.5 inch is needed within 21 days of application. Not effective on germinated weeds. Min. 60 days between applications. Max. rate is 4 lb/A.
Annual grasses and broadleaves	Karmex 80DF (diuron 80% ai) at 1.5-4 lb in 25-40 gal of water	Age Restriction: Use only in fields established at least 1 year. Apply as a band treatment at the base of bushes. Do not apply to exposed roots. For AR and MO only: Apply 1.5-2 lb in spring and repeat after harvest in the fall. Always add a nonionic surfactant at 0.25% v/v. For IN and OH only: Apply 2-4 lb in late spring. Alternatively, apply 2 lb in fall and repeat in spring.
Annual and perennial grasses and certain broadleaves	Kerb 50WP (pronamide 50% ai) at 2-4 lb in 20-50 gal of water	Dormant application only: Apply as a directed spray in the fall prior to soil freeze-up or early winter when temperatures are below 55°F. Best weed control results if followed by rainfall or irrigation. Max. 1 application per year and 4 lb/A per year. Do not apply to newly transplanted blueberries until roots are well established. Kerb also has early postemergence activity. Restricted use pesticide.
Annual grasses and broadleaves	Princep 4L (simazine 4 lb ai/gal) at 2-4 qt in min. 40 gal of water	Apply in spring before weeds emerge and before canes leaf out, or a split application 2 qt in spring plus 2 qt in fall. Do not apply when fruit is present, or illegal residues may result. For plants established less than 6 months, apply half the above rate.
Annual grasses and broadleaves	Sinbar 80WP (terbacil 80% ai) at 3 lb in min. 25 gal of water	Age restriction: Use only on plantings established at least 1 year. Best results when applied shortly before or after weed emergence. Avoid contact of foliage or fruit with spray or mist. Apply either in the spring or after harvest in the fall before weeds emerge or during early stage of seedling regrowth. Do not use on soils where roots are exposed.
Annual grasses and certain broadleaves	Snapshot 2.5TG (isoxaben+trifluralin 2.5% ai) at 100-200 lb	Non-bearing only: May only be used on crops that will not be harvested within one year of application. For best results, 0.5 inch of rain or irrigation is needed within 3 days of application. Not effective on germinated weeds. Min. 60 days between applications. Max. rate is 600 lb per year.

Weed Problem	Material & Rate/A	Comments and Limitations
Annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (norflurazon 78.6% ai) at 2.5-5 lb in min. 20 gal of water	Apply as a directed spray to settled and firm soil from fall to early spring before weeds emerge. Rainfall or irrigation of 0.5 inch is needed within 4 weeks. Do not contact fruit or foliage. Do not apply after bud break on sandy loam soils. Check label for maximum amount allowed per year depending on soil type. Min. 6 months after planting before first application. PHI=60 days.
Annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lb ai/gal) at 2-6 qt in 20-40 gal of water Other names: Oryzalin	Make a single band or broadcast application to the ground beneath plants before weeds emerge. Apply alone to weed-free soil or postemergence mixed with Roundup or Gramoxone. Min. 0.5 inch of rainfall or irrigation is required for activation. Min 2.5 months between applications. Max. rate is 12 qt per year.
Annual grasses and broadleaves	Velpar 2L (hexazinone 2 lb ai/gal) at 0.5-1 gal in 20 gal of water	Apply to pruned blueberries in the spring before leaf emergence as a directed soil application. PHI=90 days. Some clones are susceptible to injury. Age Restriction: Use on plantings established at least 3 years.
Postemergence		
Annual broadleaves	Aim 2EC or Aim 2EW (carfentrazone 2 lb ai/gal) at 1-2 fl oz in 20 gal of water	Apply broadcast at base of trunks during dormant stage or with hooded shields between rows during growing season. Always add nonionic surfactant at 0.25% v/v or crop oil at 1% v/v. Max. 2 fl oz during dormant season and 6.1 fl oz during growing season. Min. 14 days between applications. PHI=1 day.
Annual broadleaves and yellow nutsedge	Basagran 4L (bentazon 4 lb ai/gal) at 1.5-2 pt in min. 20 gal of water	Non-bearing only: May only be used on crops that will not be harvested within one year of application. Apply as a directed postemergence spray. Include crop oil at 0.5% v/v. Avoid spraying stems, bark, or foliage. Max. 2 pt per application and 4 pt per season.
Most annual and perennial grasses	Fusilade DX 2EC (fluazifop-p 2 lb ai/gal) at 16-24 fl oz in 25 gal of water	Non-bearing only: May only be used on crops that will not be harvested within one year of application. Apply as a directed spray to actively growing grasses before tillering. Always add crop oil at 1% v/v or nonionic surfactant at 0.25% v/v. Avoid contact with foliage. Rainfast in 1 hour. Max. rate is 72 fl oz per year. Min. 5 days between applications. PHI=1 year.
Most annual grasses and broadleaves and top kill of perennial weeds	Gramoxone Inteon 2L (paraquat 2 lb ai/gal) at 2-4 pt in min. 10 gal of water Other names: Firestorm	Apply as directed spray to actively growing weeds before emergence of new canes or shoots. Repeat applications are necessary to give sustained control. Apply as a coarse spray to avoid drift injury. Avoid contact with desired new shoots, fruit, or foliage. Always add nonionic surfactant at 0.25% v/v or crop oil at 1% v/v. Max. 5 applications per year. Restricted use pesticide.
Annual and perennial grasses	Poast 1.5EC (sethoxydim 1.5 lb ai/gal) at 1.5-2.5 pt in min. 5 gal of water	Apply as a directed spray to actively growing grasses before tillering. Always add crop oil at 1% v/v. Max. 2.5 pt per application and 5 pt per season. PHI=30 days.

Weed Problem	Material & Rate/A	Comments and Limitations
Annual grasses and broadleaves	Reglone 2L (diquat 2 lb ai/gal) at 1.5-2 pt in min. 15 gal of water	Non-bearing only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray using a shield for contact burn of weeds. Complete coverage is essential for good control. Always add a nonionic surfactant at 0.06-0.5% v/v. Can be used during site preparation and up to 1 year of harvest. Do not allow contact with green stems, foliage, or fruits. PHI=1 year.
Annual and perennial grasses and broadleaves	Rely 1L (glufosinate 1 lb ai/gal) at 3-6 qt in min. 20 gal of water	Apply as a directed spray to actively growing weeds. Do not apply on desirable foliage or drift on foliage, green or uncallused bark. Coverage of all foliage is necessary for optimum control. Max. rate is 3 gal/year. PHI=14 days.
Annuals and some perennial grasses and broadleaves	Roundup WeatherMax 5.5EC (glyphosate 5.5 lb ai/gal) at 0.5-5.3 qt in 10-40 gal of water. Other names: Touchdown, Honcho, Rattler, others	Apply as preplant broadcast application or in fall for control of roots and rhizomes of perennial weeds or as a directed spray or wiper application (20-100% solution) to actively growing weeds in established plantings. Always add ammonium sulfate 8.5-17 lb/100 gal in hard water or drought conditions. Do not allow spray to contact any part other than mature bark. Rate depends on weed species and stage of growth. Does not provide residual control; can be mixed with labeled preemergence herbicides. PHI=14 days.
Annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lb ai/gal) at 3-10% spray 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 2EC (clethodim 2 lb ai/gal) at 6-8 fl oz Other names: Clethodim, Envoy	Non-bearing only: May only be used on crops that will not be harvested within one year of application. Apply as a directed spray to actively growing grasses before tillering. Do not use crop oil. Always add nonionic surfactant at 0.25% v/v. May be applied as a spot treatment at 0.32-0.64 fl oz per gal. Rainfast in 1 hr. Max. rate is 32 fl oz per year.

Herbicide Recommendations for Brambles

Weed Problem	Material & Rate/A	Comments and Limitations
Preemergence		
Annual and perennial grasses and broadleaves	Casoron 4G (granular) (dichlobenil 4% ai) at 100 lb	Apply in early spring after cultivation before weeds emerge. Thoroughly incorporate granules into the surface through watering-in. Do not apply during new shoot emergence. Do not apply until 4 weeks after transplanting.
Annual grasses and broadleaves	Devrinol 50DF (napropamide 50% ai) at 8 lb in min. 20 gal of water	Apply from late fall prior to soil freeze-up to early spring prior to weed emergence. If no rainfall of 1 inch or more occurs within 24 hours after treatment, cultivate or irrigate to activate. Apply alone to weed-free soil or in tank mix with Roundup or Gramoxone. Do not allow spray to contact fruit or foliage. PHI=35 days.
Most broadleaves	Gallery 75DF (isoxaben 75% ai) at 0.66-1.33 lb in min. 10 gal of water	Non-bearing only: May only be used on crops that will not be harvested within 1 year of application. Apply in late summer to early fall; or in early spring prior to weed germination or anytime immediately after cultivation. Do not apply to new transplants until soil has settled with no cracks present. Rainfall or irrigation of 0.5 inch is needed within 21 days of application. Not effective on germinated weeds. Min. 60 days between applications. Max. rate is 4 lb/A.
Annual grasses and broadleaves	Karmex 80DF (diuron 80% ai) at 3 lb in 25-40 gal of water	Age restriction: Apply in fields established at least 1 year. Max. 1 application per year. Do not spray exposed roots to avoid injury. IN and OH only: Apply 3 lb in late spring for raspberries. If used postemergence, avoid contact with foliage. Best results if temperature is at least 70°F with high humidity.
Annual grasses and broadleaves	Princep 4L (simazine 4 lb ai/gal) at 2-4 qt in min. 40 gal of water	Apply in spring before weeds emerge and before canes leaf out, or make a split application of 2 qt in spring plus 2 qt in fall. Do not apply when fruit is present, or illegal residues may result. On plants established less than 6 months, apply at half the rate.
Annual grasses and broadleaves	Sinbar 80WP (terbacil 80% ai) at 1-2 lb in min. 20 gal of water	Make a single band or broadcast application as a directed spray to soil beneath the canes in the fall or early spring before fruit set and shortly before or after weed emergence. Avoid contact of foliage or fruit with spray or mist. Do not use on soils where roots are exposed. Age restriction: Use only on plantings established at least 1 year. PHI=70 days.
Annual grasses and certain broadleaves	Snapshot 2.5TG (isoxaben+trifluralin 2.5% ai) at 100-200 lb	Non-bearing only: May only be used on crops that will not be harvested within 1 year of application. For best results, 0.5 inch of rain or irrigation is needed within 3 days of application. Not effective on germinated weeds. Min. 60 days between applications. Max. rate is 600 lb per year.
Annual grasses and broadleaves and suppression of yellow nutsedge	Solicam DF (norflurazon 78.6% ai) at 2.5-5 lb in min. 20 gal of water	Apply as a directed spray to settled and firm soil from fall to early spring before weeds emerge. Rainfall or irrigation of 0.5 inch within 4 weeks to activate. Do not contact fruit or foliage. Do not apply after bud break on sandy loam soils. Check label for maximum amount allowed per year depending on soil type. Age Restriction: Minimum 12 months after planting before first application. PHI=60 days.

Weed Problem	Material & Rate/A	Comments and Limitations
Annual grasses and certain broadleaves	Surflan 4AS (oryzalin 4 lb ai/gal) at 2-6 qt in 20-40 gal of water Other names: Oryzalin	Make a single band or broadcast application to the ground beneath vines before weeds emerge. Apply alone to weed-free soil or postemergence mixed with Roundup or Gramoxone. Rainfall or irrigation of 0.5 inch is required for activation. Min 2.5 months between applications. Max. rate is 12 qt per year.
Postemergence		
Annual broadleaves	Aim 2EC or Aim 2EW (carfentrazone 2 lb ai/gal) at 1-2 fl oz in 20 gal of water	Apply with hooded shields between rows during growing season. Always add nonionic surfactant at 0.25% v/v or crop oil at 1% v/v. Max. 25.6 fl oz per year. Min. 14 days between applications. PHI=15 days. Primocane control: Apply when primocanes are 6 inches at 6.4 fl oz in min. 20 gal of water at intervals 14-21 days. Direct sprays to bottom 18 inches of canes.
Annual broadleaves and yellow nutsedge	Basagran 4L (bentazon 4 lb ai/gal) at 1.5-2 pt in min. 20 gal of water	Non-bearing only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed postemergence spray. Include crop oil at 0.5% v/v. Avoid spraying stems, bark, or foliage. Max. 2 pt per application and 4 pt per season.
Most annual and perennial grasses	Fusilade DX 2EC (fluazifop-p 2 lb ai/gal) at 16-24 fl oz in 25 gal of water	Non-bearing only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray to actively growing grasses before tillering. Always add crop oil at 1% v/v or nonionic surfactant at 0.25% v/v. Avoid contact with foliage. Rainfast in 1 hour. Max. rate is 72 fl oz per year. Min. 5 days between applications. PHI=1 year.
Most annual grasses and broadleaves and top kill of perennial weeds	Gramoxone Inteon 2L (paraquat 2 lb ai/gal) at 2-4 pt in min. 10 gal of water Other names: Firestorm	Apply as directed spray to actively growing weeds before emergence of new canes or shoots. Repeat applications are necessary to give sustained control. Apply as a coarse spray to avoid drift injury. Avoid contact with desired new shoots, fruit, or foliage. Always add nonionic surfactant at 0.25% v/v or crop oil at 1% v/v. Max. 5 applications per year. Restricted use pesticide.
Annual grasses and broadleaves	Karmex 80DF	See "Preemergence" for more details.
Annual and perennial grasses	Poast 1.5EC (sethoxydim 1.5 lb ai/gal) at 1.5-2.5 pt in min. 5 gal of water	Apply as a directed spray to actively growing grasses before tillering. Always add crop oil at 1% v/v. Max. 5 pt per season. May be used as a spot treatment at 1-1.5% solution. PHI=45 days.
Annual grasses and broadleaves	Reglone 2L (diquat 2 lb ai/gal) at 1.5-2 pt in min. 15 gal of water	Non-bearing only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray using a shield for contact burn of weeds. Complete coverage is essential for good control. Always use a nonionic surfactant at 0.06-0.5% v/v. Can be used during site preparation and up to 1 year of harvest. Do not allow contact with green stems, foliage or fruits. PHI=1 year.
Annuals and some perennial grasses and broadleaves	Roundup WeatherMax 5.5EC (glyphosate 5.5 lb ai/gal) at 0.5-5.3 qt in 10-40 gal of water. Other names: Touchdown, Honcho, Rattler, others	Rate depends on weed species and stage of growth. See label for details. Apply as preplant broadcast application or in fall for control of roots and rhizomes of perennial weeds or as a directed spray or wiper application (20-100% solution) to actively growing weeds in established plantings. Always add ammonium sulfate 8.5-17 lb/100 gal in hard water or drought conditions. Do not allow spray to contact any part other than mature bark. Does not provide residual control; can be mixed with labeled preemergence herbicides. PHI=14 days.

Herbicide Recommendations for Brambles (continued)

Weed Problem	Material & Rate/A	Comments and Limitations
Annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lb ai/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 2EC (clethodim 2 lb ai/gal) at 6-8 fl oz Other names: Clethodim, Envoy	Non-bearing only: May only be used on crops that will not be harvested within one year of application. Apply as a directed spray to actively growing grasses before tillering. Do not use crop oil. Always add nonionic surfactant at 0.25% v/v. May be applied as a spot treatment at 0.32-0.64 fl oz/gal). Rainfast in 1 hr. Max. rate is 32 fl oz per year.

Herbicide Recommendations for Strawberry

Weed Problem	Material & Rate/A	Comments and Limitations
Preemergence		
Annual broadleaves and suppression of grasses	Chateau 51WDG (flumioxazin 51% ai) at 3 oz	<p>Pre-transplanting: Apply a minimum of 30 days before transplanting and before laying plastic. Can be mixed with Gramoxone or Roundup.</p> <p>Preemergence on dormant plants: Add crop oil at 1% v/v or nonionic surfactant at 0.25% v/v to help control emerged broadleaf weeds. Do not apply to frozen ground.</p> <p>Shielded or hooded application in row middles: Do not apply after fruit set and not over strawberry plants. Apply prior to weed emergence or mixed with Gramoxone or Roundup.</p> <p>Note: Supplemental label must be in user's possession.</p>
Annual grasses and some broadleaves	Dacthal 6F (DCPA 6 lb ai/gal) at 8-12 pt in min. 20 gal of water	<p>At planting: Apply 12 pt at transplanting. Can be preplant incorporated. Clean cultivate or hoe if necessary before treatment.</p> <p>Established: Apply in early fall or in early spring immediately after mulch removal. Clean cultivate or hoe if necessary before treatment. Applications may be made directly over the plants without injury. Do not apply from bloom through harvest.</p>
Annual grasses and certain broadleaves	Devrinol 50DF (napropamide 50% ai) at 8 lb in min. 20 gal of water	<p>Apply in spring immediately after removal of straw mulch to a weed-free soil or in fall before straw is mulched over the plants and before soil freeze-up. Cultivate or irrigate 1 inch within 24 hr of application. Do not apply from bloom to harvest.</p> <p>For strawberries not grown on plastic, apply to weed-free soil surface. Delay application until desired number of daughter plants have become established. If no rainfall occurs within 24 hours after treatment, cultivate or irrigate 1 inch to incorporate. Devrinol 2EC can be used in plant bed preparation if plastic mulch is used. Preplant incorporate 2 gal/A to a weed-free soil within 24 hrs before laying plastic. Maximum 1 application per year.</p>
Annual broadleaves, especially winter annuals	Goal 2XL (oxyfluorfen 2 lb ai/gal) at 1-2 pt in min. 40 gal of water Other names: Galigan, Goaltender, Oxiflo, others	<p>Fallow bed preparation only: Apply with Roundup for control of winter annual broadleaves a minimum of 30 days before transplanting. Fallow bed should be worked thoroughly to a depth of 2.5 inches prior to planting.</p>
Annual grasses and certain broadleaves	Prowl H ₂ O 3.8E (pendimethalin 3.8 lb ai/gal) at 1.5-3.0 pt in min. 10 gal of water. Rate depends on soil type. See label for details.	<p>Apply as a broadcast spray before transplanting. A second application may be used in a band between rows up to 35 days before harvest. Adequate rainfall or irrigation after application prior to weed emergence will provide the most benefit. Max. 3 pt per application and 6 pt per season. PHI=35 days. Do not use if row is to later be covered with plastic.</p>

Weed Problem	Material & Rate/A	Comments and Limitations
Annual grasses and broadleaves	Sinbar 80WP (terbacil 80% ai) at 2-8 oz in min. 20 gal of water	<p>Planting year: Apply 2-3 oz immediately after transplanting but before runners start to root. Application of 2-6 oz can also be made to dormant plants in late summer or early fall for control of winter annual weeds. If transplants have started to develop new foliage in the spring, or are not dormant in late summer or early fall at time of application, then 0.5-1 inch of rain or irrigation is necessary to wash Sinbar off. Do not use on soils with less than 0.5% organic material, as plant injury can occur.</p> <p>Harvest years: Apply 4-8 oz after post-harvest renovation and before new growth begins in midsummer. An additional 4-8 oz prior to mulching in late fall is recommended to extend weed control through harvest of the following year. Max. 8 oz per season. PHI=110 days. Strawberry varieties vary in Sinbar sensitivity. See Table 5 on page 42 for varietal sensitivity, or conduct a field test before adoption as a normal practice, particularly for newer varieties.</p>
Postemergence		
Annual broadleaves	Aim 2EC or Aim 2EW (carfentrazone 2 lb ai/gal) at 0.5-2 fl oz in min. 10 gal of water	Apply with hooded shields between rows during growing season to actively growing weeds. Best results when weeds are <4 inches and rosettes <3 inches across. Always add nonionic surfactant at 0.25% v/v or crop oil at 1% v/v. Max. 6.1 fl oz per year. Min. 14 days between applications. PHI=0 day.
Annual and some perennial broadleaves	2,4-D amine (4lb ai/gal) at 2-3 pt in 25-50 gal of water Other names: Formula 40, Amine 4, Clean Amine, others	For established plantings only: Apply in early spring when strawberries are dormant or immediately after last picking. Do not apply unless possible injury to the crop is acceptable. Do not tank mix with Poast. Several 2,4-D amine products are available, but only a few are labeled for strawberry. Check label for specific use directions.
Most annual and perennial grasses	Fusilade DX 2EC (fluazifop-p 2 lb ai/gal) at 16-24 fl oz in 25 gal of water	Non-bearing only: May only be used on crops that will not be harvested within 1 year of application. Apply as a directed spray to actively growing grasses before tillering. Always add crop oil at 1% v/v or nonionic surfactant at 0.25% v/v. Avoid contact with foliage. Rainfast in 1 hour. Max. rate is 72 fl oz per year. Min. 5 days between applications. PHI=1 year.
Annual broadleaves	Goal 2XL	See "Preemergence" section above for details.
Most annual grasses and broadleaves and top kill of perennial weeds	Gramoxone Inteon 2L (paraquat 2lb ai/gal) at 2-4 pt in min. 10 gal of water Other names: Firestorm	Apply as a directed spray between rows, using shields to protect strawberry plants. Do not allow spray to contact foliage. Add a nonionic surfactant at 0.25% v/v or crop oil at 1% v/v. Max. 3 applications/year. Restricted use pesticide. PHI=21 days.
Most annual and perennial grasses (postemergence only)	Poast 1.5EC (sethoxydim 1.5 lb ai/gal) at 1-2.5 pt in 25 gal of water	Apply to actively growing grasses before tillering. Always add crop oil at 1% v/v. May be used as a spot treatment at 1-1.5% spray solution. Max. 2.5 pt per application and 2.5 pt per season. Caution: Application of Poast up to six weeks after Sinbar application can occasionally cause strawberry leaf injury. PHI=7 days.
Annuals and some perennial grasses and broadleaves	Roundup WeatherMax 5.5EC (glyphosate 5.5 lb ai/gal) at 0.5-5.3 qt in 10-40 gal of water. Other names: Touchdown, Honcho, Rattler, others	Apply as pre-plant broadcast application or in fall for control of roots and rhizomes of perennial weeds or as a directed spray or wiper application (20-100% solution) to actively growing weeds in established plantings. Always add ammonium sulfate 8.5-17 lb/100 gal in hard water or drought conditions. Do not allow spray to contact any part other than mature bark. Does not provide residual control; can be mixed with labeled preemergence herbicides. Rate depends on weed species and stage of growth. PHI=14 days.

Weed Problem	Material & Rate/A	Comments and Limitations
Annual and perennial grasses and broadleaves	Scythe 4.2E (pelargonic acid 4.2 lb ai/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 2EC (clethodim 2 lb ai/gal) at 6-8 fl oz Other names: Clethodim, Envoy	Apply as a directed spray to actively growing grasses before tillering. Always add crop oil at 1% v/v. Rainfast in 1 hr. Max. rate is 32 fl oz per year and 8 fl oz per application. Min. 14 days between applications. May be applied as a spot treatment at 0.32-0.64 fl oz/gal. PHI=4 days.
Annual grasses and broadleaves	Ultra Blazer 2E (acifluorfen 2 lb ai/gal) at 1.5 pt in min. 20 gal of water	<p>May be applied up to the maximum application rate of 1.5 pt per acre per application using ground equipment. Make broadcast applications in 20 to 40 gal water per acre. Reduce rates proportionally for band or strip treatment. Do not apply more than 3 pt per acre per season. Apply with nonionic surfactant or crop oil concentrate.</p> <p>Annual strawberries grown on plastic mulch: Make one banded application before laying plastic and after final land preparation, and prior to transplanting the crop. For application between rows of plastic mulch, apply as a direct-shielded application between mulched beds. Do not allow contact with strawberry plants. PHI=60 days.</p> <p>Perennial strawberry (matted row): Make 2 applications: the first can be made after the last harvest or following bed renovation, the second can be made when plants are dormant during late fall to early spring. PHI=120 days.</p>

Table 11. Herbicides Registered for Weed Control in Small Fruit

Trade Name	Common Name	Crop Use	Risk of Resistance	Signal Word	REI	HRAC ¹
Preemergence control of grasses and/or broadleaf weeds						
Casoron, Norosac	dichlobenil	blueberry, brambles, grape	medium	caution	12 hr	L
Chateau	flumioxazin	grape, strawberry	medium	caution	12 hr	E
Dachtal	DCPA	strawberry	-	caution	12 hr	-
Devrinol	napropamide	blueberry, brambles, grape, strawberry	low	caution	12 hr	K3
Gallery	isoxaben	nonbearing blueberry, brambles, grape	medium	caution	12 hr	L
Goal	oxyfluorfen	grape, strawberry	medium	warning	24 hr	E
Karmex	diuron	blueberry, brambles, grape	medium	caution	12 hr	C2
Kerb RUP	pronamide	blueberry, grape	low	caution	12 hr	K1
Princep	simazine	blueberry, brambles, grape	medium	caution	12 hr	C1
Prowl	pendimethalin	nonbearing grape	low	caution	12 hr	K1
Prowl H ₂ O	pendimethalin	strawberry	low	caution	12 hr	K1
Sinbar	terbacil	blueberry, brambles, strawberry	medium	caution	12 hr	C1
Snapshot	isoxaben + trifluralin	nonbearing grape, blueberry, brambles	medium	caution	12 hr	L+K1
Solicam	norflurazon	blueberry, brambles, grape	medium	caution	12 hr	F1
Surflan	oryzalin	blueberry, brambles, grape	low	caution	12 hr	K1
Treflan	trifluralin	grape	low	caution	12 hr	K1
Velpar	hexazinone	blueberry	medium	danger	24 hr	C1
Postemergence control of grasses						
Fusilade	fluazifop	nonbearing blueberry, brambles, grape & strawberry	high	caution	12 hr	A
Poast	sethoxydim	blueberry, brambles, grape, strawberry	high	warning	12 hr	A
Scythe	pelargonic acid	blueberry, brambles, grape, strawberry	low	warning	12 hr	Z
Select	clethodim	strawberry & nonbearing blueberry, brambles, & grape	high	warning	12 hr	A
Postemergence control of broadleaf weeds						
Aim	carfentrazone	grape, blueberry, brambles, strawberry	medium	caution	12 hr	E
Amine 4	2,4-D amine	strawberry	low	danger	48 hr	O
Basagran	bentazon	nonbearing grape, blueberry, brambles	medium	caution	48 hr	C3
Goal	oxyfluorfen	grape, strawberry	medium	warning	24 hr	E
Postemergence control of grasses and broadleaf weeds						
Gramoxone Inteon RUP	paraquat	blueberry, brambles, grape, strawberry	medium	poison	12 hr	D
Roundup	glyphosate	blueberry, brambles, grape	low	caution	12 hr	G
Reglone	diquat	nonbearing grape, blueberry, brambles	medium	medium	24 hr	D
Rely	glufosinate	grape	low	warning	12 hr	H
Ultra Blazer	acifluorfen	strawberry	medium	danger	48 hr	E

¹HRAC= Herbicide Resistance Action Committee Groups. Herbicides in the same HRAC group have similar modes of action for killing weeds. To reduce the risk of herbicide resistance, do not rely on herbicides in a single HRAC group year after year.

Record Keeping Requirements for Production Chemicals

The following list contains the trade name, common name, manufacturer, EPA registration number, restricted entry interval (REI), runoff potential and leaching potential for pesticides registered for use in Michigan. The list was prepared to provide growers a convenient place to find information for pesticide recordkeeping requirements. This is a partial list of the commonly used pesticides on fruit crops in Michigan and is not intended to be a complete list. It is the grower's responsibility to confirm the registration number, REI, proper use, and other information for specific pesticides. Always read and follow label directions. Source: *Michigan Fruit Management Guide 2005* (Michigan State University Extension publication E154). Used with permission of Michigan State University.

FUNGICIDES/BACTERICIDES

Trade Name	Common Name	Manufacturer	EPA Reg #	REI ¹	Runoff/ Leach Potential ^F	Oral LD50	Dermal LD50	Class
Abound	azoxystrobin	Syngenta	100-1098	4 hrs	1/3	>5000	>4000	strobilurin
Agri-Mycin 17 Ag	streptomycin	Syngenta	100-899	12 hrs	-/-	>5000	>2000	antibiotic
Aliette 80 WDG	fosetyl-Al	Aventis	264-516	12 hrs	3/3	2860	>2000	organophosphorus
Armicarb 100	potassium bicarbonate	Helena	5905-541	4 hrs	-/-	2700	>5000	salt/inorganic
Auxigo	GABA+L-Glutamic Acid	Emerald Bio	70810-1	4 hrs	-/-	>5000	>5000	organic
Bayleton 50DF	triadimefon	Baycor	264-737	12 hrs	3/2	812-1470	>2000	conazole
Botran 75W	dicloran	Gowan	10163-189	12 hrs	2/3	>4640	>6320	aromatic
Bravo WeatherStik	chlorothalonil	Zeneca	50534-188-10182	48 hrs	2/3	9000	>2000	aromatic
Bravo WeatherStik	chlorothalonil	Syngenta	50534-188-100	48 hrs	2/3	9000	>2000	aromatic
BSP Sulfonix	lime sulfur	BSP	66196-3	48 hrs	-/-	820	>2000	inorganic
Cabrio	pyraclostrobin	BASF	7969-187	12-24 hrs	-/-	>2000	>2000	strobilurin
Captan 50WP	captan	Micro-Flo	51036-166	24 hrs	3/3	>5000	>2000	phthalimide
Captan 80WP	captan	Micro-Flo	51036-168	4 days	3/3	>5000	>2000	phthalimide
Captan 80WDG	captan	Arvesta	66330-29	24 hrs	3/3	>2000	>5000	phthalimide
Captan 80WDG	captan	Micro Flo	66222-58-51036	4 days	3/3	>2000	>5000	phthalimide
Captec 4FL	captan	Micro-Flo	51036-181	24-72 hrs	3/3	>5000	>2000	phthalimide
CaptEvate	fenhexamid+captan	Arvesta	66330-48	24-72 hrs	3/3	>2000	>5000	anilide phthalimide
Champ Formula 2	copper hydroxide	Agro/NUFarm	55146-64	24 hrs	1/3	1630	>5000	copper
Champ DP	copper hydroxide	Agro/NUFarm	55146-57	4 days	1/3	1346	>5000	copper
Copper Sulfate	copper sulfate	ChemOne Ltd	56576-1	24-72 hrs	1/3	300	-	copper
Cuprofix Dispers	basic copper sulfate	Cerexagri	4581-396	24 hrs	1/3	>2000	>4000	copper
Dithane M-45	mancozeb	DowAgrosciences	62719-387	24 hrs	1/3	>5000	>5000	dithiocarbamate
Elevate	fenhexamid	Arvesta	66330-35	24 hrs	3/3	>2000	>2000	anilide
Elite 45DF	tebuconazole	Bayer	264-749	24 hrs	1/2	2593-4865	>2000	conazole
Endura	boscalid	BASF	7969-197	24 hrs	-/-	>2000	>2000	pyridine
Ferbam Granuflo	ferbam	Tamco, Inc.	45728-7	12 hrs	3/2	>5000	>4000	dithiocarbamate
Flint	trifloxystrobin	Bayer	264-777	12 hrs	2/3	>5050	>2000	strobilurin
Indar	fenbuconazole	DowAgrosciences	62719-421	12 hrs	1/3	4000	>2000	conazole
JMS Stylet Oil	paraffinic oil	JMS Flower Farms	65554-1	24 hrs	-/-	10000	-	organic
Kocide 101	copper hydroxide	Griffin	1812-288	12 hrs	1/3-	833	>5000	copper
Lime Sulfur Solutions	lime sulfur	Miller	72-19	12 hrs	-/-	820	>2000	inorganic
Kumulus DF	sulfur	Micro-Flo	51036-352	4 hrs	1/1	>2200	>2000	inorganic
Maneb 75DF	maneb	Cerexagri	4581-371	24 hrs	1/3	>5000	>2000	dithiocarbamate
Maneb 80W	maneb	Cerexagri	4581-255	48 hrs	1/3	>5000	>2000	dithiocarbamate
Meritc 340-F	thiabendazole	Syngenta	100-889	24 hrs	1/3	>5000	>2000	thiazole
Messenger	harpin protein	Eden Bioscience	69834-2	24 hrs	-/-	>5000	>6000	organic

Record Keeping Requirements for Production Chemicals — FUNGICIDES/BACTERICIDES (continued)

Microthiol Dispers	sulfur	Cerexagri	458 L-373	24 hrs	1/1	>2000	>2000	inorganic
Mycoshield Ag Terramycin	oxytetracycline	Syngenta	100-900	12 hrs	3/2	>5000	>2000	organic
Nova 40W	myclobutanil	Dow Agrosciences	62719-411	4 hrs	2/2	1870-2090	>5000	conazole
Orbit	propiconazole	Syngenta	100-702	24 hrs	1/2	1310	>5000	conazole
Oxidate	hydrogen dioxide	Biosafe Systems	70299-2	12 hrs	-/-	330	1410	organic
Penncozeb 80WP	mancozeb	Cerexagri	4581-358	24 hrs	1/3	>5000	>2000	dithiocarbamate
Penncozeb 75DF	mancozeb	Cerexagri	4581-370	24 hrs	1/3	>4470	>2000	dithiocarbamate
Phostrol	phosphoric acid	Nufarm	55146-83	0 hrs		>5000	>5000	-
Polyram 80DF	metiram	UAP Platte	7969-105-34704	24 hrs	2/3	>5000	>2000	dithiocarbamate
Pristine	boscalid+pyraclostrobin	BASF	7969-199	24 hrs	-/-	>2000	>2000	pyridine/strobilurin
Procure 50WS	triflumizole	Uniroyal	400-431	4 hrs	3/2	2230	>2000	conazole
ProPhyt	potassium salts	Helena	42519-22-5905	24 hrs	-/-	>5000	>4000	-
Quintec	quinoxifen	Dow Agrosciences	62719-375	12-24 hrs	-/-	>2000	>2000	quinoline
Ridomil Gold GR	metalaxyl-M	Syngenta	100-798	12 hrs	2/1	>5000	>2000	anilide
Ridomil Gold EC	metalaxyl-M	Syngenta	100-801	4 hrs	2/1	1172	>2020	anilide
Ridomil Gold MZ	metalaxyl-M/mancozeb	Syngenta	100-803	12 hrs	1/1	>5000	>2000	anilide/dithiocarbamate
Ridomil Gold/Copper	metalaxyl-M/copper	Syngenta	100-804	48 hrs	2/1	550	>2020	anilide/copper
Rovral 50WP	iprodione	Aventis	264-453	48 hrs	3/3	>5000	>2000	dicarboximide
Rovral 4F	iprodione	Aventis	264-482	48 hrs	3/3	1170	>2000	dicarboximide
Rubigan 1EC	fenarimol	Gowan	10163-273	48 hrs	2/1	1057-1270	>2000	pyrimidine
Scala	pyrimethanil	Bayer	264-788	24-48 hrs	-/-	4150-5971	>5000	pyrimidine
Scholar	fludioxonil	Syngenta	100-969	24-48 hrs	-/-	>5050	>2020	pyrrole
Serenade	Bacillus subtilis	Agraquest	69592-7	12 hrs	-/-	>5000	<2000	-
Sovran	kresoxim-methyl	BASF	7969-154	12-24 hrs	3/3	>5000	>2000	strobilurin
Sulforix	calcium polysulfide	Miller	66196-3-72	48 hrs	-/-	820	>2000	inorganic
Switch	cyprodinil+fludioxonil	Syngenta	100-953	NA	-/-	>5000	>2000	pyrimidine/pyrrole
Syllit 65W	dodine	Platte	55260-5-34704	4 hrs	2/3	2330	>5000	aliphatic nitrogen
Thiram Granuflo	thiram	Tamimco, Inc.	45728-21	12 hrs	3/3	2400	>2000	dithiocarbamate
Thiram 65W/SB	thiram	Tamimco, Inc.	45728-24	12 hrs	3/3	2400	>2000	dithiocarbamate
Topsin-M 70WP	thiophanate-methyl	Cerexagri	4581-403	48 hrs	2/3	>5000	>2000	benzimidazole/carbamate
Vanguard WG	cyprodinil	Syngenta	100-828	24 hrs	1/3	>5000	>2000	pyrimidine
Wettable Sulfur 90WP	sulfur	Micro-Flo	51036-14	24 hrs	1/1	>5000	>2000	inorganic
Ziram 76DF	ziram	Cerexagri	4581-140	12 hrs	3/2	1889	>5000	dithiocarbamate
Ziram Granuflo	ziram	Tamimco, Inc.	45728-12	12 hrs	3/2	2700	>2000	dithiocarbamate

*=Restricted Use Pesticide

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

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

Record Keeping Requirements for Production Chemicals

HERBICIDES

Trade Name	Common Name	Manufacturer	EPA Registration #	REI ¹	Runoff /Leach Potential ²	Oral LD50	Dermal LD50	Class
Aim 2E	carfentrazone	FMC	279-3242	12 hrs	-	>5000	>4000	triazolinone
Basagran 4L	bentazon	BASF	7969-45	48 hrs	-	>10000	>10000	benzothiadiazinone
Casoron 4G	dithlobenil	Uniroyal	400-168	12 hrs	2/2	>5000	-	nitrile
Chateau 51WB	flumioxazin	Valent	59639-119	12 hrs	-	>5000	>2000	N-phenylphthalimides
Devinol 50DF	naproamide	United Phosphorus	10182-258-70506	12 hrs	2/2	>5000	>2000	amide
Evital 5G	norflurazon	Anvac	5481-506	12 hrs	2/2	>5000	>2000	pyridazinone
Formula 40	2,4-D	Rivertdale	228-357	48 hrs	3/2	866-1058	>2000	phenoxy
Fusilade DX	fluzifop-P	Syngenta	100-1070	12 hrs	2/3	>5000	>2000	FOPs
Gallery 75DF	isoxaben	DowAgrosiences	62719-145	12 hrs	1/3	>5000	>5000	amide
Goal 2XL	oxyfluorfen	DowAgrosiences	62719-424	24 hrs	2/3	2985-4594	>4000	nitrophenyl ether
*Gramoxone Extra	paraquat	Syngenta	100-1043	12-24 hrs	1/3	283	>2000	bipyridilium
Karmex 80DF	diuron	Griffin	1812-362	12 hrs	2/2	6100	>5000	urea
*Kerb 50WP	pronamide	DowAgrosiences	62719-397	24 hrs	2/1	>5000	>2000	amide
Poast 1.5E	sethoxydim	BASF	7969-58	12 hrs	3/3	4100	>5000	cyclohexene oxime
Princep 90W/DG	simazine	Syngenta	100-603	12 hrs	2/1	>5000	>2000	triazine
Princep 4L	simazine	Syngenta	100-526	12 hrs	2/1	>5000	>2500	triazine
Prowl 3.3EC	pendimethalin	BASF	241-337	24 hrs	1/3	3956	>2200	dinitroaniline
Rely 1E	glufosinate	Bayer	264-652	12 hrs	3/3	3570	>2000	phosphoric acid
Roundup	glyphosate	Monsanto	524-445	12 hrs	1/3	>5000	>5000	glycine
Roundup Ultra	glyphosate	Monsanto	524-475	4 hrs	1/3	5108	>5000	glycine
Select 2EC	clethodim	Valent	59639-3	24 hrs	3/3	2920-3610	>5000	cyclohexene oxime
Sinbar 80WP	terbacil	DuPont	352-317	12 hrs	2/1	500-2784	>5000	uracil
Snapshot 80DF	isoxaben + oryzalin	DowAgrosiences	62719-174	12 hrs	1/3	>5000	-	amide+ dinitroaniline
Solicam 80DF	norflurazon	Syngenta	100-849	12 hrs	2/2	1140	>2000	pyridazinone
Surflan AS	oryzalin	DowAgrosiences	627 19-112	24 hrs	3/3	5000	>5000	dinitroaniline
Stinger	clopyralid	DowAgrosiences	62719-73	12 hrs	3/1	>5000	>5000	pyridine
Touchdown 6F	sulfosate	Syngenta	100-1117	12 hrs	1/3	>5000	>5000	glycine
Velpar L	hexazinone	DuPont	352-392	24 hrs	2/1	1200	>5000	triazinone
Weedar 64	2,4-D	Nufarm	71368-1	48 hrs	3/2	1161	1544	phenoxy

INSECTICIDES/MITICIDES

Acramite 50WS	bifenazate	Crompton-UniRoyal	400-503	1-5 days	2/3	>5000	>5000	unclassified
Actara 25WG	thiamethoxam	Syngenta	100-938	12 hrs	2/1	>5000	>2000	nitroguanidine
Admire Pro	imidacloprid	Bayer	264-827	12 hrs	-	-	-	nitroguanidine
*Agr-Mek 0.15EC & abamectin	avermectin B1	Syngenta	100-898	12 hrs	2/3	300	>1800	antibiotic
*Ambush 25WP	permethrin	Anvac	5481-502	12 hrs	2/3	>5000	>2000	pyrethroid
Applaud	buprofezin	Nichino-America	71711-21	12 hrs	-	-	-	chitin inhibitor
Apollo SC	clofentezine	Makhteshim-Agan	66222-47	12 hrs	1/3	>5000	>2400	growth regulator
*Asana XL	esfenvalerate	DuPont	352-515	12 hrs	2/3	458	>2000	pyrethroid
Assail 70WP	acetamiprid	Aventis	264-609	12 hrs	3/2	1064	>2000	pyridylmethylamine
Avant 30WG	indoxacarb	DuPont	352-597	12 hrs	1/3	687-1867	>5000	oxadiazine
Aza-Direct	azadirachtin	Gowan	71908-1-10163	4 hrs	2/1	>5000	>2000	botanical
*Azinphos-Methyl 50	azinphos-methyl	Micro-Flo	51036-1 64	7-15 days	2/3	14	>2000	organophosphate
Baythroid	cyfluthrin	Bayer	264-745	12 hrs	-	-	-	pyrethroid
Biobit HPWP	<i>Bt. var. tenebricola</i>	Valent	73049-54	4 hrs	-	>5000	>2500	biological
*Brigade WSB	bifenthrin	FMC	279-3108	12 hrs	2/3	335	>2000	pyrethroid
*Capture	bifenthrin	FMC	279-3069	12 hrs	2/3	262	>2000	pyrethroid
Carbaryl 4L	carbaryl	Platte	34704-447	12 hrs	3/3	590	2000	carbamate
Carbaryl 80	carbaryl	Drexel	19713-50	12 hrs	3/3	281	>2000	carbamate
Confirion 2F	tebufenozide	DowAgro	62719-420	4 hrs	2/1	>5000	>5000	molting hormone agonist
*Danitol 2.4EC	fenpropathrin	Valent	59639-35	24 hrs	2/3	66	>2000	pyrethroid
Deliver	<i>Bt. var. tenebricola</i>	Certis	70051-69	4 hrs	-	>5000	-	biological

Record Keeping Requirements for Production Chemicals — INSECTICIDES/MITICIDES (continued)

*Diazinon 50WP	diazinon	Platte	100-460-34704	24 hrs	1/3	1960	>2020	organophosphate
*Diazinon AG 600	diazinon	Platte	100-784-34704	24 hrs	1/3	1600	>2020	organophosphate
*Diazinon 50W	diazinon	Micro-Flo	51036-108	24 hrs	1/3	>2000	>2000	organophosphate
Dipel	<i>Bt. var. turlstaki</i>	Valent	73049-17	4 hrs	-/-	>5050	>5050	biological
Ecozin	azadirachtin	Amvac	5481-476	12 hrs	2/1	>5050	>5050	botanical
Entrust	Spinosad	DowAgrosciences	62719-282	4 hrs	2/3	>5000	>2000	macrocyclic lactone
Endosulfan 50WSB	endosulfan	Microflo	51036-91	24 hrs	1/3	50	150	organochloride
Esteem 35WP	pyriproxyfen	Valent	59639-115	12 hrs	2/3	>5000	>5000	IGR
Evergreen	pyrethrin + piperonyl butoxide	MGK	1021-1770	12 hrs	2/3	>5000	>2000	pyrethroid
GF-120 NF	spinosad	DowAgrosciences	62719-498	4 hrs	2/3	>5000	>5000	macrocyclic lactone
*GuthionSolupak50WP	azinphos-methyl	Bayer	3125-301	2-21days days	2/3	12.3-24.7	>2000	organophosphate
Imidan 70WP	phosmet	Gowan	10163-169	24 hrs	3/3	126-681	>4.64	organophosphate
Intrepid 2F	methoxyfenozide	DowAgrosciences	62719-442	4 hrs	-/-	>5000	>2000	molting hormone agonist
Javelin WG	<i>Bt. var. turlstaki</i>	Certis	70051-66	4 hrs	-/-	>5100	>5000	-
Kelthane MF	dicofol	DowAgrosciences	62719-405	12 hrs	1/3	1835-5022	>5000	bridged diphenyl
*Lannate 90SP	methomyl	DuPont	352-342	2-7 days	3/1	30-34	>2000	carbamate
*Lannate 2.4LV	methomyl	DuPont	352-384	2-7 days	3/1	49-89	>2000	carbamate
Lorsban 50WP	chlorpyrifos	Gowan	62719-221-10163	1-4 days	2/3	382	>2000	organophosphate
*Lorsban 4FC	chlorpyrifos	DowAgrosciences	62719-220	1-4 days	2/3	300-776	>5000	organophosphate
Malathion 8 Flowable	malathion	Gowan	10163-21	12-24 hrs	3/3	370	4100	organophosphate
Malathion 57EC	malathion	U/P Platte	34704-108	12 hrs	3/3	550	>2000	organophosphate
M-Pede	fatty acids	Mycogen	53219-6	12 hrs	-/-	>5000	>2000	-
Necmex 4.5	azadirachtin	Certis	70051-9	12 hrs	2/1	>5000	-	botanical
Nexter	pyridaben	BASF	7969-106	12 hrs	1/3	1930	>2000	unclassified
Platinum	thiamethoxam	Syngenta	100-939	12hrs	-	-	-	-
*Pounce 25WP	permethrin	FMC	279-3051	12 hrs	2/3	1100	>2000	pyrethroid
*Pounce 3.2EC	permethrin	FMC	279-3014	12 hrs	2/3	1030	>2000	pyrethroid
Provado	imidacloprid	Bayer	3125-457	12 hrs	2/1	1858-2591	>2000	nitroguanidine
Pyganic	pyrethrins	MGK	1021-1771	12 hrs	2/3	-	-	pyrethroid
Pyramite 60WP	pyridazinone	BASF	7969-125	12 hrs	-/-	1930	>2000	-
Savey 50DF	hexythiazox	Gowan	10163-250	12 hrs	2/3	>5000	>5000	growth regulator
Sevin 80S	carbaryl	Bayer	264-316	12 hrs	3/3	281	>2000	carbamate
Sevin XLR Plus	carbaryl	Bayer	264-333	12 hrs	3/3	649	>2000	carbamate
Sevin 4F	carbaryl	Bayer	264-349	12 hrs	3/3	590	>2000	carbamate
Spintor 25C	spinosad	DowAgrosciences	62719-294	4 hrs	2/3	>5000	>5000	macrocyclic lactone
Sunspray Ultra-fine Spray Oil	superior oil	Sun Company	862-28	4 hrs	-/-	>15000	-	-
Surround WP	kaolin	Engelhard	70060-14	4 hrs	-/-	>5000	-	clay
*Ven dex 50WP	fenbutatin-oxide	Griffin	1812-413	48 hrs	1/3	>5000	>2000	organotin
Venom	dinotefuron	Valent	33657-17-59639	12 hrs	-	-	-	neonicotinoid
*Vydate L	oxamyl	DuPont	352-372	48 hrs	3/3	9-10	>5000	carbamate
Zeal	etoxazole	Valent	59639-123	12 hrs	-/-	>5000	>5000	unclassified

*=Restricted Use Pesticide

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

²1= high, 2=intermediate, 3=low. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties Database <http://www.wcc.nrcs.usda.gov/pestmg/wimpst.html>.

Record Keeping Requirements for Production Chemicals

PLANT GROWTH REGULATORS

Trade Name	Common Name	Manufacturer	EPA Registration #	REI ¹	Runoff /Leach Potential ²	Oral LD50	Dermal LD50	Class
Accel	6BA + GA4+7	Valent	73049-29	12 hrs	-/-	>3000	>2000	cytokinin+gibberellin
Apogee	Prohexadione-Ca-Calcitriolcalcium calcium	BASF	7969-188	12 hrs	3/2	>5000	>2000	unclassified
Armid-Thin-W	NAD	Amvac	5481-426	48 hrs	3/2	>10000	>5000	auxin
Ethrel	ethephon	Aventis	264-267	48 hrs	2/3	>5000	>2000	ethylene releaser
Fruitone N	NAD	Amvac	5481-427	48 hrs	3/2	>10000	>5000	auxin
K-Salt Fruit Fix 800	NAD	Amvac	5481-413	24 hrs	3/2	>5050	>2020	auxin
K-Salt Fruit Fix 200	NAD	Amvac	5481-414	24 hrs	3/2	>5050	>2020	auxin
MaxCel	6-benzyladenine	Valent	73049-407	12 hrs	-/-	>5000	>5000	cytokinin
Pro-Gibb	gibberellic acid (GA3)	Valent	73049-15	12 hrs	-/-	>5000	>2000	gibberellin
Pro-Vide	gibberellic acid	Valent	73049-3	12 hrs	-/-	2100	>2000	Gibberellin
Promalin	6BA+GA4+7	Valent	73049-41	4 hrs	-/-	>5050	>5050	cytokinin+gibberellin
ReTain	AVG	Valent	73049-45	12 hrs	-/-	>7000	>5000	ethylene inhibitor
Sucker-Stopper	NAD	Lawn & Garden	5481-429-54705	12 hrs	3/2	5585	>5000	auxin

NEMATOCIDES

*Nemacur 3S	fenamiphos	Bayer	264-731	48 hrs	2/1	10.6-24.8	71.5-75.7	organophosphate
*Nemacur 15G	fenamiphos	Bayer	264-726	48 hrs	2/1	10-14	>2000	organophosphate
*Telone II	dichloropropene	Dow-Agrosciences	627-19-32	5 days	3/2	224-300	333	unclassified
*Telone C-17	dichloropropene and chloropicrin	Dow-Agrosciences	62719-12	5 days	3/2	304-519	200-500	unclassified
Vapam	metam-sodium	Amvac	5481-466	48 hrs	3/2	812	>2020	unclassified
*Vydate L	oxamyl	DuPont	352-372	48 hrs	3/3	9-10	>5000	carbamate

*=Restricted Use Pesticide

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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 (1.44 sq in)	930 square centimeters
	1 Square Yard (9 sq ft)	0.84 square meters
	1 Acre (43,560 sq ft)	0.405 hectares
	1 Square Mile (640 acres)	259 hectares
Weight	1 Ounce	28.3 grams
	1 Pound (16 oz.)	0.454 kilograms
	1 Ton (U.S.) — 2,000 lb	0.907 tons (metric)
Volume	1 Tablespoon (3 teaspoons)	14.79 milliliters
	1 Fluid ounce (2 tablespoons)	29.6 milliliters
	1 Cup (8 fl oz)	0.237 liters
	1 Pint (2 cups)	0.473 liters
	1 Quart (4 cups)	0.946 liters
	1 Gallon (U.S.) — 4 qts	3.8 liters
	1 Cubic Foot	28.3 liters

Metric Abbreviations: mm=millimeter; cm=centimeter; m=meter; km=kilometer; ha=hectare; mg=milligram; g=gram; kg=kilogram; ml=milliliter; l=liter.

Midwest Commercial Small Fruit & Grape Spray Guide 2008

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

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