Southeast Regional Bunch Grape

INTEGRATED MANAGEMENT GUIDE

2026

A Guide for Managing Diseases, Insects, Weeds, and Wildlife in Grapes in the Southeast

2026 Southeast Regional Bunch Grape Integrated Management Guide

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A publication of the Southern Region Small Fruit Consortium, www.smallfruits.org

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Pesticide Emergencies

1-800-222-1222

This number automatically connects you with a local Poison Control Center from anywhere in the United States.

Symptoms of Pesticide Exposure

- **Tightening of the chest, mental confusion, blurred vision, rapid pulse, intense thirst, vomiting, convulsions, and unconsciousness are always serious symptoms! Dial 911!**
- **Pesticides with 'DANGER' or 'DANGER/POISON' on the product label can cause severe injuries or death very quickly, even with small exposures. Take immediate action!**
- *Other symptoms of pesticide poisoning*: headache, fatigue, weakness, restlessness, nervousness, profuse sweating, tearing and drooling, nausea, diarrhea, or irritation of the skin/ eyes/nose/throat. Consult the product Material Safety Data Sheet (MSDS or SDS) for symptoms associated with a particular pesticide.

Pesticide on Skin

- WASH, WASH, WASH! Immediately wash pesticide from skin as thoroughly as possible with any available water that does not contain pesticides.
- Quickly remove protective clothing and any contaminated clothing.
- *Rewash* contaminated skin with soap and water as soon as possible.
- If the victim experiences *any* symptom(s) of poisoning, get medical assistance immediately. *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.

Pesticide in Eyes

- Rinse eye(s) gently with *clean* water for *at least* 15 minutes. Be careful of water temperature.
- **If eye remains irritated or vision is blurry after rinsing, get medical attention right away!** *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.

Pesticide in Mouth or Swallowed

- Provide / drink large amounts of water or milk to drink. *Do not give liquids to a person who is unconscious or convulsing!*
- Consult the label **BEFORE** vomiting is induced – the label may advise against inducing vomiting. Do not induce vomiting with emulsifiable concentrate (E, EC) formulations.
- Do not induce vomiting if a person is unconscious or is convulsing!
- Seek medical attention. *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.
- If the pesticide was not swallowed, *rinse mouth thoroughly with clean water*. If mouth is burned or irritated, consult a physician.

Pesticide Emergencies (Cont'd)

Pesticide Inhaled

- Move victim to fresh air immediately!
- Warn others in the area of the danger.
- Loosen tight clothing.
- Administer artificial respiration, if necessary, but try to determine if the person also may have swallowed any pesticide. Avoid any pesticide or vomit that may be around the victim's mouth.
- **Seek medical attention**. *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.

Heat Stress

- Move the victim to a cooler area, remove protective clothing, and pour cool water over the person.
- Give cool liquids to drink. *Do not give liquids to a person who is unconscious or convulsing!*
- **Pesticide poisoning may mimic heat illness**! Get medical attention if the person is unconscious or if the person is not fully recovered within 15 minutes of cooling down and drinking liquids.

Signal Words

The pesticide signal word will appear on the pesticide label. It provides information about the acute risks of the pesticide to people.

- **DANGER/POISON**: *Highly toxic* - less than a teaspoon can kill an adult.
- **DANGER**: *Highly toxic* - pesticide can cause severe eye and/or skin injury.
- **WARNING**: *Moderately toxic* - two tablespoons or less can kill an adult.
- **CAUTION**: *Slightly toxic* - an ounce or more is required to kill an adult.

Understand that the signal word does *not* provide information about long term pesticide exposure risks (e.g., cancer) or allergic effects. Minimize your exposure to *all* pesticides. The signal word does *not* indicate environmental toxicity or other environmental effects.

Pesticide Spills and Environmental Emergencies

Spills on Public Roads (Usually call the state police/state highway patrol. In many cases, you can call or 911.)

State	Agency	Phone Number
Alabama	Alabama Highway Patrol Alabama Department of Environmental Management Alabama Emergency Management Agency	Cell: call *HP 334-271-7700 205-280-2200
Arkansas	Arkansas Department of Emergency Management	501-683-6705
Georgia	Georgia State Patrol	Cell: call *GSP or 911
Louisiana	LDAF Emergency Hotline; Louisiana State Police Hazardous Material Hotline	1-855-452-5323 225-925-6595 or 877-925-6595
Mississippi	Mississippi Emergency Management Agency	1-800-222-6362
North Carolina	Regional Response Team (RRT) For spills not on public roadways, contact the Pesticide Section of NCDA&CS	911 or your RRT 919-733-3556 *or* 800-662-7956 during non-business hours
South Carolina	South Carolina Highway Patrol South Carolina DHEC Emergency Response Section	Cell: call *HP 1-888-481-0125
Tennessee	Tennessee Emergency Management Agency (TEMA) State Emergency Operations Center	1-800-262-3300
Virginia	Virginia Emergency Operations Center	804-267-7600

For assistance with **on-farm spills**, contact your local state department of agriculture.

Environmental Emergencies (contamination of waterways, fish kills, bird kills, etc.)

State	Agency	Phone Number
Alabama	Alabama Department of Environmental Management Alabama Emergency Management Agency Alabama Department of Conservation and Natural Resources	334-271-7700 205-280-2200 334-242-3469
Arkansas	Arkansas Department of Emergency Management	501-683-6705
Georgia	Georgia Department of Natural Resources Response Team	1-800-241-4113
Louisiana	LDAF Emergency Hotline	1-855-452-5323
Mississippi	Mississippi Emergency Management Agency	1-800-222-6362
North Carolina	North Carolina Div. of Water Quality	1-800-858-0368
South Carolina	South Carolina DHEC	1-888-481-0125
Tennessee	Tennessee Wildlife Resources Agency	Region 1, West Tennessee: 1-800-372-3928 Region 2, Middle Tennessee: 1-800-624-7406 Region 3, Cumberland Plateau: 1-800-262-6704 Region 4, East Tennessee: 1-800-332-0900
Virginia	Virginia Emergency Operations Center	804-267-7600

Pesticide Liability and Stewardship

The **Pesticide Environmental Stewardship** website is located at https://pesticidestewardship.org/. Information on proper pesticide use and handling, calibration of equipment, reading pesticide labels, disposal, handling spills, and other topics are presented.

Pesticide applicators, supervisors, and business owners may all face severe criminal and/or civil penalties if pesticides are misused – knowingly or accidentally.

***The Pesticide Label*:** Federal and state laws require pesticide applicators to follow the directions on the pesticide label exactly. Do not exceed maximum label rates, apply a pesticide more frequently than stated on the label, or apply a pesticide to a site that is not indicated on the label. Labels change; review yours regularly.

Compliance with the Endangered Species Protection Program: Beginning in 2024, additional pesticide label instructions, intended to protect threatened and endangered species and their designated critical habitat, may be required for certain pesticides, when applied in a pesticide use limitation area (PULA). If a pesticide label directs product users to the Bulletins Live! Two system, users are REQUIRED to obtain an Endangered Species Protection Bulletin prior to product application. Endangered Species Protection Bulletins are specific for an intended application area, pesticide product, and application month and may provide additional limitations or restrictions for product use. Users must know the site of product application (location), application month, and EPA Registration Number of the product in order to obtain a bulletin. Bulletins may be accessed up to 6 months before product application and can saved to a computer or printed. Bulletins are enforceable, if referenced on a pesticide label, by Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). For additional information or updates on these new requirements, visit the EPA Endangered Species Protection Bulletin webpage, and contact your local county Extension agent or specialist.

***Restricted Use Pesticides (RUP)*:** These pesticides are clearly labeled "Restricted Use Pesticide" in a box at the top of the front label. Applicators purchasing, applying, or supervising the application of a RUP must be certified or licensed through their state pesticide regulatory agency. Some states have mandatory licensing for certain pesticide use categories whether or not RUPs are applied.

***Personal Protective Equipment (PPE)*: Anyone** handling or applying pesticides must wear the PPE stated on the pesticide label. The EPA Worker Protection Standard (WPS) requires applicators to wear the label required PPE and agricultural employers to supply the label PPE **and** ensure that the PPE is worn correctly by applicator employees. Do not wear PPE items longer than it has been designed to protect you. Clean, maintain, and properly store PPE. Do not store PPE with pesticides.

***Reentry Interval (REI)*:** The period of time immediately following the application of a pesticide during which unprotected workers should not enter a field.

***Pre-Harvest Interval (PHI)*:** The time between the last pesticide application and harvest of the treated crops.

***EPA Worker Protection Standard (WPS)*:** WPS changes continue to be implemented. Growers should consult the EPA website (https://www.epa.gov/pesticide-worker-safety/agricultural-worker-protection-standard-wps) or their local extension service for the most up to date information. Growers who employ one or more *non*-family members must comply with the WPS. This standard requires agricultural employers to protect applicator employees and agricultural worker employees from pesticide exposure in the workplace by 1) providing specified pesticide safety training, 2) providing specific information about pesticide applications made on the agricultural operation, 3) providing and ensuring that applicators wear clean

Pesticide Liability and Stewardship (Cont'd)

and properly maintained label required PPE, 4) providing decontamination facilities for potential pesticide and pesticide residue exposures, and 5) providing timely access to medical assistance in the event of a suspected pesticide exposure. These protections apply to both restricted use pesticides *and* general use pesticides used in agricultural plant production.

***Enclosed Structures*:** Pesticides labeled for field applications may not be allowed for use in enclosed structures or may have additional restrictions. Definitions of enclosed structures differ between states but may include greenhouses and high tunnels. Consult your local Extension service or state Department of Agriculture for guidance and appropriate recommendations. WPS for enclosed structures may also differ than those for field-grown plants.

***Pesticide Recordkeeping*:** You must keep records of all RUP applications for at least two years under the Federal (USDA) Pesticide Recordkeeping Requirement if your state does not have its own pesticide recordkeeping requirements. Some states require records be kept for longer than the federal requirement. Maintaining records of all pesticide applications, not just RUP applications, indefinitely, cannot only help troubleshoot application problems, but also allows you to reference successful applications and can help protect against future liability. Consult your local Extension Service for details.

***Emergency Preparedness*: Be prepared for emergencies.** Store pesticides and clean empty containers securely. Develop and provide written plans and training to prepare your employees and family members for pesticide fires, spills, and other emergencies. Assign responsibilities to be carried out in the event of pesticide emergencies. Keep copies of the pesticide labels and MSDSs away from the area where pesticides are stored. Provide copies of product MSDSs to your community first responders. Consult your local Extension Service and insurance company for assistance.

***Pesticide Disposal*: Properly dispose of clean empty pesticide containers and unwanted pesticides as soon as possible**. Containers can often be recycled in a pesticide container recycling program. Unwanted pesticides may pose a risk of human exposure and environmental harm if kept for long periods of time. Consult your local Extension office for assistance.

Compliance with the Endangered Species Protection Program: Beginning in 2024, additional pesticide label instructions intended to protect threatened and endangered species and their designated critical habitat may be required for certain pesticides, when applied in a pesticide use limitation area (PULA). If a pesticide label directs product users to the Bulletins Live! Two system, users are **REQUIRED** to obtain an Endangered Species Protection Bulletin **prior to product application**. Endangered Species Protection Bulletins are specific for an intended application area, pesticide product, and application month and may provide additional limitations or restrictions for product use. Users must know the site of product application (location), application month, and EPA Registration Number of the product in order to obtain a bulletin. Bulletins may be accessed up to 6 months before product application and can saved to a computer or printed. Bulletins are enforceable, if referenced on a pesticide label, by Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). For additional information or updates on these new requirements, visit the EPA Endangered Species Protection Bulletin webpage, and contact your local county Extension agent or specialist.

General Pesticide Information

Mode of Action (MOA): Pesticides affect target pests in a variety of ways, and the way a pesticide kills the target organism is called the ***mode of action* (MOA)**. Although pesticides have different names and may have different active ingredients, they may have the same MOA. Over time, pests can become resistant to a pesticide, and typically this resistance applies to all pesticides with the same MOA. When rotating pesticides, it is important to select pesticides with different MOAs.

The **Fungicide Resistance Action Committee** (FRAC), **Insecticide Resistance Action Committee** (IRAC) and IRAC Nematode Working Group, and the **Weed Science Society of America** (WSSA) have organized crop protection materials into groups with shared MOAs and given them specific codes, which appear on pesticide labels. Some MOAs may be unknown and given a code with a **U**. *When selecting pesticides, avoid successive applications of materials in the same MOA group to minimize potential resistance development*. MOA categories are listed in this guide to aid in the development of resistance management programs. More information about this topic can be found at www.frac.info, www.irac-online.org, and www.hracglobal.com.

Organic Materials Review Institute (OMRI; www.omri.org): Products that are listed by OMRI are commonly accepted for use in organically certified production systems. Always consult your organic certifier prior to use. **OMRI-listed** materials are indicated in the comments section.

Generics: Many pesticide active ingredients are available in generic formulations. For brevity, these formulations are not generally listed. Listed trade names are included to aid in identifying products and are not intended to promote the use of these products or to discourage the use of generic products. Generic products generally work similarly to their brand name counterparts, but formulation changes can impact efficacy and plant response. As with any new chemical, read and follow all label instructions. Chemical names are subject to change; please check the active ingredient for all materials.

Pesticide Environmental Stewardship. Information on pesticide use is available from the Pesticide Environmental Stewardship website (pesticidestewardship.org) including information on sprayer calibration, personal protective equipment, recordkeeping, and resistance management.

Resistance Management: Insects, weeds, and disease-causing organisms are all capable of developing resistance to pesticides. To minimize the likelihood of resistance development against your material of choice:

1. Only use pesticides when necessary. When the damage caused by the pest you are controlling is greater than the cost of the pesticide and no other, effective options are available.
2. Use the appropriate material for the pest.
3. Use the recommended rate of the material. Do not use a lower rate than listed on the label.
4. If more than one treatment is needed when the same pest is present, rotate the pesticide MOA between treatments.

Potential Pesticide Regulation Changes: EPA is constantly proposing restrictions on current pesticides. At this point, there are new proposed restrictions on captan, iprodione, mancozeb, and Ziram. Nothing is officially announced yet, but they may change the use of iprodione (e.g., Rovral) to once a season for grape production. Please keep an eye on extension newsletters and other information sources for more up to date information. Even while we try to keep this guide as updated as possible, keep an eye on the pesticide labels for changes.

General Pesticide Information (Cont'd)

State Registrations: Keep in mind that this publication is a regional guide. Every product listed may not be available or registered for use in every state. Before purchasing and applying a product, verify that that product is registered for use in your state. This may be done by visiting one of several online databases (examples provided below) that provide information on the state registration status of various products, by visiting product manufacturer websites, or by contacting your Extension agent or an appropriate state Extension specialist.

Database	Web Address
TELUS Agronomy (formally Agrian Label Database)	https://www.agrian.com/labelcenter/results.cfm
Crop Data Management Systems	https://www.cdms.net/Label-Database
EPA Pesticide Product and Label System	https://ordspub.epa.gov/ords/pesticides/f?p=PPLS:1
Greenbook Data Solutions	https://www.greenbook.net/
Kelly Registration Systems[1]	https://www.kellysolutions.com
National Pesticide Information Retrieval System[2]	https://www.npirs.org/state/

[1]Available for AL, FL, GA, MS, NC, SC, and VA in the southeastern U.S.
[2]Available for AL, AR, FL, KY, LA, NC, TX, and VA in the southeastern U.S.

CAUTION: Specific rates, application methods, and sometimes target pests vary on product labels containing the same active ingredient and are subject to change at any time. Always refer to and read the pesticide label before making any application!!

Formulation Abbreviations: Abbreviations commonly used in product formulations that appear in the tables include DF = dry flowable; EC = emulsifiable concentrate; EW = emulsion, oil in water; F = flowable; L = liquid; SC = spray concentrate; SG = soluble granule; SL = soluble concentrate; EG, WG, or WDG = water dispersible granule; W or WP = wettable powder; and WSB = water soluble bag.

Other Abbreviations: Another abbreviation that may appear in product names is XLR = xtra long residual.

Efficacy Ratings: The efficacy of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended. These ratings are benchmarks, actual performance will vary. A superscript 'R' (^{R}) next to the efficacy rating indicates that isolates with resistance to this fungicide have been identified in the southeastern U.S. If a pathogen with resistance to this fungicide is present, this fungicide will not be as effective as indicated.

Pollinator Protection

Before making insecticide applications, monitor insect populations to determine if treatment is needed. If pesticide (fungicide, insecticide, or miticide/acaricide) application is necessary:

1. Use selective pesticides to reduce risk to pollinators and other non-target beneficial insects.
2. Read and follow all pesticide label directions and precautions. The label is the Law! EPA now requires the addition of a "Protection of Pollinators" advisory box on certain pesticide labels. Look for the bee hazard icon in the Directions for Use and within crop specific sections for instructions to protect bees and other insect pollinators.
3. Minimize infield exposure of bees to pesticides by avoiding applications when bees are actively foraging in the crops. Bee flower visitation rate is highest in early morning. Apply pesticides in the late afternoon or early evening to allow for maximum residue degradation before bees return the next morning. Bee foraging activity is also dependent upon time of year (temperature) and stage of crop growth. The greatest risk of bee exposure is during bloom.
4. Minimize off-target movement of pesticide applications by following label directions to minimize off target movement of pesticides. Do not make pesticide applications when the wind is blowing towards beehives or off-site pollinator habitats.

For specific pesticide hazard levels to honey bees, visit the table of "Commonly Used Pesticides Grouped According to Their Relative Hazards to Honey Bees" in the *Georgia Pest Management Handbook* (https://fieldreport.caes.uga.edu/publications/SB28-04/).

Sprayer Equipment Considerations for Pesticides

In addition to appropriate selection of pesticides for product efficacy and resistance management, proper application of products for disease, insect, and weed management requires appropriate selection and preparation of spray equipment for adequate spray coverage and canopy penetration. Without regard to the spray equipment utilized, nozzle selection and sprayer calibration are extremely important considerations. Calibration factors include tractor speed and pumping system pressure, and all producers need to understand how these factors impact spray coverage and product efficacy for each targeted use pattern.

Again, using an appropriate nozzle for the intended use is critical. Numerous nozzles of various shapes, sizes, and output (gallons per minute, GPM) are available for purchase. Nozzle selection will determine droplet size, GPM of the spray leaving the nozzle, and spray pattern. Droplet size not only affects product coverage and distribution on surfaces but also influences the potential for drift. For example, larger droplets have a reduced potential for drift than smaller droplets. It is, therefore, important to apply herbicides with sufficient droplet size to minimize drift. Smaller droplets, in comparison to larger droplets, increase spray distribution on surfaces and increase the chance for contact with fungal spores. Use of a nozzle that provides smaller (finer) droplet size may be beneficial when applying fungicides.

Routine sprayer calibration is necessary to achieve and maintain optimal performance of spray equipment and to insure the desired and precise output (gallons per acre, GPA) of the IPM products. Pressure losses in the pumping system can alter the exact GPM being applied. In addition, nozzles may wear over time, become plugged, break, or have a slightly different output than that listed in the catalog. It is best to calibrate spray equipment BEFORE the season begins; in-season calibration may also be needed, particularly if distribution differences, such as "skips," or other problems are observed. Spray equipment should also be calibrated if nozzles are replaced or if adjustments to spray equipment, such as changes to sprayer pressure, are made.

Tractor speed should be set to allow for sufficient spray coverage of target plants/tissue. Moving too fast will minimize the amount of spray that is delivered to an area and may not allow for sufficient spray delivery to plants. Moving too slow may deliver an overabundance of spray to plants, essentially 'wasting' spray and increasing costs. Sprayer pressure may also need to be adjusted, as plants grow, to insure delivery of spray into plant canopies. Early-season applications will likely require less gallons of spray per acre than late-season applications, as the canopy increases in density and shoots grow.

Always conduct trials with water-sensitive cards scattered throughout the plant canopy to make sure you are getting the coverage you desire for the particular application, whether that be herbicides, insecticides, fungicides, etc. The time for determining whether the sprayer is effective is before applications are needed for insect, pathogen, or weed management.

For additional details on these topics, including example calculations for calibration of broadcast and banded sprayer applications, see the Nozzle Selection and Calibration Guide, available on the Southern Region Small Fruit Consortium website (https://smallfruits.org).

Mobile and Online Tools

Southern Region Small Fruit Consortium (WRSFC) Website

A valuable repository (smallfruits.org) of resources for small fruit production and pest management. The SRSFC produces the e-newsletter *Small Fruit News*; sign up to receive future issues or search the archive for past articles. The SRSFC also provides funding for research and outreach activities; search the project list to learn the outcome of previously funded projects. Visit the website to learn more about the SRSFC and other available resources.

MyIPM App

A FREE smartphone app that contains pest and disease information (diagnostic keys, photos, management guidelines, audio, and pesticide information). App content is updated by regional specialists and is available for download from the Apple App Store or the Google Play Store. Learn more at https://vimeo.com/486538727.

Bugwood Image Database

The Bugwood Image Database (https://images.bugwood.org/) is an online database that includes high-quality images of many insects, diseases, and weeds. The database is comprised of various websites for specific pest problems, including websites for Insect Images, IPM Images (diseases), and Weed Images. Website users can browse the websites for images of specific crops or search for specific pests.

Grape IPM.org

GrapeIPM.org (http://grapeipm.org) is an online personal database to aid you plan, organize, and share your spray plan, print WPA-required spray record, and keep EPA-required spray record.

Videos

A fungicide resistance management video from FRAC can be found on Youtube.

Southern Region Disease and Insect Diagnostic Laboratories

Additional university diagnostic services may be available. Visit the Southern Plant Diagnostic Network (SPDN) website (www.npdn.org/spdn) for a directory of SPDN diagnostic laboratories. Private laboratories may also offer diagnostic services. Contact each laboratory or your local county Extension agent to determine which services are offered, the fee structure, and sample submission instructions.

Auburn University
Auburn Plant Diagnostic Lab (Auburn, AL):
https://www.aces.edu/go/PlantLab

University of Arkansas
Arkansas Nematode Diagnostic Laboratory (Hope, AR):
https://www.uaex.uada.edu/farm-ranch/pest-management/plant-disease/nematodes/diagnostic-lab.aspx

Plant Health Clinic (Fayetteville, AR):
https://www.uaex.uada.edu/yard-garden/plant-health-clinic/

Clemson University
Plant and Pest Diagnostic Clinic (Pendleton, SC):
https://www.clemson.edu/public/regulatory/plant-problem/

Molecular Pathogen and Pest Detection Lab (Pendleton, SC):
https://www.clemson.edu/public/regulatory/plant-problem/mppd.html

University of Florida
UF/IFAS Plant Diagnostic Center (Gainesville, FL):
https://plantpath.ifas.ufl.edu/extension/plant-diagnostic-center/

University of Georgia
Plant Molecular Diagnostic Lab (Tifton, GA):
https://site.caes.uga.edu/mdl/

Plant Disease and Nematode Clinics (Athens, GA, and Tifton, GA):
https://plantpath.caes.uga.edu/extension/plant-disease-clinics.html

University of Kentucky
Plant Disease Diagnostic Laboratory (Lexington, KY):
https://plantpathology.ca.uky.edu/extension/diagnostic-laboratories

Louisiana State University
Plant Diagnostic Center (Baton Rouge, LA):
https://www.lsuagcenter.com/portals/our_offices/departments/plant-pathology-crop-physiology/plant_disease_clinic

Mississippi State University
Extension Plant Diagnostic Lab (Starkville, MS):
https://extension.msstate.edu/lab

North Carolina State University
Plant Disease and Insect Clinic (Raleigh, NC): https://pdic.ces.ncsu.edu/

Oklahoma State University
Plant Disease and Insect Diagnostic Lab (Stillwater, OK):
https://agriculture.okstate.edu/departments-programs/entomol-plant-path/research-and-extension/plant-disease-insect-diag-lab/

University of Tennessee
Soil, Plant and Pest Center (Nashville, TN):
https://soillab.tennessee.edu/plant-pests/

Virginia Tech
Plant Diagnostic Clinic (Blacksburg, VA):
https://spes.vt.edu/affiliated/plant-disease-clinic.html

New Pest Alert (Spotted lanternfly, SLF)

A new insect pest, spotted lanternfly (SLF, Lycorma delicatula (White)), has entered the Southeastern region. This insect is spreading through Virginia and has been found in Tennessee, Georgia, South Carolina, and North Carolina to date. SLF is in the planthopper family, and all stages are active jumpers. SLF has a broad host range. While grape is by far the most vulnerable crop, SLF feeds on more than 70 species of plants. Early SLF (nymphal stages) instars are black with white spots and are the stage most likely to be found earlier in the season. Fourth instar nymphs are bright red with black and white markings. Adults have pinkish grey front wings with black spots. The pink cast is due to the bright red hind wings showing through the front wings. Evidence of SLF feeding includes the accumulation of honeydew on leaf surfaces, which supports the growth of the fungus that causes sooty mold. Economic significance of SLF is currently being examined. Nymphs can be controlled by many insecticides that are used for other early-season strawberry pests, e.g. bifenthrin, fenpropathrin, and carbaryl. Where adults are the main problem (late season), continued re-immigration is a significant problem. Risk may be higher if plantings are near stands of tree-of-heaven, a key host tree.

Additional information on SLF can be found on the Virginia Tech Spotted Lanternfly webpage (https://www.virginiafruit.ento.vt.edu/SLF.html), in the article "Spotted lanterfly – Watch for a new invasive pest!" and in the Virginia Cooperative Extension publication "Spotted lanternfly, Lycorma delicatula (White) (Hemiptera: Fulgoridae)" (https://www.pubs.ext.vt.edu/ENTO/ENTO-180/ENTO-180.html). An updated SLF distribution map, maintained by Cornell University, is available at https://cals.cornell.edu/new-york-state-integrated-pest-management/outreach-education/whats-bugging-you/spotted-lanternfly/spotted-lanternfly-reported-distribution-map.

Early and Fourth Instar Nymphs and Adults of Spotted Lanternfly.

Bunch Grape Integrated Management Guide (Diseases and Insects)

Seasonal 'at a glance' **fungicide** spray schedule options for bunch grapes

Diseases to be considered								**Fungicide(s) to be used**		
Developmental stage	**Anthracnose**	**Bitter rot, Ripe rot**	**Black rot**	**Botrytis bunch rot**	**Downy mildew (DM)**	**Phomopsis**	**Powdery mildew (PM)**	**Basic program**	**Options**	**Notes**
Dormant (7–10 days prior to bud break)	Main trunk and cordons					Main trunk and cordons			Lime sulfur (15–20 gal/A)	Dormant application is recommended if Phomopsis or anthracnose has been a major issue in previous years (which may also reduce powdery mildew population.)
Bud break and new shoots ***(Very important sprays for Phomopsis management)	Leaf and shoot		Leaf and shoot		Leaf and shoot	***Leaf and cane	Initial leaf infection	mancozeb *plus* sulfur	Captan *plus* sulfur	
Pre-bloom (critical period)	Leaf shoot, and flower	Flower	Leaf shoot, and flower		Leaf shoot, and flower	Leaf and shoot	Leaf and flower	mancozeb *plus* sulfur	Add PM or DM materials based on your needs. Canopy management will assist.	This is the start of the critical period for berry infection by various diseases.
Bloom (Critical period)	Leaf, shoot, and flower	Flower	Leaf and berry	Flower	Leaf and flower	Leaf, shoot, and flower	Leaf, rachis, and flower	mancozeb *plus* sulfur *plus* Botrytis specific material: Elevate, Vangard, etc.	Add PM or DM material based on your needs. Canopy management assists control	Bloom may last several weeks; thus, you may need to spray for bloom twice.

Seasonal 'at a glance' **fungicide** spray schedule options for bunch grapes

Diseases to be considered								**Fungicide(s) to be used**		
Developmental stage	**Anthracnose**	**Bitter rot, Ripe rot**	**Black rot**	**Botrytis bunch rot**	**Downy mildew (DM)**	**Phomopsis**	**Powdery mildew (PM)**	**Basic program**	**Options**	**Notes**
Immediate post bloom (Critical period)	Leaf, shoot, and berry	Berry	Leaf and berry		Leaf and berry	Leaf, cane, and berry	Leaf, rachis, and berry	mancozeb *plus* sulfur *plus* a PM or DM specific material	DM specific material (Revus - protectant, Ridomil products– some kick back), Black rot (Rally– some kick back),	Under wet conditions, add Ridomil or a Phosphite product for DM and Rally for Black rot
Early cover (critical period is almost over)	Leaf, shoot, and berry	Berry	Leaf and berry		Leaf	Berry	Leaf, rachis, and berry	mancozeb *or* captan *plus* sulfur (*plus* a PM or DM specific material, if needed)	DM specific material, *plus* Rally (or other DMI), if Black rot is a concern	mancozeb may not be an option due to its 66-day PHI
Bunch closure/berry touch	Leaf, shoot, and berry	Berry	Leaf and berry	Berry	Leaf		Leaf and rachis	captan *plus* sulfur *plus* Botrytis specific material: Elevate, or Vangard, or Scala, or Endura, or Pristine.	Canopy management, birds, and grape berry moth control are very important for Botrytis *plus* sour rot management.	This is the last opportunity to deliver the material into the cluster for tight-clustered cultivars.

Seasonal 'at a glance' **fungicide** spray schedule options for bunch grapes

Diseases to be considered								**Fungicide(s) to be used**		
Developmental stage	**Anthracnose**	**Bitter rot, Ripe rot**	**Black rot**	**Botrytis bunch rot**	**Downy mildew (DM)**	**Phomopsis**	**Powdery mildew (PM)**	**Basic program**	**Options**	**Notes**
Post berry touch	Leaf, shoot, and berry	Berry	Leaf and berry		Leaf	Berry	Leaf and rachis	captan *plus* sulfur (*plus* a PM or DM specific material, if needed)	Downy mildew specific material (Phosphite)	Scout young leaves for DM and PM. If the early-season protection was successful, you may be able to relax the schedule a bit as fruit becomes more resistant to infection.
Veraison		Berry		Berry	Leaf		Leaf and rachis	captan *plus* sulfur *plus* Botrytis specific material: Elevate, or Vangard, or Scala, or Endura, or Pristine, etc.	Bird and yellow jacket management. Ripe rot management. Begin application of insecticides for managing drosophila (sour rot)	We only have protective materials against Botrytis.
Preharvest		Berry		Berry	Leaf	Berry	Leaf	captan *plus* sulfur *plus* a Botrytis material (Captan has some efficacy against sour rot and other general rots)	Downy mildew specific material (Phosphite) Ripe rot management	

Seasonal 'at a glance' **fungicide** spray schedule options for bunch grapes

Diseases to be considered								**Fungicide(s) to be used**		
Developmental stage	**Anthracnose**	**Bitter rot, Ripe rot**	**Black rot**	**Botrytis bunch rot**	**Downy mildew (DM)**	**Phomopsis**	**Powdery mildew (PM)**	**Basic program**	**Options**	**Notes**
Postharvest					Leaf		Leaf	mancozeb (DM) *plus* sulfur (PM)	Fixed copper material for DM	Cleanup for the next season. Vines still need leaves for accumulation of carbohydrates for the winter.

Seasonal 'at a glance' **insect activity and monitoring** options for bunch grapes

Common and key insect pests and monitoring suggestions

Developmental Stage	**Spotted Lanternfly**	**Mealybugs**	**Sharpshooters/ Leafhoppers**	**Grape berry moth**	**Mites**	**Japanese beetles**	**Grape root borer**	**Spotted wing drosophila**
Dormant	Check for eggs, which can look like smeared mud on surfaces	Scout for mealybugs by looking under the bark.			Examine twigs using a hand lens for European red mite eggs (round reddish-orange eggs)			
Bud swell (bud is visibly swollen but no green or pink tissue is observed)		Scout for mealybugs by looking under the bark and near base of vine.						
Bud break and new shoot		Peel back loose bark on canes and look for the presence of grape mealybug crawlers	Place several double-sided yellow sticky traps per block. Check traps weekly and replace when they become dirty or discolored.					
Pre-bloom	Check for early instars of SLF, while every SLF age can feed on grapevines, they		Continue monitoring with double-sided yellow sticky traps.	Flight periods can be monitored using commercially				

Seasonal 'at a glance' **insect activity and monitoring** options for bunch grapes

Common and key insect pests and monitoring suggestions

Developmental Stage	Spotted Lanternfly	Mealybugs	Sharpshooters/ Leafhoppers	Grape berry moth	Mites	Japanese beetles	Grape root borer	Spotted wing drosophila
	may also feed on any Tree-of-Heaven in the nearby landscape			available pheromone-baited traps. For the first three flights, expect 50% emergence at 187-, 869-, and 1094-Degree Days above a base of 47 ºF after first male catch.				
Postbloom		Check leaves for sticky honeydew and black sooty mold. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor using commercially available pheromone-baited traps.	Check leaves for chlorotic spots and "bronzing". Using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf			
Fruit set		Check leaves for sticky honeydew and black sooty mold. Often associated with	Continue monitoring with double-sided yellow sticky traps.	Monitor with pheromone-baited traps. Look for webbing in the clusters when berries	Check leaves for "bronzing" and using a hand lens, check the underside of the leaf, along	Shiny green and copper-colored adults. Feeding "skeletonizes" leaves and is concentrated in		

Seasonal 'at a glance' **insect activity and monitoring** options for bunch grapes

Common and key insect pests and monitoring suggestions

Developmental Stage	Spotted Lanternfly	Mealybugs	Sharpshooters/ Leafhoppers	Grape berry moth	Mites	Japanese beetles	Grape root borer	Spotted wing drosophila
		the presence of ants.		are small. Larvae will web together multiple berries.	the leaf veins. Manage if more than 10 mites per leaf.	the upper part of the vine canopy.		
Berry touch and bunch closure	Monitor for adult SLF	Check clusters for waxy, white residue between berries and on rachis. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor with pheromone-baited traps. Check berries for holes, webbing, and dark tunneling underneath skin. Check berries showing symptoms for larvae.	Check leaves for "bronzing" and using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf.	Check for beetle aggregations and skeletonized leaves in the upper part of the vine canopy.		
Pre-veraison	Monitor for adult SLF	Check clusters for waxy, white residue between berries and on rachis. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor with pheromone-baited traps. Check berries for holes, webbing, and dark tunneling underneath skin. Check berries showing symptoms for larvae.	Check leaves for "bronzing" and using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf	Check for beetle aggregations and skeletonized leaves in the upper part of the vine canopy.	Monitor flight activity using commercially available pheromone-baited traps. Examine soil near base of vine for empty pupal skins.	

Seasonal 'at a glance' **insect activity and monitoring** options for bunch grapes

Common and key insect pests and monitoring suggestions

Developmental Stage	Spotted Lanternfly	Mealybugs	Sharpshooters/ Leafhoppers	Grape berry moth	Mites	Japanese beetles	Grape root borer	Spotted wing drosophila
Veraison	Adult SLF often aggregate in the vineyard and can reduce sugar and flavonoid production in ripening fruit.	Check clusters for waxy, white residue between berries and on rachis. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Continue monitoring as above.	Check leaves for "bronzing" and using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf	Check for beetle aggregations and skeletonized leaves in the upper part of the vine canopy.		Berries become attractive at 15°Brix. Presence in vineyards can be monitored with homemade traps, commercial lures, and larvae in fruit. Control decisions should be influenced by field history.
Preharvest	Adult SLF often aggregate, can collect on mechanical harvesters. They can also reduce carbon sequestration which can cause vines to be more vulnerable to winter injury and reduced productivity in following years.	Check clusters for waxy, white residue between berries and on rachis. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor with pheromone-baited traps. Check berries for holes, webbing, and dark tunneling underneath skin. Check berries showing symptoms for larvae.	Check leaves for "bronzing" and using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf	Check for beetle aggregations and skeletonized leaves in the upper part of the vine canopy. Severe feeding after veraison can have significant impact on fruit quality.		Presence in vineyards can be monitored with homemade traps, commercial lures, and larvae in fruit. Control decisions should be influenced by field history

Bunch Grape Integrated Management Guide (Cultural Practices)

For a visual reminder of the cultural practices as well as the timing for pests and diseases, see UGA Extension publication No. C1151: https://fieldreport.caes.uga.edu/publications/C1151/viticulture-management/.

Seasonal 'at a glance' **cultural practice** schedule for bunch grapes		
Developmental Stage	**Practice**	**Note**
Dormant	Cane and Spur Pruning	One of the most important annual tasks. Typically completed from December through March in Southeastern U.S. vineyards. Pruning sets the crop potential by retaining buds that are anticipated to bear fruitful shoots and to remove dead/diseased wood.
	Nutrient Soil Sampling (Post plant)	Collect soil samples in the fall or winter when plants are dormant (and soil is slightly damp) from the upper 8 in. of soil under plant. Soil sampling should be performed every 2 to 3 years to monitor changes in nutrients, pH, and organic matter. Note: There is a poor correlation between soil nutrients (or the nutrients that are available) and plant tissue nutrition (what the plant has absorbed); however, having a record of both over years can help identify nutrient problems early before vine health is impacted.
Bud Swell	Cane and Spur Pruning	Final pruning should be completed during bud swell, unless delaying final prune for frost protection in which pruning should not be delayed past 6 in. of new shoot growth.
Bud Break	Frost damage protection	Use frost protection methods: air mixing (through wind machines) and delayed pruning are common methods to protect vine tissue.
Bud Break to Pre-bloom	Shoot thinning	Thinning should occur by 3–7 in. of shoot growth, preferably as soon as it is possible to determine fruitful vs. non-fruitful shoots to reduce damage to shoots. Shoots should be thinned to roughly 3–5 shoots per linear foot of cordon or cane.
Pre-bloom through Fruit Set	Cluster thinning	Especially important on young (< 3-year-old), stressed, or otherwise low vigor vines, cluster thinning may be used to refine the crop load to balance the reproductive and vegetative growth of the vine. The earlier cluster thinning occurs, the more pronounced the effects. Thinning can be delayed until almost bunch-closure, if insurance is needed for accidental crop loss, but any cluster thinning post-veraison should only be used for disease sanitation and will have minimal effects on fruit quality or vine health.

Seasonal 'at a glance' **cultural practice** schedule for bunch grapes		
Developmental Stage	**Practice**	**Note**
Pre-bloom through Fruit Set	Shoot positioning	Most effective when done before the shoot tendrils firmly attach to the wires or neighboring shoots. Positioning should occur according to the intended training system to maximize leaf exposure and limit leaf shading.
Bloom	Nutrient tissue sampling	Collect leaf tissue (leaf blades and/or petioles) opposite of the flower clusters at the base of a primary shoot. Routine tissue nutritional analysis can be helpful to identify issues early, often better than a soil test for identifying nutritional issues. If necessary, apply ground-applied fertilizer. Bloom nutritional sampling can be better for micronutrient analysis, while veraison can be better for macronutrient analysis.
Fruit Set	Fruit zone leaf removal	Immediately after fruit set and ideally prior to BB-sized berries, fruit zone leaf removal can acclimate grapes to ambient radiation and temperature, reducing threat of severe fruit sunburn. Leaf removal speeds cluster drying, improves spray penetration, and, therefore, offers better bunch rot control relative to unmanaged fruit zones.
BB-sized Fruit	Fruit zone leaf removal	Complete any fruit zone leaf removal
Pea-sized Fruit to Veraison	Canopy hedging or skirting	Depending on training and trellis, hedge top and sides (or bottom and sides) of vines to ensure optimal canopy sunlight and spray penetration. Lateral shoots should be hedged from the sides of the primary shoots and primary shoots should be hedged at their apex before they bend over and shade the canopy below. Trailing, downward trained vines should be skirted to leave 3–5 ft between the ground and the canopy.
Bunch Closure	Fruit zone leaf removal	A 'cleanup pass' may be necessary around bunch closure to remove any foliage that has regrown into the fruit zone.
Veraison	Nutrient tissue sampling	Collect leaf tissue from the youngest fully expanded leaf at the top of a primary shoot. Routine tissue nutritional analysis can help identify issues early. Veraison sampling can be better for macronutrient analysis. Additionally, at this time, visual symptoms of nutrient deficiencies or toxicities are more likely to be apparent, as the vines are allocating more resources away from the leaves, allowing for better targeted sampling of potential issues. However, if deficiencies are identified, fertilization may need to wait until the following growing season.
Veraison	Bird netting	Place immediately upon berry softening and color change to prevent bird depredation.

Seasonal 'at a glance' **cultural practice** schedule for bunch grapes		
Developmental Stage	**Practice**	**Note**
Preharvest	Scouting	Nutrient disorders and systemic infections are more likely to be apparent at this time, though scouting should occur throughout the year for potential issues. Red or yellow leaves can be indicative of potential nutritional or disease issues. If time is limited, flag the vines and plan to attend to them after harvest.
Harvest	Harvest	Harvest decisions are region-, site-, and cultivar-specific. Use grape chemistry analyses, sensory perception (taste, color, fruit integrity), intended wine style, and predicted weather patterns to make judicious harvest decisions.

Establishment

Time spent selecting, preparing, and maintaining a site can result in greater cropping consistency, higher fruit quality, reduced pest pressures, increased efficiency in maintaining the vineyard, and longer vineyard life. **Site Elevation** relative to immediate surroundings provides some protection from frosts and diseases; frosts and fogs settle in low areas first. Vineyards in elevated sites may escape damaging low temperatures. They may also dry off faster after rain or dew due to better airflow, thus lessening the potential for development of certain diseases. **Direction of slope** may also impact vineyard performance. Vines on a south-facing slope are more prone to trunk injury from winter cold and, since they become active earlier in spring, to spring frosts. An east-facing slope dries off quicker than others thus lessening pressure from certain diseases. **Soils** should have a minimum rooting depth of 24 to 30 in. with good internal and surface drainage. Highly fertile soils are not desirable as vine growth may be excessive resulting in reduced yields, poor fruit quality and high disease potential. The spacing between vines and rows may be increased and the type of trellis used may be modified to accommodate more fertile sites, however, many of the problems due to excessive vigor will still exist. The ideal pH of vineyard soils is in the range of 6.0 to 6.5 for American bunch and interspecific hybrid bunch grapes and 6.5 for *Vitis vinifera* cultivars. The presence of wild grapevines near the site may increase problems with certain pests of grapes. Adjacent woodlands, brushy areas and power lines may be good nesting and roosting sites for birds, which can cause significant damage to crops.

Site development

Once a site has been selected, ample time should be devoted to preparing the site well in advance of planting. Hedgerows, overgrown fencerows, or any other obstacles that reduce air drainage out of the vineyard site should be removed. Certain non-persistent herbicides that are not labeled for vineyards can be used in advance of planting to eliminate noxious weeds. **Soil testing** should be done to determine the nutritional status of the soil. Nematode testing should also occur at this time. Collect one sample in the upper 8 in. of soil (discard the top inch) and a second sample in the 8 to 16-in. depth. If needed, fertilizer and lime should be applied and incorporated into the soil well in advance of planting. Where magnesium levels are low, use dolomitic limestone. The desired amount of phosphorus should be incorporated during preplant soil preparation and should provide adequate phosphorus for the life of the vineyard. If the field is rough, it should be tilled to provide a smoother vineyard floor and reseeded to a desirable sod. If this is not necessary, 4- to 6-ft wide strips where the rows will be located should be sprayed with a suitable herbicide in advance of planting to eliminate competition for moisture, nutrients and sunlight between young vines and grasses or weeds. Tilling these strips once the herbicide has had time to act will help to incorporate lime and fertilizers. If the field to be planted is flat or very gently sloping, orienting rows north and south may result in more uniform exposure of clusters and leaves throughout the life of the vineyard, especially with certain trellis designs and training systems. However, if the site is not level, or close to level, consider orienting rows across the slope.

The ideal floor management system for most southern vineyards involves maintaining a 3- to 4-ft wide strip under the trellis free of grasses and weeds through the use of appropriate herbicides. The area between rows should be maintained in sod which serves as a deceleration and diffusion strip for runoff water to lessen erosion problems. A protective vine guard, like a grow tube, can be used to protect the vines from herbicide or mechanical damage; vine guards can potentially hide insect infestations (e.g., Japanese beetles, fire ants, black widow spiders) inside the tube and should be monitored. A sod strip can provide support for equipment travel.

Establishment

Site development (cont.)
The precision in pesticide application and the ease in designing and operating an irrigation system is better when working across slopes as opposed to up and down them. Constructing and maintaining trellises on a contour can be very difficult. Operating a mechanical harvester on contoured rows is also difficult. Instead, plant straight rows across the slope. Where the direction of the slope changes, stop the trellis and start anew on the different slope. This will facilitate construction and maintenance of the trellis, provide a drainage path for air out of the vineyard and give a place to turn equipment. Use a trellis design and a training system that keeps the vine up off the ground to allow for good air drainage under the trellis. The function of a trellis is to support the vine and the crop, orient the foliage and fruit for maximum sunlight exposure and to facilitate ease of working in the vineyard. The trellis should be designed and constructed to last a long time. These concepts will not only allow for better quality fruit production but also serve to lessen pest pressure by good sunlight penetration, wind movement and spray coverage throughout the canopy.

Plant selection
Please make sure to 1) obtain clean materials (certified vines) where possible from reputable nurseries. Obtain materials that were certified for the protocol 2010 (= based on meristem shoot culture from the National Clean Plant Network in CA, = virus-tested vines), if possible. The risk of viral infection can be greatly reduced by planting clean vines. The only remedy for virus diseases is rogueing of the infected vines. 2) Consider cultivars (and rootstocks) that fit our environment. Rootstocks should have phylloxera resistance (American grape heritage), as well as nematode tolerance. Many hybrid cultivars are resistant to certain diseases that are common in the South. Proper cultivar selection will help you reduce the number of fungicide applications. Communicate with Extension agents and nurseries about cultivars. It is often recommended to start communicating with a nursery a season or two prior to your planting so that they can grow vines for you.

Rootstock selection
Without a doubt, the primary factor in deciding whether a grapevine needs to be grafted or not is its resistance to grape phylloxera. Muscadine is resistant, or at least highly tolerant, to phylloxera, while resistance of native American and interspecific hybrid cultivars is variable. All vinifera grapes and hybrid grapes with 50% or more vinifera in their parentage should be grafted to a rootstock that provides resistance to phylloxera and nematode-transmitted viruses, such as tomato ringspot virus (Wolf, 2008). See table below for more rootstock information. Currently, there is very limited information on rootstock performance in the southeast region specifically.

There are advantages and disadvantages for own-rooted cuttings vs grafted vines. Own-rooted cuttings, plants tend to be less expensive. If their trunks are damaged or destroyed, new shoots will grow from buds located at or below the soil line whereas grafted vines will develop shoots from the rootstock that will either need to be regrafted or the vine will need to be removed. Also, the graft union is generally the weakest part of the vine, and the incidence of crown gall is apt to become a problem at that point. The list of disadvantages includes sensitivity to certain pests such as nematodes, and phylloxera. Rootstocks can provide a better adaptability to either high or low pH soils, adaptability to saline and/or wet soils, as well as adaptability to drought. Additional benefits of rootstock use include their ability to advance or delay blooming and crop ripening, adjust vigor, increase yield, and improve fruit quality. When replanting a vineyard, choose a rootstock having a different genetic composition than the one being replaced to lessen the chances of resistance development. If, for example, the original vineyard was on 3309 C rootstock, avoid planting 3309 C or 101-14 Mgt, which share the same resistance mechanism–for nematodes.

Establishment

Fumigant risk mitigation.
There are now numerous risk mitigation regulations for all fumigants. See **https://www.epa.gov/soil-fumigants/implementing-safety-measures** or specific regulations associated with risk mitigation. Follow all mitigation measurements carefully. Prior to any fumigation action, soil testing should be conducted to determine if it is necessary.

Fumigation with Telone products. Fumigant products are highly toxic. Carefully abide by all label precautions and review the label before each application. Follow guidelines on the label on safety (e.g., PPE, WPS, timing and conditions of application, etc.), and it is highly recommended to hire professionals who can apply the fumigants safely.

Replant disorder. This is a poorly defined condition caused by replanting in the same vineyard without allowing sufficient time between old plant removal and new plant establishment. This can occur broadly when whole vineyards are replanted or it can occur with individual vines. Broad-spectrum fumigation may help with this disorder, but good information as to the benefit of these practices is lacking in the Southeast. (Replant with grafted vines, in between old vines' hole.)

Establishment

Common rootstocks with resistance level to soilborne pests and environmental characteristics

Rootstock

	Riparia Gloire	101-14 Mgt.	3309 Couderc	1103 Paulsen	110R	5C	SO4	420A
Parentage	*V. riparia*	*V. riparia* x *V. rupestris*		*V. berlandieri* x *V. rupestris*		*V. berlandieri* x *V. riparia*		
Scion vigor	Low	Moderate	High	High	High	Very High	Very High	Low
Phylloxera resistance	Very High	High	High	High	High	High	High	High
Dagger nematode resistance	Moderate	Moderate	Low	Low	Low	Moderate	Low	Low
Root knot nematode resistance	Moderate	Moderate	Low	Moderate	Moderate	Moderate	Moderate	Low
Drought resistance	Low	Low to Moderate	Moderate	High	Very High	Moderate	Moderate	Moderate
Wet feet resistance	Moderate	Moderate	Moderate	Moderate	Low to Moderate	Moderate	Moderate	Low to Moderate
Lime tolerance	Very low	Low	Low	High	High	Moderate	Moderate	High
Salinity tolerance	Low	Low	Low	Moderate	Moderate	Moderate	Low	Low
Maturity	Early	Early	Mid	Late	Late	Early	Mid	Early
Cotton root rot resistance	Unknown	Unknown	Low	Moderate to High	Low	Low	Low	Unknown
Pierce's disease resistance	Unknown	Unknown	Unknown	High	Moderate	Moderate	Moderate	Unknown

The contents of the table were adapted from the Wine Grape Production Guide for Eastern North America (Wolf, 2008), Growing Grapes in Texas (Kamas, 2014), and Grape Rootstocks for Michigan (Perry and Sabbatini, 2015), and reproduced with a permission from Double A vineyards. Another reference from Oklahoma State University is available at *https://extension.okstate.edu/fact-sheets/rootstocks-for-grape-production*.

Establishment

Efficacy, PHI, and REI of each management option in this guide

In the following sections, the efficacy or importance of management options is indicated by **E = excellent, VG = very good, G = good, F = fair, and P = poor**. These ratings are benchmarks; actual performance will vary.
The PHI and REI are based on the material with the longest PHI and REI. E.g., if the section suggests mancozeb (PHI=66 days, REI = 24 hours) AND Mettle (PHI = 14 days, REI = 12 hours), PHI and REI shown in the table is 66 days and 24 hr, respectively.

Establishment (Nematode management)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments
Nematodes (test field prior to management action)	1,3-dichloro-propene (Telone II)	27–35 gal	E	5 days		SEE LABEL FOR ADDITIONAL INFORMATION. **Suggested pre-plant interval:** 4–8 weeks, longer when dissipation is slow.
	metam sodium (Vapam, Sectagon II, Busan 1020)	75 gal	G	48 hr		SEE LABEL FOR ADDITIONAL INFORMATION If tarps are used for the application, non-handler entry is prohibited while tarps are being removed. Soil temperature must be 40 ˚F–90 ˚F for activity. Soil moisture must be adequate and has to be thoroughly cultivated prior to application. On well-drained soils with light to medium texture planting can begin 14–21 days after treatment. If soils are heavy or high in organic matter, or if the soils remain wet and/or cold (< 60 ˚F) following the application, a minimum interval of 21 days is necessary. Dissipation can be increased through cultivation. **Plan for at least a 4-week interval between treatment and planting. More time may be required.**
	Pic-Clor 60 EC (1,3-dichloropropene 37% *plus* chloropicrin 57%)	19.5–44.5 gal	VG	5 days		SEE LABEL FOR ADDITIONAL INFORMATION

Establishment (Nematode management)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments**
Nematodes	1,3-dichloro-propene (Telone II)	27–35 gal	E	5 days		SEE LABEL FOR ADDITIONAL INFORMATION **Suggested pre-plant interval:** 4 to 8 weeks, longer when dissipation is slow.
	metam sodium (Vapam, Sectagon II, Busan 1020)	75 gallons	G	48 hr		SEE LABEL FOR ADDITIONAL INFORMATION If tarps are used for the application, non-handler entry is prohibited while tarps are being removed. Soil temperature must be 40 ˚F to 90˚F for activity. Soil moisture must be adequate, and soil must be thoroughly cultivated prior to application. On well-drained soils with light to medium texture planting can begin 14–21 days after treatment. If soils are heavy or high in organic matter, or if the soils remain wet and/or cold (< 60 ˚F) following the application, a minimum interval of 21 days is necessary. Dissipation can be increased through cultivation. **Plan for at least a 4-week interval between treatment and planting. More time may be required.**
	Pic-Clor 60 EC (1,3-dichloropropene 37% *plus* chloropicrin 57%)	19.5–44.5 gal	VG	5 days		SEE LABEL FOR ADDITIONAL INFORMATION

Dormant (no visible activities on buds)

General Comments

Dormant pruning – Pruning has several functions: removal of non-productive or marginally productive wood, encouraging the growth of new wood where fruiting will occur the following year, opening the canopy to sunlight, air and spray penetration, adjusting crop load and eliminating dead, diseased or insect-infested wood. Annual pruning is essential to the consistent production of high-quality fruit. Pruned wood materials should be removed from the vineyard or finely chopped using a flail mower to lessen the chances of perpetuating a disease and insect problems that might have existed on the pruned woods. Any remaining mummy clusters should be removed or at least cut off and dropped to the ground. The time to prune depends on the amount of labor available, the size of the vineyards, fruitfulness of the cultivar on secondary buds, conflicting demands for time, and rainfall events. Pruning vines should not happen during a rain event.

Generally, the later in the dormant season that pruning can be done, the better. Pruning after growth has started can be used to delay bud break, thus, possibly escaping damage from a late frost. This practice is especially effective with early-budbreak cultivars, but the final pruning of canes should always occur before shoots reach 5–7 in.

Double pruning—This is a practice to perform rough pruning in the fall or in winter that leaves spurs or long canes with excessive bud numbers, followed with a final pruning in the spring before bud break. It can reduce the risk of some woody/vascular diseases, such as *Botryosphaeria* canker, Eutypa dieback, etc. An application of a protective fungicide spray within 24 hours of pruning may help reduce disease infection. Some people combine double pruning and delayed pruning.

Dormant application of fungicides—A high rate of lime sulfur (10 gal per acre using 100 gal of water, or Sulforix 1–2 gal) is known to be the most important management tool for anthracnose. This spray needs to be applied BEFORE bud break. It should suppress Phomopsis and powdery mildew; however, the dormant season application will not be a substitute for in-season protective fungicide applications. Thus, use the dormant season application in conjunction with in-season applications for target pathogen(s). Norton and other sulfur-sensitive cultivars are sensitive to lime-sulfur sprays (i.e., spray before you see any green tissues). List of sulfur-sensitive cultivars at https://pnwhandbooks.org/plantdisease/cultivar-tables/grape-vitis-spp-relative-disease-susceptibility-sensitivity-sulfur.

Pruning wound protection—Pruning wound treatment has been discussed in different places and in different contexts. In California, where Eutypa dieback is a big issue, they tested a wound paste that contained boron, like **B-Lock** (Nutrient Technologies, CA). Although it is not available locally, you can order it from Farm Supply Company in CA (https://www.farmsupplycompany.com/), and they will ship it to you. Also, there is a new product called **VitiSeal**, which contains essential oils. These pastes protect wounds from the infection by Eutypa and Esca. However, Eutypa is a minor problem in the southeastern U.S. The survey of wood canker diseases by Dr. Phillipe Rolshausen in 2008 did not find a positive Eutypa case from VA samples. In addition to the pastes, there are several labeled fungicides; however, Topsin-M and Pristine have a better efficacy against Botryosphaeria canker. These will be applied as paint-on or as a spray. Please see the newest labels for detailed rate and application information.

Soil testing—Soil tests should be conducted every 2 to 3 years after planting. Samples should be collected from 1 to 8 and 8 to 16 in. in depth. Results from soil tests may be useful in understanding results from petiole testing. It is better to test soil in the fall.

Insect scouting—Scout for mealybugs by looking under the bark. Examine twigs using a hand lens for European red mite eggs (round reddish-orange eggs). Scout twigs for scale insects. If any of these arthropods are found, a dormant oil application may be justified at bud swell. High spray volume (100 gal per acre) is needed to coat and subsequently kill the mealybugs, mite eggs, or scale hidden in rough bark.

(Grape illustrations are by Megan Mccoy adapted from SRSFC Viticulture Management Poster)

Dormant

Disease Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Black rot Bitter rot Phomopsis Ripe rot	Prune out mummies, cankers, dead wood		Very important			Removal of mummies, rachises, and cankered and dead wood (including prunings) from the vineyard is very important to reduce inoculum of rot fungi.
Downy mildew	Shred, remove or bury leaves		Very important			By shredding leaves with a flail mower, burying them by cultivation, or removing them, the inoculum of the downy mildew fungus will be reduced. (Application of urea is known to reduce the risk of apple scab and the same principal may apply. It can aid in breakdown of leaves at ¾ defoliation, spray on canopy and the ground at 4–5 lb/A)
Anthracnose and Phomopsis	Calcium polysulfide (generic lime sulfur) (Sulforix)	10 gal or see label 1.0–2.0 gal w/ sufficient water, please see label.	G (no data)	48 hr 48 hr	0 days (see label)	**A dormant spray of lime sulfur is very effective on anthracnose.** Many hybrids are very sensitive to this disease and if they are known to have anthracnose, spray lime sulfur. Sufficient water should be used to thoroughly wet the vines. This spray helps reduce the overwintering inoculum of the Phomopsis and it may reduce powdery mildew fungus inoculum. A newer product, Sulforix, claims that it can be effective as low as 1 gal per acre, but we are lacking data to validate the efficacy.
Trunk diseases (in general)	Double pruning		G			Please see the comment section above. Our main trunk disease is Botryosphaeria canker (Bot canker). Once the vine is affected, practice cane or cordon renewal. To prevent infection, pruning wound protectants like B-lock, VitiSeal, or Topsin can reduce risk of infection.
	Cane/cordon renewal		Very Important			Retraining of vines can prolong vine life from trunk diseases. Cut back diseased wood a minimum of 4 in. below the discolored wood. Train new shoots the following year.

Dormant

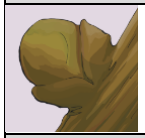
Disease Management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Trunk diseases (in general, cont.)	latex paint with boron (B-lock) (VitiSeal)		G			Protective paint for wound protection. B-lock has some efficacy against Bot canker. VitiSeal is a relatively new material that claims its efficacy against Bot canker.
	thiophanate-methyl (Topsin-M WSB)	0.75–1.5 lb see label	G	7 days		Make sure to get the new label that has the instructions for dormant application. (**FRAC = 1**)

Insect pest management

Dormant application of insecticides – Sprays at this time are complicated by difficulties in achieving adequate coverage because of the fibrous nature of bark. European red mite eggs would be a target for oil sprays at this time if thorough coverage could be achieved. Mealybugs and scale insects may be targeted in dormant or delayed dormant period if there was a problem the previous year. If control cannot be achieved at this time, summer timing is also available.

Bud swell



Bud swell is when the bud is visibly swollen but no green or pink tissue is observed. (Grape illustrations are by Megan Mccoy adapted from SRSFC Viticulture Management Poster)

Insect pest management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC Code)
Climbing cutworms	carbaryl (Sevin XLR Plus)	2 qt	G	48 hr	7 days	REI is 6 days for grape girdling and cane turning **(IRAC = 1A)**
	zeta-cypermethrin (Mustang Maxx)	2–4 oz	G	12 hr	1 day	**(IRAC = 3A)**
	bifenthrin (Brigade eVo) (Sniper)	3.2–6.4 oz	G	12 hr	30 days	**(IRAC = 3A)**
	beta-cyfluthrin (Baythroid XL)	2.4–3.2 fl oz	G	12 hr	3 days	**(IRAC = 3A)**
	methoxyfenozide (Intrepid 2F)	12–16 fl oz	G	4 hr	30 days	**(IRAC = 18)**
	spinetoram (Delegate 25 WG) (Hemi SC)	3–5 oz 6–10 fl oz	G	4 hr 4 hr	7 days 3 days	**(IRAC = 5)**
	spinosad (Entrust 80W, Entrust SC)	1.25–2.5 oz 4–8 fl oz	G	4 hr	7 days	OMRI approved. **(IRAC = 5)**
	Bacillus thuringiensis [Bt] (Dipel DF and others)	0.5–1 lb	F	4 hr	0 days	OMRI approved. **(IRAC = 11)**
	chlorantraniliprole (Altacor eVo)	1.5–2.2 oz	G	4 hr	14 days	Use between 100-200 gallons per acre total spray volume. **(IRAC = 28)**

Bud swell						
Grape flea beetle	carbaryl (Sevin XLR Plus)	1–2 qt	G	48 hr	7 days	REI is 6 days for grape girdling and cane turning **(IRAC = 1A)**
	zeta-cypermethrin (Mustang Maxx)	4.0 oz	G	12 hr	1 day	**(IRAC = 3A)**
	beta-cyfluthrin (Baythroid XL)	2.4–3.2 fl oz	G	12 hr	3 days	**(IRAC = 3A)**
	phosmet (Imidan 70-W)	1.33–2.125 1b	G	14 days	14 days	The 14-day REI may make this product impractical to use for most growers. **(IRAC = 1B)**
Mealybugs	mineral oils (various)	see label	G	See label	See label	Also helps control European red mites and scale. **(IRAC = UNM)** Oil may not work well with grapes: high volume of water is necessary. Do not spray within 30 days of a lime sulfur spray.
	JMS Stylet Oil and Organic JMS Stylet Oil	1–2 gal per 100 gal of water**,** apply 200–300 gal per acre	G	4 hr	NA	The Organic JMS Stylet Oil is OMRI approved. **(IRAC = UNM)** Oil may not work well with grapes: high volume of water is necessary. Do not spray within 30 days of a lime sulfur spray.
	clothianidin (Belay)	6 fl oz (foliar) 6-12 fl oz (soil)	G VG	12 hr 12 hr	0 days 30 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. For foliar application, do not make more than one application per year. Choose the lower rate for light infestation, and the lower rate for heavy infestation. **(IRAC = 4A)**
	buprofezin (Applaud 70DF)	24 oz	G	12 hr	7 days	**(IRAC = 16)**

Bud swell						
Mealybugs (cont.)	dinotefuran (Venom) (Scorpion 35SL)	5–7.5 oz (foliar) 9–10.5 fl oz (soil) 1.75–5.25 fl oz (foliar) 9–13.25 fl oz (soil)	G VG G VG	12 hr 12 hr	1 day 28 days 1 day 28 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. **(IRAC = 4A)**
	imidacloprid (Admire Pro)	7–14 fl oz (soil)	VG	12 hr	30 days (soil)	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. **(IRAC = 4A)**
	acetamiprid (Assail 30SG)	2.5–5.3 oz	G	12 hr	3 days	**(IRAC = 4A)**
	beta-cyfluthrin (Baythroid XL)	2.4–3.2 fl oz	G	12 hr	3 days	**(IRAC = 3)**
Grape scale	acetamiprid (Assail 30SG)	2.5–5.3 oz	G	12 hr	3 days	**(IRAC = 4A)** If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made.
	imidacloprid (Admire Pro)	7–14 fl oz (soil)	G	12 hr	30 days	Soil application **(IRAC = 4A)** If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made.
	buprofezin (Applaud 70DF)	24 oz	G	12 hr	7 days	**(IRAC = 16)** Check your state's information
Aphid						Aphid populations on grapevines usually do not require control. The vigor of grapevines helps them tolerate aphid feeding, and natural enemy populations often respond to increasing aphid numbers.

Bud Swell

Leafroll and red blotch diseases—Both are virus diseases that have similar symptoms. Once infected, vines can show red discolorations on interveinal area of leaf (on red-fruited cultivars), and cupping or rolling of leaves (on both red- and white-fruited cultivars) is often associated with leafroll disease. Damage from these virus infections include reduced yields, delayed ripening, reduced sugar levels, and reduced color (~anthocyanin) in skin tissues, and it can also cause reduction of overall vine vigor. Both viruses can enter a vineyard through transplanting of infected nursery stock, thus, it is highly recommended to obtain vines produced using Protocol 2010, which is the newest protocol for clean plant material production (Foundation Plant Services (ucdavis.edu)). Several types of leafroll viruses are known, and vines can be tested for these viruses. Contact your local extension agent if you have suspicious vines. If leafroll or red blotch virus has been confirmed, infected vines should be immediately removed and destroyed to reduce risks of spreading. Several species of mealybugs are primary vectors of leafroll viruses. When both leafroll virus(es) and mealybug presence is confirmed, insecticide application should be initiated to minimize spread of mealybug infestations and leafroll. Nutrient tissue testing should also be done if viruses are suspected, which can often present similar symptoms.

Bud Break and New Shoot Sprays

General Comments

(7–10-day interval from 1-in. shoot growth until pre-bloom)

Shoot positioning – Increasing shoot growth, light penetration, air movement, and spray coverage throughout the canopy will improve fruit quality and reduce pest pressure. Leaves in heavily shaded portions of the canopy do not photosynthetically contribute much and can create conditions beneficial to the pathogens like powdery mildew thrive under the shade. The potential for next year's crop can also be adversely affected if the leaves at the nodes to be retained for that crop are shaded. Shoot positioning methods differ with the vine training system. For example, with the VSP, shoots will be tacked into support wires with no or little overlaps between shoots to be trained vertically from the cordon or cane. With a high wire bilateral cordon training, it involves moving shoots on the top of the canopy and those that overlap other shoots on the sides to a vertical position on each side of the canopy. The basic idea here is to allow better sunlight interception by all the leaves and to promote better air circulation throughout the canopy. Shoot positioning may need to be done several times during the growing season beginning before bloom.

Observations on growth and fruiting – note any abnormalities in leaf or shoot growth, leaf color and crop development.

(Grape illustrations are by Megan Mccoy adapted from SRSFC Viticulture Management Poster)

Diseases

During the early season, Phomopsis cane and leaf spot and anthracnose are primary diseases of concern, as the pathogens of these two diseases can be active in relatively low temperature ranges (can cause infection in the mid-40's).

Also, when there are unseasonably warm rain events, both downy mildew and black rot can appear early as well. Mancozeb products, when applied for Phomopsis, will also be effective against downy mildew and black rot. A low rate of sulfur can be a relatively cheap and effective material that can be tank mixed as insurance for powdery mildew in non-sulfur sensitive cultivars.

Notes on the use of sulfur products: Avoid sulfur on sulfur-sensitive cultivars. List of sulfur-sensitive cultivars at https://pnwhandbooks.org/plantdisease/cultivar-tables/grape-vitis-spp-relative-disease-susceptibility-sensitivity-sulfur.

Generally, do not use sulfur within 2 weeks of an oil application. Sulfur injury may occur on cultivars not otherwise sensitive if temperatures are greater than 85 °F with relative humidity greater than 75% at the time of application. Sulfur injury may potentially occur when the temperature exceeds 85 °F while the leaf surface is still wet from the application.

List of cultivars with sensitivity to different chemicals at https://www.umass.edu/agriculture-food-environment/fruit/ne-small-fruit-management-guide/grapes/diseases/table-55-relative-disease-susceptibility-chemical-sensitivity-for-selected.

Bud break and new shoot sprays

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Disease management						
Phomopsis Black rot Powdery mildew Downy mildew	mancozeb (various formulations) **plus** sulfur (various formulations)	see label see label	VG	24 hr	66 days	This should be the backbone of your fungicide program, especially early in the season. Mancozeb targets Phomopsis, downy mildew, and black rot, while sulfur targets powdery mildew. **FRAC = M3** for mancozeb and **M2** for sulfur If your vineyard has a history of anthracnose, consider replacing mancozeb with captan. Note: sulfur may not be as effective at low temperature < 65 °F. Note: There can be phytotoxicity problems when applying sulfur on Norton or other sulfur sensitive cultivars. If unsure if your cultivar is sulfur-sensitive, test on single vine.
When disease conditions are conducive, other materials can be tank mixed or alternated with the backbone materials to provide additional protection.						
Anthracnose (Bird's-eye rot)	boscalid + pyraclostrobin (Pristine 38WG)	8.0-10.5 oz	E	24 hr	14 days	Mancozeb and captan both have efficacy against anthracnose, but in case of severe infection, an additional Pristine application may be needed. Do not apply Pristine to Concord, Worden, Fredonia, Niagara or related grape cultivars (with *V. labrusca*) due to possible injury. This class of fungicides is prone to resistance. (**FRAC = 7 + 11**) Anthracnose is generally more sensitive in hybrid bunch grapes than in *V. vinifera.*

Bud break and new shoot sprays						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
	pydiflumetofen + fludioxonil (Miravis Prime)	9.2–13.4 fl oz	See comments	12 hr	14 days	Based on the mode of action group, efficacy is most likely be VG – E. (**FRAC = 7 + 12**)
	benzovindiflupyr (Aprovia)	8.6–10.5 fl oz	See comments	12 hr	21 days	Based on the mode of action group, efficacy is most likely be VG – E. (**FRAC = 7**)
	benzovindiflupyr + difenoconazole (Aprovia Top)	8.5–13.3 fl oz	See comments	12 hr	21 days	Based on the mode of action group, efficacy is most likely be E. (**FRAC = 7 + 3**)
	difenoconazole + cyprodinil (Inspire Super)	16–20 fl oz	See comments	12 hr	14 days	Based on the mode of action group, efficacy is most likely be G-VG. (**FRAC = 3 + 9**)
	captan (various formulations)	see label	G	48 hr	0 days	Captan does not need to be used this early in the season if mancozeb is being used. This is the backbone product that should be saved for later in the season. Please check your label for REI since it differs with the product. (**FRAC = M4**, low resistance risk)
Insect pest management						
Sharpshooter, leafhoppers (Pierce's disease suppression)	imidacloprid (Admire Pro)	7–14 fl oz (soil)	VG	12 hr	30 days (soil)	Soil applications can provide better control than a foliar application. If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. Only apply 14 fl oz per season. **(IRAC = 4A). Imidacloprid may be applied in two 7 fl oz applications 30 days apart to increase the efficacy.**

Bud break and new shoot sprays

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Sharpshooter, leafhoppers (Pierce's disease suppression) (cont.)	dinotefuran (Venom) (Scorpion 35SL)	5–7.5 oz (soil) 9–10.5 fl oz (soil)	VG VG	12 hr 12 hr	28 days 28 days	Soil applications can provide better control than a foliar application. If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. **(IRAC = 4A)**
	clothianidin (Belay)	6–12 fl oz (soil)	VG	12 hr	30 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. For foliar application, do not make more than one application per year. Choose the lower rate for light infestation, and the higher rate for heavy infestation. **(IRAC = 4A)**
Mealybugs	clothianidin (Belay)	6 fl oz (foliar) 6–12 fl oz (soil)	G VG	12 hr 12 hr	0 days 30 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. For foliar applications, do not make more than one application per year. Choose the lower rate for light infestation and the higher rate for heavy infestation. (**IRAC = 4A**)
	JMS Stylet Oil and Organic JMS Stylet Oil	1–2 gal per 100 gal of water, apply 200–300 gal per acre	G	4 hr	NA	This is only applicable to Stylet oil or other highly refined mineral oils. The Organic JMS Stylet Oil is OMRI approved. (**IRAC = NA**). *Do not apply within 14 days of a captan or sulfur application.* Frequent application may be needed.
	buprofezin (Applaud 70DF)	9–12 oz	G	12 hr	7 days	**(IRAC = 16)**

Bud break and new shoot sprays

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Mealybugs (cont.)	spirotetramat (Movento)	6–8 fl oz	G	24 hr	7 days	Movento is fully systemic and translocated to shoots and roots. Fully expanded leaf tissue is required for systemic activity. **(IRAC = 23)**
	dinotefuran (Venom)	1–3 fl oz (foliar) 5–7.5 oz (soil)	G VG	12 hr 12 hr	1 day 28 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. **(IRAC = 4A)**
	dinotefuran (Scorpion 35SL)	1–5.25 fl oz (foliar) 9–13.25 fl oz (soil)	G VG	12 hr 12 hr	1 day 28 days	
	imidacloprid (Admire Pro)	7–14 fl oz (soil)	VG	12 hr	30 days (soil)	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. **(IRAC = 4A)**
	acetamiprid (Assail 30SG)	2.5–5.3 oz	G	12 hr	3 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. **(IRAC = 4A)**
	beta-cyfluthrin (Baythroid XL)	2.4–3.2 fl oz	G	12 hr	3 days	Restricted material. **(IRAC = 3)**

Pre-Bloom

General Comments

(~7–10 days before bloom)

Shoot thinning and positioning—It is important to thin excess vegetative shoots (no more than 3 to 5 shoots/ linear foot remaining) and position remaining shoots while they are still flexible. Also, in terms of disease management, an open canopy will provide good airflow and better sunlight penetration to reduce the risk of disease development and allow fungicides to reach the fruiting zone for an optimal coverage.

Cluster thinning—Cluster thinning may be done to further refine crop load adjustment on the vine. Overproduction on a vine can result in poor cluster size and quality and reduced shoot growth, which under extreme situations, may mean that there will be too few buds formed to produce a good crop the following year. Cluster thinning should be done early—before bloom but no later than 2 weeks after bloom to achieve the best results however, some response will be received even when thinning is delayed as late as during the veraison stage. The earlier that it is done, the more pronounced the effects; however, many people wait until bunch closure or late to have an "insurance" for accidental loss of yield. Excess clusters should be removed from shoots, as there may not be sufficient leaf area to ripen the fruit. Third clusters on a shoot should be removed, and, in some cases, the second cluster may be removed as well. When thinning to one cluster per shoot, yields will be reduced which may be desirable only in cases where a premium price will be received for the crop. When thinning at veraison, it is desirable to remove clusters that appear to be lagging in their development. Typically, all clusters are removed from first- and second-year vines.

For more detailed information on vine management, please refer to Wine Grape Production Guides (example: https://content.ces.ncsu.edu/north-carolina-winegrape-growers-guide, https://blogs.cornell.edu/grapes/production/

Diseases

The pre-bloom to bloom sprays are the most important sprays for downy mildew, powdery mildew, Phomopsis, and black rot for the season.

From this stage, grape flower clusters and berries become highly susceptible to infection by black rot, downy mildew, and powdery mildew, and all of these pathogens become active due to higher temperatures. Once again, mancozeb and sulfur combination is the backbone of the spray program at this stage. Mancozeb materials are effective against Phomopsis, black rot, and downy mildew. Sulfur materials are effective against powdery mildew. If you decide to use captan instead of a mancozeb product, make sure to tank mix it with a material with efficacy against black rot.

Pre-bloom or bloom can be the time disease-specific materials are added to the mancozeb plus sulfur backbone program to strengthen the application. Some start mixing specific materials at pre-bloom, and others mix at bloom. The decisions about the timing of adding these materials and what to add to the mix should be made based on the target diseases. If you have seen a particular disease in the past, there is a good chance that you will see it again.

Pre-Bloom

- If **black rot** is the target, combine mancozeb with a QoI (Quadris, Flint, Pristine, etc. FRAC = 11) or DMI (FRAC = 3) or SDHI (FRAC = 7) fungicide. Note that some DMI materials work better than others, for example, Rally and Elite are more active on black rot than Procure (efficacy table). If there is a rain event, which can lead to black rot infection, and your vines are not protected by previous application, Rally can provide some kick-back activity as long as you apply within a few days after the infection event. Fungicide resistance issues may be happening with FRAC =3 and 11; if you suspect your material is losing its efficacy, contact your local extension agent.
- For **downy mildew**, consider mixing a downy mildew specific material with either mancozeb, captan, or copper (FRAC = M3, M4, M1, respectively). Materials that contain FRAC group 40 (Revus, Forum, and Zampro) and FRAC group 21 (Ranman) are protective materials. Note: there are several cases of downy mildew isolates that are resistant to FRAC group 40 in Virginia, Georgia, and North Carolina. Thus, make sure to tank mix FRAC group 40 with mancozeb or captan. Phosphonate materials (Prophyt, Phostrol, etc. FRAC = P07), and Ridomil (FRAC = 4) products have some kick-back activity; however, please note that the protective application provides much better efficacy than the curative application of fungicide. The efficacy of QoI fungicides (FRAC = 11) and Phosphonate (FRAC = P07) against downy mildew has been questionable due to the existence of fungicide resistant strains.
- For **powdery mildew**, mix one of the following powdery mildew materials with sulfur (FRAC = M2). Vivando, Prolivo (FRAC = 50), Quintec (FRAC = 13), Torino (FRAC = U6), and DMI (FRAC = 3) fungicides are good protective materials. SDHI materials (FRAC = 7) such as Aprovia and Luna Experience can be used too; however, the SDHIs are often used as a material for Botrytis, thus, at bloom or other growth stages when Botrytis management is also needed may be the best timing to use SDHIs. Unfortunately, the efficacy of QoI fungicides (FRAC = 11) against powdery mildew has been compromised due to the existence of fungicide resistant strains. Also, there are some cases of powdery mildew isolates with DMI resistance reported in our region. Some DMI fungicides (FRAC = 3), e.g., Mettle, Cevya, Revus Top, may provide better efficacy than the others, where DMI resistance is present, but do not rely on one mode of action. Always mix with sulfur and rotate among different FRAC groups. If you have an outbreak of powdery mildew on clusters in the past, early application of DMI or SDHI (at pre-bloom) is effective.

Make sure to rotate FRAC groups that start with a number (e.g., 3, 7, 11, etc.) and limit the use of these disease-specific materials to less than three times a season (two or fewer is ideal) because all of these materials are prone to developing fungicide resistance. Tank mix them with a material with FRAC group starts with “M”, e.g., mancozeb, sulfur, etc. It is best to come up with a plan prior to the season so that you do not have to make a decision on the fly. Please visit VA grape disease updates at http://ext.grapepathology.org/ for more information about infection conditions for major grape diseases.

Pre-Bloom

Fungicide resistance—Fungicide resistance is very serious and present in certain diseases against several chemistries throughout the southeast. There are several mechanisms by which fungal pathogens can develop resistance. In general, when a mode of action is used, we select for fungal populations that are resistant to that mode of action. Once a resistant population is found at your vineyard, chances are it will stay with you for a long time.

The mode of action is conveniently summarized for you as FRAC code (Fungicide Resistance Action Committee, https://www.frac.info/). They can be found on the fungicide label and throughout this IPM guide. In many cases, different chemicals (i.e., products) have the same mode of action or are pre-mix of two different modes of action together. It is important to understand that the key is rotating the modes of action (= FRAC groups), and some of products under different product or chemical names may have the same mode of action. For example, if you rotate Rally (myclobutanil) with Elite (tebuconazole), it is not really a rotation since both are FRAC group 3. The same is true with rotation of Flint and Pristine because both contain FRAC group 11. (Specific information on each FRAC group is discussed in Comments area of this IPM guide.) Newer materials tend to have a single mode of action (or combination of two single modes of action). If you do not see "M" in the FRAC group, chances are it is a single mode of action. Therefore, when you are using newer materials, please rotate the FRAC group, limit the use (twice per year). Also, tank-mix with a multisite material (sulfur, copper, mancozeb, ziram, captan, etc.) to lower the risk of fungicide resistance development.

Cases of resistance against a particular mode of action groups found in the Southeastern region.

- Resistance against benzimidazoles, FRAC = 1 and QoIs (**Q**uinone **o**utside **I**nhibitors, or also known as strobilurins), FRAC = 11, by powdery mildew, downy mildew, and Botrytis bunch rot are widespread.
- Several cases of QoI resistance with ripe rot pathogens have been reported in VA.
- Quadris is more active on downy mildew than Flint or Sovran; however, in some areas of southeast, both powdery mildew and downy mildew pathogens have already developed resistance against Quadris and other QoI fungicides (FRAC = 11). Resistance is conferred by the same mechanism, so resistance to one FRAC 11 product means it will be resistant to the others.
- Reduced efficacy of DMI (FRAC =3) and QoI (FRAC = 11) against powdery mildew has been observed in southeast.
- Quintec (FRAC = 13) resistant strains of powdery mildew have been observed in VA (Note: Only one case reported, not widespread as of 2024).
- Pristine (QoI FRAC=11 plus SDHI FRAC = 7) resistance to botrytis has been documented in multiple crops, including wine grapes, with many cases reported in VA.
- Revus (FRAC = 40) resistance to downy mildew has been reported in several VA, NC, and GA vineyards.
- Effectiveness of Vangard (FRAC = 9), Elevate (FRAC = 17), and Topsin M (FRAC = 1) is at risk in GA, NC, and VA for Botrytis.

Please contact your local extension office or state's plant health clinic for information on fungicide resistance testing.

Pre-Bloom

Pierce's Disease

Pierce's disease (PD), caused by the bacterium *Xylella fastidiosa*, is spread by xylem sap-feeding insect vectors like sharpshooters (leafhoppers), especially glassy-winged and broad-headed sharpshooters. Yellow sticky panel traps may be used to determine the presence of sharpshooters. There are no thresholds established, but high-risk years are when there are fewer than three nights with temperatures lower than 10°F. When the bacterium invades the water-conducting vascular tissues (xylem) in grapevines, the vines respond with distinct, characteristic symptoms. The most common symptom of PD is marginal scorching of foliage. It often appears as an irregular, necrotic margin with a reddish-brown and brown necrotic tissue. Foliar symptoms appear with rising temperatures and drier conditions in June and July. Another common symptom is called matchstick where the leaf blade falls while the petioles are retained on the shoots. The formation of "green islands," resulting from irregular or incomplete periderm maturation on the canes, is also a common symptom. Berries on the infected vines may also shrivel. PD will be affected by vector presence, vine genotype, cold winters, environmental factors, and other vine stress elements.

Resistant varieties such as the native *Vitis mustangensis* (mustang grape) or *V. rotundifolia* (muscadine) might exhibit little or no symptoms and survive. Some American hybrids such as Blanc du Bois and Black Spanish are highly tolerant. Lomanto may show symptoms and decline over several years. All *V. vinifera* and some hybrid cultivars (e.g., Vidal blanc) are susceptible, but tolerance levels vary. All cultivars have not been tested in all locations and performance can differ greatly across the southeast region. Some purported PD-tolerant vines such as Victoria Red really have very little tolerance to PD and will die quickly in areas where pressure is extreme.

The grape breeding program at UC Davis has recently developed and released five predominantly *Vitis vinifera* varieties resistant to PD (link). UC Davis grapes in Central Alabama, the experimental vines neither exhibited symptoms nor tested positive for PD during vine establishment (Svyantek et al., 2020). The results from this study indicate grapevines with predominantly *V. vinifera* background can survive under humid viticulture conditions in central Alabama and portions of the southeast with the incorporation of alleles for PD resistance. Hu et al., (2012) evaluated 11 PD tolerant American and hybrid grape cultivars in North Alabama and found that Villard Blanc and Black Spanish (Lenoir) were the best performing cultivars producing high yield and good fruit quality. However, Villard Blanc may not be a suitable cultivar for the Gulf coast regions, as it was found to survive only 3 to 5 years in south Mississippi. Please contact your local extension office or state's plant health clinic for Pierce's Disease testing information.

Pre-bloom						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Disease management						
Phomopsis Black rot Powdery mildew Downy mildew **The backbone program**	mancozeb (various formulations) **plus** sulfur (various formulations) When conditions are not favorable to disease development, these two materials are sufficient.	see label see label	VG	24 hr	66 days (The REI and PHI refer to the most stringent aspect of the combined spray)	This should be the backbone of your fungicide program, especially early in the season. Mancozeb targets for Phomopsis, downy mildew, and black rot management, and sulfur targets for powdery mildew management. Both mancozeb and sulfur are low risk for fungicide resistance development **FRAC Group = M3** for mancozeb and **M2** for sulfur

Pre-bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Phomopsis Black rot Powdery mildew Downy mildew **for better black rot and powdery mildew control** The backbone program (mancozeb plus sulfur) may be sufficient, but if the season is really wet adding a DMI or QoI fungicide during this period may be beneficial.	mancozeb **plus** sulfur **plus** a DMI fungicide: myclobutanil (Rally 40WSP) or tebuconazole (various) or triflumizole (Procure 48SC) or triflumizole (Trionic 4SC) or tetraconazole (Mettle 1ME) or flutriafol (Rhyme) or mefentrifluconazole (Cevya)	see label 3–5 oz see label 4–8 oz 4–8 oz 3–5 fl oz 4–5 fl oz 4 fl oz	VG	24 hr	66 days	DMI stands for **D**e**M**ethylation **I**nhibitors or sometimes some chemicals in this group are called Sterol Inhibitors (SI) because they inhibit biosynthesis of sterol in fungi. (**FRAC = 3**) The highest rate is recommended for DMI fungicides. DMI fungicides work well against powdery mildew and black rot; however, loss of efficacy among powdery mildew isolates have been documented in VA. Where resistance is found, Mettle, Cevya, and Revus Top are more effective than other group 3 fungicides. For generic myclobutanil or tebuconazole products, please see the label for rates and other instructions. The PHI and REI is based on the material with the longest PHI and REI. E.g., if the section suggests mancozeb (PHI=66 days, REI = 24 hr) AND Mettle (PHI = 14 days, REI = 12 hr), PHI and REI shown in the table is 66 days and 24 hr, respectively.

Pre-bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Phomopsis Black rot Powdery mildew Downy mildew **QoI options for better black rot and Phomopsis control**	for better black rot and Phomopsis control mancozeb **plus** sulfur **plus** a QoI fungicide azoxystrobin (Quadris F) or kresoxim-methyl (Sovran) or trifloxystrobin (Flint Extra) or mandestrobin (Intuity)	 See label 10–15.5 fl oz 3.2–4.8 fl oz (Phomopsis/ black rot) 3.5–3.8 fl oz 6.0 fl oz	 E VG VG VG	 24 hr	 66 days	This class of fungicides, often called QoI (Quinone outside Inhibitor), is prone to resistance. (**FRAC = 11**) Sovran offers suppression on Botrytis at 3.2 to 6.4 fl oz. The use of less resistant prone chemistries, such as mancozeb, captan, and sulfur, provides good management during this timeframe while allowing the class 11 materials to be utilized better. Do not use the QoIs on Concords or other cultivars with *V. labrusca* background.
The section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Anthracnose (Bird's-eye rot)	See the bud break recommendations.					
Phomopsis Downy mildew Black rot	mancozeb + zoxamide (Gavel 75DF)	2.0–2.5 lb	VG	48 hr	66 days	Gavel contains zoxamide that provides an extra protection against downy mildew. (**FRAC M3 + 22**). See seasonal limits for active ingredients on the label.

Pre-bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Downy mildew (specific)	mefenoxam + copper (Ridomil Gold Copper) or mefenoxam + mancozeb (Ridomil Gold MZ)	2.0 lb 2.5 lb	E E	48 hr 48 hr	42 day 66 day	Ridomil products provide excellent curative activity against downy mildew. However, only one or two applications are recommended per year, due to potential resistance issues. Use these products conservatively. In general, other products should be utilized till downy mildew symptoms are first observed or environmental conditions are very conducive for this disease; if observed, use Ridomil immediately. (**FRAC** = **4**)
	mandipropamid (Revus) (Revus Top) or dimethomorph (Forum)	8.0 fl oz 7 fl oz 6 fl oz	E E E	4 hr 12 hr 12 hr	14 day 14 day 14 day	Make no more than two consecutive applications before switching to a non-Group 40 fungicide. The addition of a spreading/penetrating type adjuvant such as a nonionic based surfactant or crop oil concentrate or blend is recommended. (**FRAC = 40**) This is a protective material. Several cases of mandipropamid resistant downy mildew isolates have been reported in Virginia, Georgia, and North Carolina.
	ametocradin + dimethomorph (Zampro SC)	14 fl oz	E	12 hr	14 day	Please see the comment above. (**FRAC = 40 + 45**)
	phosphonate (e.g., Prophyt, Phostrol, etc.)	See label	VG	4 hr	0 day	High dose of a phosphonate material may cause phytotoxicity, please see label for rate information. **(FRAC = P07)** A mixture of a phosphonate and copper can cause phytotoxicity. It is best to avoid spray copper and phosphonate within two weeks.

Pre-bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Downy mildew (specific)(cont.)	cyazofamid (Ranman 400SC) **plus** phosphonate (e.g. Prophyt, Phostrol, etc.)	2.1–2.75 fl oz See label	VG	12 hr	30 days	Do not use Ranman with surfactant **(FRAC = 21).** Combine with phosphonates for best efficacy.
Powdery mildew (specific) Best to be applied before symptom development. Do not make more than two sequential applications of the same FRAC group.	metrafenone (Vivando SC) or pyriofenone (Prolivo 300SC)	10.3–15.4 fl oz 4–5 fl oz	VG	12 hr 4 hr	14 days 0 days	If your vineyard suffers chronic powdery mildew issue add one of these to "mancozeb *plus* sulfur" OR if you could not use sulfur (e.g., under high heat, growing sulfur-sensitive hybrids), consider these options to replace sulfur **(FRAC = 50)**
	quinoxyfen (Quintec SC)	3–4 fl oz	VG	12 hr	14 days	No more than 3 applications per season. Please see the label for higher rate usages (**FRAC = 13**)
	cyflufenamid (Torino SC)	3.4 fl oz	G	4 hr	3 days	Do not make more than two applications per year. (**FRAC = U6)**
	fluxapyrad + pyraclostrobin (Merivon)	4–5.5 fl oz	E	12 hr	14 days	**(FRAC = 7 + 11)**
	potassium bicarbonate (Armicarb, Kaligreen, Milstop, etc.)	See label	F	4 hr	1 day	These materials can suppress on-going powdery mildew infection; however, the product cost tends to be high. (**FRAC = NC**)

Pre-bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Powdery mildew, Black rot (specific)	benzovindiflupyr (Aprovia) or benzovindiflupyr + difenoconazole (Aprovia Top) or azoxystrobin + difenoconazole (Quadris Top) or pydiflumetofen + fludioxonil (Miravis Prime) or isofetamid (Kenja 400SC)	8.6–10.5 fl oz 8.5–13.3 fl oz 12–14 fl oz 11.2–13.4 fl oz 20.0–21.0 fl oz	E E E E E	12 hr 12 hr 12 hr 12 hr 12 hr	21 days 21 days 14 days 14 days 14 days	Please check the label for application near aquatic areas. Aprovia, Aprovia Top, and Quadris Top list anthracnose on the label. Note that FRAC = 7 products are also recommended for Botrytis management (but not listed on Aprovia label). Aprovia is known to suppress ripe rot; however, Kenja and Miravis may not work on ripe rot. (Aprovia: **FRAC = 7**) (Aprovia Top: **FRAC 7 + 3**) (Quadris Top: **FRAC = 3 + 11**)
Insect Pest Management						
Sharpshooter leafhoppers Also refer to Pierce's disease section.	carbaryl (Sevin XLR Plus)	1–2 qt	F	48 hr	7 days	REI is 6 days for grape girdling and cane turning **(IRAC = 1A)**

Pre-bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Sharpshooter leafhoppers (continued) Initiation of foliar treatments should be based on trap captures.	malathion (Malathion 8F) (Malathion 5 EC)	 1.88 pt 3 pt	 F	24 hr	3 days	Rates are based on 200 gal per acre spray volumes. As is common with most EC formulations, adverse effects, such as spotting or discoloration of the fruit or foliage may occur with high temperatures, poor drying conditions, excessive spray runoff, or certain tank mixes with other chemicals or pesticides. **(IRAC = 1B)**
	fenpropathrin (Danitol 2.4 EC)	 5.33–10.66 fl oz	 F	24 hr	21 days	**(IRAC = 3A)**
	beta-cyfluthrin (Baythroid XL)	 1.6–3.2 fl oz	 F	12 hr	3 days	**(IRAC = 3A)**
	bifenthrin (Brigade eVo) (Sniper 2EC)	 3.2–6.4 oz 6.4 fl oz	 F F	12 hr	30 days	**(IRAC = 3A)**
	imidacloprid (Admire Pro)	 1–1.4 fl oz (foliar) 7–14 fl oz (soil)	 G VG	12 hr	0 days (foliar) 30 days (soil)	If a soil application of a IRAC 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a IRAC 4A material is made. Only apply 14 fl oz per season. **(IRAC = 4A)**
	dinotefuran (Venom) dinotefuran (Scorpion 35SL)	 1–3 oz (foliar) 5–7.5 oz (soil) 1.75 fl oz (foliar) 9–13.25 fl oz (soil)	 G VG G VG	12 hr	1 day 28 days 1 day 28 days	If a soil application of a IRAC 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a IRAC 4A material is made. (**IRAC = 4A**) Note: Management strategies for sharpshooters may also help manage spotted lanternfly.
	acetamiprid (Assail 30SG)	 2.5 oz	 G	12 hr	7 days	**(IRAC = 4A)**

Pre-bloom

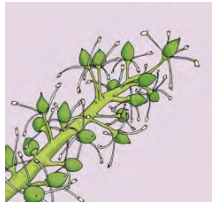
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Spotted lanternfly (SLF)	bifenthrin (Brigade eVo)	3.2–6.4 oz	G	12 hr	30 days	**(IRAC = 3A)**
	zeta-cypermethrin (Mustang Maxx)	4.0 oz	G	12 hr	1 day	**(IRAC = 3A)**
	carbaryl (Sevin XLR Plus)	1–2 qt	G	48 hr	7 days	REI is 6 days for grape girdling and cane turning **(IRAC = 1A)**
	Beauveria bassiana (BioCeres WP) (BotaniGard 22WP)	1–2 lb 0.5–2 lb	F F	4 hr 4 hr	0 days 0 days	**(IRAC = UN)**
Grape berry moth Only treat for grape berry moth if adults are captured in pheromone traps. For the first three flights, expect 50% emergence at 187, 869, and 1,094 Growing Degree Days above a base of 47 F after first male catch.	fenpropathrin (Danitol 2.4 EC)	10.66–21.33 fl oz	F	24 hr	21 days	Use caution in the use of postbloom pyrethroids; they may flare mealybug populations with resulting issues with leafroll virus **(IRAC = 3)**
	methoxyfenozide (Intrepid 2F)	12–16 fl oz	G	4 hr	30 days	Minimum application volume for airblast sprayers of 40 gallons per acre. See supplemental label for this use rate. **(IRAC = 18)**
	spinosad (Entrust 80W, Entrust SC)	1.25–2.5 oz 4–8 fl oz	G	4 hr	7 days	OMRI approved. **(IRAC = 5)**
	chlorantraniliprole (Altacor eVo)	1.5–2.2 oz	VG	4 hr	14 days	Use between 100-200 gallons per acre total spray volume. **(IRAC = 28)**
	phosmet (Imidan 70-W)	1.33–2.125 1b	G	14 days	14 days	The 14-day REI may make this product impractical to use for most growers. **(IRAC = 1B)**
	spinetoram (Delegate) (Hemi SC)	3 –5 oz 6–10 fl oz	VG	4 hr	7 days 3 days	**(IRAC = 5)**
	indoxacarb (Avaunt eVo)	5–6 oz	G	12 hr	7 days	**(IRAC = 22)**

Pre-bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Grape berry moth (cont.)	carbaryl (Sevin XLR Plus)	1–2 qt	G	48 hr	7 days	REI is 6 days for grape girdling and cane turning **(IRAC = 1A)**
	phosmet (Imidan 70-W)	1.33–2.125 1b	G	14 days	14 days	The 14-day REI may make this product impractical to use for most growers. **(IRAC = 1B)**
Grape scale (also see dormant recommendation)	buprofezin (Applaud 70DF)	9.0–12.0 oz	G	12 hr	7 days	Apply when crawlers are active, or at 493 and 990 degree-days (base 50 °F), starting at April 1 (early and peak activity of first generation). **(IRAC = 16)**
Grape tumid gallmaker	spirotetramat (Movento 2SC)	6.0–8.0 fl oz	G	24 hr	7 days	Apply when galls first appear in blocks with a history of high populations of grape tumid gallmaker. Certain cultivars are more susceptible (e.g., Traminette, Niagara) **(IRAC = 23)**
Fire ant control Red imported fire ant	pyriproxyfen (Esteem Ant Bait)	1.5–2.0 lb	VG	12 hr	1 day	For grapes do not exceed 0.22 lb active ingredient (ai, pyriproxyfen) per season. **(IRAC = 7C)**
	methoprene (Extinguish Professional Fire Ant Bait)	1.0–1.5 lb	VG	4 hr	0 day	Labeled for use on cropland, including grape vineyards. **(IRAC = 7A)**
	hydramethylnon (Amdro Pro (bait station))	1.5 lb See labeled chart for bait directions	VG	12 hr	n/a	**DO NOT** apply Amdro Pro directly to the ground around the crop and **DO NOT** apply directly to any part of the crop plant **(IRAC = 20)**
	abamectin (Clinch Ant Bait)	1 lb	VG	12 hr	0 days	For best results, do not apply if rainfall is anticipated within 4–6 hr after application, and wait at least 48 hr before irrigating the treated area. **(IRAC = 6)**

Bloom

General Comments



Fertilizing the vineyard—Annual, modest fertilization applications to the vineyard are best for maintaining consistent yields of high-quality grapes. Nitrogen is the element most likely to be limiting in vineyards. About 0.1 pound of actual nitrogen per vine, is preferred for consistently good yields of high-quality fruit.

This amount may need to be adjusted depending on vine growth and fruiting. Leaf tissue (petiole or leaf blade) analysis should be utilized each year to determine whether nitrogen fertilization is needed. The best time to apply nitrogen to the soil in vineyards is around bloom. It is important in growing grapes for wine to realize that fertilization not only affects vine growth and productivity but also impacts the wine. Some of symptom development (e.g., yellowing from N deficiency) may happen late in the season. Thus, you may need to test the symptomatic vines or the soil 6–7 months in advance.

Petiole (or leaf blade) analysis: Tissue analysis—Collect petioles (or leaf blades) at full bloom from leaves opposite the first or second bloom cluster from the bottom of a shoot. Do not collect more than two petioles per vine. Randomly sample vines of the same cultivar and age in a vineyard accumulating a minimum of 50 petioles or leaf blades for analysis. Routine tissue analysis from the same vineyard over a period of years can help detect trends in nutrient levels thus helping avoid nutritional problems that may adversely affect yields and quality, but it is important to use the same tissues (petioles or leaf blades) and collect at similar phenological times. Vines having different growth characteristics should be sampled separately from normal vines. Contact your county extension office for more details on collecting and sending samples for analysis. More information can be found at: https://fieldreport.caes.uga.edu/publications/C1164/vineyard-nutrition-tissue-sampling-for-nutrient-analysis/

Records on vineyard performance over previous years—Notes on yields and fruit quality plus any unusual weather conditions that may have impacted vine performance may be of value in refining the fertility program.

Bloom

Disease Management

Bloom may last long enough to require more than one spray. Bloom grape clusters are still susceptible to downy mildew, powdery mildew, and black rot. In addition, pathogens of ripe rot and Botrytis infect flowers. Although you may not see symptoms later in the season, it is critical to protect flowers from these pathogens. In addition, both ripe rot and bitter rot pathogens can infect flower parts to cause disease later in the season. Thus, if you have a history of bitter rot or ripe rot, consider protecting flowers using mancozeb, QoI, captan, or ziram.

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Phomopsis Black rot Powdery mildew Downy mildew Anthracnose	A backbone program is the same as pre-bloom recommendations Additional materials to be considered for tank-mixing with mancozeb (or captan) plus sulfur to provide improved protections against multiple diseases					
Phomopsis Black rot Powdery mildew	flutriafol + azoxystrobin (Topguard EQ)	5–6 fl oz	E	12 hr	14 days	**(FRAC = 3 + 11)**
Black rot Powdery mildew Downy mildew	mandipropamid + difenoconazole (Revus Top)	7 fl oz	VG	12 hr	14 days	**(FRAC = 3 + 40)**
Black rot Bitter rot Ripe rot	boscalid + pyraclostrobin (Pristine 38WG)	8–10.5 fl oz	E	12 hr (5 days for vine handling)	14 days	**(FRAC = 7 + 11)**

Bloom

The section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
A spray for Botrytis during bloom can be beneficial, especially when it's wet. It will lower the risk of Botrytis outbreak later in the season. Materials in different classes should be rotated through the season when needed to avoid resistance development. Resistance to some active ingredients is known in the US and European countries. See product labels for complete information on resistance management and use restrictions. Do not make more than 2 sequential applications of the same FRAC group. Add these materials to "mancozeb ***plus*** sulfur" backbone program.						
Botrytis	iprodione (Rovral 4F, Meteor, etc.)	1–2 pt (or see label)	G	12 hr	7 days	Risk of resistance is high. (**FRAC = 2**)
	fenhexamid (Elevate 50WDG)	1 lb	E	12 hr	0 days	**(FRAC = 17)**
	cyprodinil + fludioxonil (Switch 62.5WG)	11–14 oz	VG	12 hr	7 days	Do not use an adjuvant. Do not make more than two sequential applications of Switch before switching to a fungicide with different modes of action. Fludioxonil can be photodegraded, thus, it may not provide a long protection (> 7 days) under intense sunlight. (**FRAC = 9 + 12**)
	cyprodinil (Vangard 75WG)	5–10 oz	E	12 hr	7 days	The rate depends on whether you will tank mix them with other product(s), please refer to the labels for more information. (**FRAC = 9**)
	pyrimetanil (Scala SC)	9–18 fl oz	E	12 hr	7 days	The rate depends on whether you will tank mix them with other product(s), Please refer to the labels for more information. (**FRAC = 9**)

Bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Botrytis (cont.)	cyprodinil + difenoconazole (Inspire Super)	16–20 fl oz	VG	12 hr	14 days	Please note that many pre-mixed materials contain the same mode of action of other products. (**FRAC = 9 + 3**)
	boscalid + pyraclostrobin (Pristine 38WG)	18.5–23 oz	E	12 hr plus 5 days for vine handling	14 days	Pristine also has activity on black rot, Phomopsis, downy mildew, and powdery mildew. Do not apply to Concord, Worden, Fredonia, or Niagara. (**FRAC = 7 + 11**) Botrytis isolate that are resistant to both a.i. of Pristine is common in VA.
	boscalid (Endura 30WG)	8 oz	E	12 hr	14 days	Endura will also control powdery mildew. (**FRAC = 7**) (High resistance development risk.)
	isofetamid (Kenja 400SC)	20–22 fl oz	E	12 hr	14 days	Kenja will also control powdery mildew, and lists anthracnose on the label (**FRAC = 7**)
	pydiflumetofen + fludioxonil (Miravis Prime)	10.3–13.4 fl oz	E	12 hr	14 days	Miravis Prime also controls black rot and lists other fungal diseases including anthracnose (rate varies: see the label for more details) (**FRAC = 7 + 12**)
	fluopyram + tebuconazole (Luna Experience)	6.0–8.6 fl oz	E	12 hr plus 5 days for vine handing	14 days	Do not apply more than 34 fl oz of Luna Experience per acre per season (**FRAC = 7 + 3**). Due to its 5-day cane work REI, this product may be suited more for late season applications. Also works against powdery mildew.

Bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Botrytis (cont.)	fluopyram + trifoxystrobin (Luna Sensation)	7.0 fl oz	E	12 hr	14 days	Do not apply or allow drift to Concord grapes or crop injury may occur. Rinse spray equipment before application of other products to Concord grapes or crop injury may occur. Do not apply more than 27.1 fl oz per acre per year. **(FRAC = 7 + 11)**
	thiophanate-methyl (Topsin-M WSB)	1–1.5 lb	G	48 hr	7 days	May have widespread resistance. **(FRAC = 1)**
Downy mildew (specific)	Please refer to the pre-bloom recommendations					
Powdery mildew (specific)	Please refer to the pre-bloom recommendations					
Black rot (specific)	In addition to QoI fungicides (listed above), DMI fungicides are effective against black rot. Please refer to pre-bloom DMI recommendations.					

Post-Bloom

General Comments

(7–10 days after the bloom spray)

Canopy management—Proper canopy management initiated at this time is very important to ensure that conditions are less favorable for disease development later in the season. Often, leaf removal on the east side of a north-south oriented row or the north side of an east-west oriented row is recommended in the early season. Leaf removal on the western or southern side can be performed on reds. Pulling leaves from both sides of the canopy can increase airflow, and reduce disease pressure, but to expose fruit clusters to increase the risk of sunburn. White varieties have a greater risk of sunburn. Leaf removal around bloom will lower the risk of sunburn. Shoot positioning and tucking shoots are required for many training systems and for the VSP-trained vines to top and hedge as needed 18 to 24 in. above the top wire.

Diseases

The post-bloom spray is one of the most important sprays for downy mildew, powdery mildew, Phomopsis, and black rot.

From bloom to 4–5 weeks after bloom, grape berries become susceptible to infection by black rot, downy mildew, and powdery mildew, and all of these pathogens become active due to warmer temperatures. Once again, mancozeb and sulfur combination is the backbone of the spray program. Mancozeb materials are effective against Phomopsis, black rot, and downy mildew. Sulfur materials are effective against powdery mildew.

If there is a rain event that leads to black rot infection and your vines are not protected by previous application (preventative applications are generally the most effective), Rally and likely other DMIs (FRAC=3) should provide good kick-back activity as long as you apply it as soon as possible (within 24 hr) after the infection event. If black rot is established, use mancozeb to protect healthy tissues.

The best management for downy mildew is preventative protection; please see the previous section for materials. However, if there is an outbreak of downy mildew, the best approach is to use copper (FRAC = M1), or mancozeb (FRAC = M3), or captan (FRAC = M4) to protect healthy tissues by preventing spread.

If powdery mildew is a problem (i.e, you can see active powdery colonies on leaves and berries), use a potassium salt product such as Kaligreen or Armicarb. Thorough coverage is needed for these contact fungicides to be effective, so keep rain events around this in mind. Another product to be considered is Stylet Oil; however, the use of oil can be very difficult because it can cause phytotoxicity and other damage (e.g., delay of ripening). In addition, a mixture of oil and captan or sulfur can result in vine injury. Thus, it is often recommended to use no more than two applications per year, and to be applied earlier in the season. Check Michigan State University's extension publication (https://www.canr.msu.edu/news/jms_stylet_oil_can_be_used_to_knock_down_powdery_mildew_on_grapevines) for more information on the use of Stylet Oil against powdery mildew.

Post-bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Disease management						
Phomopsis Black rot Powdery mildew Downy mildew Anthracnose	See pre-bloom backbone spray recommendations The recommendations below are ADDITIONAL material for each target disease to be used with a combination of captan and sulfur (or mancozeb and sulfur, if PHI is not a concern).					
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Downy mildew (specific)	See pre-bloom recommendations					
Powdery mildew (specific)	See pre-bloom recommendations					
Black rot (specific)	See pre-bloom DMI recommendations or pre-bloom QoI recommendations					
Bitter rot Ripe rot	See bloom recommendations					
Insect pest management						
Grape berry moth	See pre-bloom recommendations					
Sharpshooter leafhoppers (Pierce's disease suppression)	See pre-bloom recommendations					
Mealybugs	See bud break recommendations					
Periodical cicadas	You can track anticipated emergence at www.cicadamania.com and via the Cicada Safari App. Young vines are particularly susceptible to damage. Mesh netting (0.25 in. mesh) can effectively prevent damage. Check your local Extension resources for information on emergence in your area as problematic areas tend to be sporadic. Also check (https://www.virginiafruit.ento.vt.edu/cicada.html) for additional information.					

Post-bloom

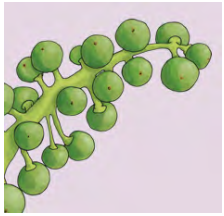
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Phylloxera (foliar)	Grape phylloxera has root feeding and foliar feeding forms. Rootstocks used in grape propagation are resistant to root feeding forms and do not require treatment. Foliar phylloxera may be problematic in interspecific hybrid cultivars (i.e., Vidal blanc, Seyval blanc, Chambourcin, etc.) and cause distinctive, wart-like galls on leaves. The mobile crawler stage of phylloxera is susceptible to insecticide treatment, but closed galls are not. Scouting for galls and crawlers should begin once leaves are expanded. If infested leaves are found in susceptible cultivars, insecticide treatments should be timed to crawler emergence. The more damaging root form is controlled by resistant rootstocks. See table on rootstocks in the establishment section.					
	acetamiprid (Assail 30SG)	2.5 oz	G	12 hr	7 days	The use of spray adjuvants, such as high-quality non-ionic surfactants, methylated seed or horticultural oils, may enhance coverage and plant uptake and may improve pest control. The use of stickers is not recommended. **(IRAC = 4A)**
	spirotetramat (Movento 2SC)	6–8 fl oz	G	24 hr	7 days	Minimum application interval 30 days. Movento also provides control of root infestations. **(IRAC = 23)**
Grape rootworm	carbaryl (Sevin XLR Plus)	2 qt	VG	12 hr	7 days	Apply when beetles first appear, usually in mid-June or early July. A second application may be necessary 10 days later. **(IRAC = 1A)**
European red mite (ERM) or Twospotted spider mite (TSM)	There are some important differences between the two spider mite species. Relative to ERM, TSM develops faster, has greater fecundity, has a more severe impact on leaf function, and is harder to kill. Any thresholds that have been developed for ERM should be cut in half if TSM is the predominant mite. TSM usually is the predominant mite in the arid west. Here in the east, where it is more humid, ERM predominates. This changes in hot dry years, and TSM can then be our main species.					
	bifenazate (Acramite 50WS)	1 lb	E	12 hr	14 days	The reentry interval is 1 day for pruning, thinning, or leaf pulling and 5 days for cane turning, tying, and girdling. Minimum of 50 gal per acre spray volume. **(IRAC = 20D)**

Post-bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
European red mite (ERM) or Twospotted spider mite (TSM) (cont.)	etoxazole (Zeal)	2–3 oz	VG	12 hr	14 days	This is an ovicide/larvicide, so it has to be used early in the life cycle of the mites. Use this no more than once per season. **(IRAC = 10B)**
	fenpyroximate (Portal 5EC)	2 pt	VG	12 hr	14 days	Nonbearing use only. Do not apply more than 2 pints per acre per season. Use a minimum of 50-gal spray volume per acre. **(IRAC = 21A)**
	abamectin (Agri-Mek 0.15EC)	16 fl oz	VG	12 hr	28 days	With Agri-Mek, add a nonionic surfactant. **(IRAC = 6)**
	pyridaben (Nexter 75WP)	10.67 oz	G	12 hr	7 days	Only for ERM. Do not make more than two applications per season. May be fatal if inhaled **(IRAC = 21A)**
	fenbutatin-oxide (Vendex 50WP)	2.5 lb	G	48 hr	28 days	Do not make more than two applications per season. **(IRAC = 12B)**
	spirodiclofen (Envidor 2SC)	18 fl oz	VG	12 hr	14 days	The reentry interval is 6 days for cane turning, tying, and girdling of table grapes. **(IRAC = 23)**
	hexythiazox (Onager 11.8EC)	12–24 fl oz	G	12 hr	28 days	Ovicide only: if adults or larva are present use another miticide with activity against active stages **(IRAC = 10A)**
	cyflumetofen (Nealta)	13.7 fl oz	G	12 hr	14 days	Do not make more than two applications per season. **(IRAC = 25)**
	mineral oils (TriTek) or (JMS Stylet Oil) or other mineral oils	See label	G (performs better with 2–3 sequential 7–10 day applications)	4 hr	0 days	OMRI approved. DO NOT use in combination with or immediately before or after spraying with fungicides such as captan or any product containing sulfur (two weeks are recommended). DO NOT use with carbaryl or dimethoate. DO NOT use with any product whose label recommends the use of no oils. Do not use in combination with NPK foliar fertilizer applications. **(IRAC = UNM)**

Fruit Set

General Comments



Early cover (7–10 days after the post-bloom spray) and Second cover (7–10 days after first cover)

Leaf removal—Leaf removal facilitates better sunlight penetration into the canopy thus lessening disease pressure following rain or dew and increasing fruit quality. Leaves should be removed shortly after fruit set to allow berries to acclimate to higher sunlight levels prior to berry softening. Waiting until after the berries begin to soften increases the risk of sunscald/sunburn. Leaves in the vicinity of the cluster should be removed (generally, 2–5 leaves are removed). For some cultivars, especially white-fruited cultivars, sunscald can be a problem. If the fruit is located at the top of the trellis, the potential for sunscald is high and the amount of leaf removal, if done at all, should be conservative.

Diseases

This is still the critical period for downy mildew, powdery mildew, Phomopsis, and black rot infection.

From bloom to 4–5 weeks after bloom, grape berries are susceptible to infection by black rot, downy mildew, and powdery mildew, and all of these pathogens become more active due to warmer temperature. Once again, mancozeb plus sulfur combination can be an economical and strong backbone of the spray program. Mancozeb materials are effective against, Phomopsis, black rot, downy mildew, and sulfur materials are effective against powdery mildew. Please see the notes on post-bloom section for more details.

However, at or after second cover (20–28 days after post-bloom), mancozeb products may not be used because either 1) some early cultivars have less than 66 days to harvest or 2) the use of mancozeb reaches the season limit (19.2 lb/A of a.i.). Thus, another broad-spectrum fungicide, captan, can be used in substitution to mancozeb. Since captan does not provide much efficacy against black rot, either QoI (FRAC = 11) or DMI (FRAC = 3) fungicide should be added.

Fruit Set

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Disease management						
Phomopsis Black rot Powdery mildew Downy mildew	mancozeb (various formulations – ***see the comment)*** **plus** sulfur (various formulations**)**	see label see label	VG	24 hr	66 days	**With early cultivars, you may need to substitute mancozeb with captan (see below).** Mancozeb targets for Phomopsis, downy mildew, and black rot management, and sulfur targets for powdery mildew management. Both mancozeb and sulfur are low risk for fungicide resistance development **FRAC = M3** for mancozeb and **M2** for sulfur
Phomopsis Powdery mildew Downy mildew Backbone program after the 66-day PHI	captan (various formulations) **plus** sulfur (various formulations**)**	see label see label	VG	(see label)	0 days	**This should be the backbone of your fungicide program during the second half of the season.** Captan targets for Phomopsis, and downy mildew, and sulfur targets for powdery mildew management. (Note: captan cannot control black rot.) Both captan and sulfur are low risk for fungicide resistance development **FRAC = M4** for captan and **M2** for sulfur
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Downy mildew (specific)	See pre-bloom recommendations.					
Powdery mildew (specific)	See pre-bloom recommendations.					
Anthracnose (specific)	See pre-bloom recommendations.					
Black rot (specific)	See pre-bloom DMI recommendations or pre-loom QoI recommendations.					
Black rot Bitter rot Ripe rot	See bloom recommendations.					

Fruit Set

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Insect pest management						
Japanese beetle Green June beetle	carbaryl (Sevin XLR Plus)	1–2 qt	VG	48 hr	7 days	REI is 6 days for grape girdling and cane turning **(IRAC = 1A)** Management for Japanese beetles are warranted when feeding damage reaches below the top trellis wire.
	phosmet (Imidan 70-W)	1.33–2.125 1b	G	14 days	14 days	The 14-day REI may make this product impractical to use for most growers. **(IRAC = 1B)**
	azadirachtin (Neemix 4.5) **plus** neem oil (Trilogy)	7–16 fl oz **plus** 2% solution	G	4 hr	0 days	OMRI approved. (**IRAC = UN,** Neemix, **IRAC = UNM**, Trilogy) These two products must be applied together. Mode of action is repellency; products need to be applied before beetles become established. **Cannot be applied within two weeks of sulfur or captan spray due to phytotoxicity**.
	malathion (Malathion 8F or Malathion 5EC)	1.88 pt (8F) 3 pt (5EC)	F F	24 hr 24 hr	3 days 3 days	REI = 72 hr for girdling and tying. As is common with most EC formulations, adverse effects, such as spotting or discoloration of the fruit or foliage may occur with high temperatures, poor drying conditions, excessive spray runoff, or certain tank mixes with other chemicals or pesticides. **(IRAC = 1B)**
	acetamiprid (Assail 70 WP)	1.1–2.3 oz	G	12 hr	7 days	**(IRAC = 4A)**
	indoxacarb (Avaunt eVo)	3.5–6.0 oz	G	12 hr	7 days	Very effective against lepidopteran pests such as grape berry moth. **(IRAC = 22A)**
Grape berry moth	See pre-bloom recommendations					

Fruit Set

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Sharpshooter leafhoppers (Pierce's disease suppression)	See pre-bloom recommendations					
Spotted lanternfly	See pre-bloom recommendations					
Mealybugs	See bud break recommendations					
Grape rootworm	See post-bloom recommendations					
European red mite Twospotted spider mite	See post-bloom recommendations					

Berry touch and Bunch closure

For varieties with tight clusters, this may be the last opportunity to penetrate pesticides into the cluster. This is the end of the critical window for most diseases, though.

Disease management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Botrytis Ripe rot Bitter rot	Leaf removal		G			Complete leaf pulling if not completed earlier. Removing leaves will help expose the fruit clusters, which will reduce drying time and increase pesticide deposition on and within the clusters.
Phomopsis Powdery mildew Downy mildew	See the early cover recommendation for the backbone chemical management options. If you are concerned about black rot (its critical period should be over, or the very end of it), see pre-bloom DMI recommendations or pre-bloom QoI recommendations.					
Below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Ripe rot Bitter rot	See bloom recommendations for chemical management options					
Downy mildew (specific)	See pre-bloom recommendations.					
Powdery mildew (specific)	See pre-bloom recommendations.					
Botrytis	See bloom recommendations for chemical management options					
Anthracnose (specific)	See pre-bloom recommendations.					

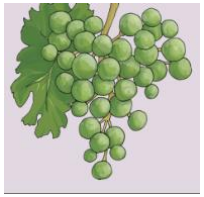
Insect pest management

Sharpshooter leafhoppers (Pierce's disease suppression)	See pre-bloom recommendations
Spotted lanternfly	See pre-bloom recommendations

Berry touch and Bunch closure	
Mealybugs	See bud break recommendations
European red mite Twospotted spider mite	See post-bloom recommendations
Japanese beetle	See first cover recommendations
Spotted wing drosophila	While too early for conventional control of SWD, an application of **Surround** just before clusters close may aid subsequent control of this pest. Oviposition sites often occur in the interior of clusters, out of reach of insecticide sprays closer to harvest. Use block history as a guide in decision making.

Post berry touch to Veraison

General comments



At this time, berries are maturing and become resistant to black rot, downy mildew, and powdery mildew.
However, the rachis (the bunch stem) is still susceptible to powdery mildew infection, and Phomopsis can cause fruit rot late in the season. In addition, Botrytis and other late-season rots can become active. Also, some *V. vinifera* cultivars are susceptible to black rot up to 7-8 weeks after bloom. Please check susceptibility to black rot with nursery or other sources.

If you do not see major downy mildew and powdery mildew infection at this point, you can shift your downy and powdery mildew management target from the protection of fruit to the protection of healthy foliage on the vines. One of options is to use captan and sulfur as a backbone of your fungicide program and add a phosphonate product as needed. Also, you need to be aware that some products such as mancozeb have a long PHI (e.g., 66-day for mancozeb) and become not practical to use at some point.

Some winemakers do not want to have sulfur residues on berries. If sulfur cannot be used, one of DMI or QoI or other newer materials can be used; however, please note that repeated use of these materials can result in fungicide resistance development. Typically, a cut off point for sulfur and copper is 30 days before the harvest.

Post Berry Touch to Veraison

Disease management (10 to 14 days interval)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Botrytis Bitter rot Ripe rot Downy mildew	canopy management		G	none	none	Shoot training, removal, and pruning/hedging through the summer will enhance drying and improve disease control and pesticide penetration within the canopy.

Post berry touch to Veraison	
Phomopsis Powdery mildew Downy mildew	See the early cover recommendation for the backbone chemical management options. The recommendations below are ADDITIONAL material for each target disease with a combination of captan and sulfur.
The section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.	
Downy mildew (specific)	See pre-bloom recommendations.
Powdery mildew (specific)	See pre-bloom recommendations.
Botrytis	See bloom recommendations for chemical management options
Insect pest management	
Grape berry moth	See pre-bloom recommendations
Sharpshooter leafhoppers (Pierce's disease suppression)	See pre-bloom recommendations
Spotted lanternfly	See pre-bloom recommendations
Mealybugs	See budbreak recommendations
European red mite or Twospotted spider mite	See post-bloom recommendations

Post berry touch to Veraison

Japanese beetle	See first cover recommendations

Grape Root Borer control

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Grape root borer	Isomate-GRB Z	100 dispensers	VG			Pheromone-based mating disruption has worked well in the Southeast. Works best on vineyards of 5 acres or more and can take two years before mating disruption efficacy becomes evident in a vineyard. NOTE: currently, this product has a Section-18 label for use in only Delaware, Georgia, North Carolina, South Carolina, Tennessee, and Virginia.
	Entomopathogenic nematodes (EPN) *Steinernema feltiae* Or *Heterorhabditis bacteriophora*	See label for rate	G			These are beneficial nematodes that will NOT attack the vines. They feed exclusively on insects. Apply EPNs to the base of the vines with a backpack sprayer or through the irrigation system. The EPNs need the soil to be moist, so either apply the nematodes just prior to a rain event or water them in with irrigation. **Remove any filters on spray equipment prior to application.** Exact timing for application is still being worked out, but applications during May through June have been effective.

Post berry touch to Veraison

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Grape root borer (cont.)	Cultivation or mounding soil		See comments			Use clean cultivation, mound soil (July 1 or at first moth emergence when using pheromone traps) or using tightly sealed plastic mulch 3 ft from the base of vines. This practice will inhibit adult emergence from the soil when well timed. Mounded soil needs to be removed by September 1st. Labor intensive and challenging to implement. Can be effective if implemented well. May be useful in blocks not amenable to other approaches.

Fire ant control

See pre-bloom recommendations

Veraison

General comments

Some nutrient-deficiency symptoms may appear this time of the season. When you receive petiole and/or soil sample results, make sure to apply necessary nutrients in the following year (Please see the nutrient section for more information.).

Crop thinning should happen no later than veraison. Once berries start to accumulate sugar, dropped berries may attract birds and insects, which could find hanging berries and puncture them. Wounding is a major entry point for late season rots such as Botrytis and sour rot, thus proper insect and bird management can significantly reduce the risk of later season rot development.

Additionally, crop thinning after veraison has minimal effect on fruit quality (unless removing diseased fruit).

Disease management

Phomopsis Powdery mildew Downy mildew	See early cover recommendation for the backbone chemical management options. The recommendations below are ADDITIONAL material for each target disease to be used with a combination captan and sulfur.
The section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.	
Botrytis	See bloom recommendations for chemical management options (Critical period for Botrytis management)
Sour rot	In a recent study done at Cornell University, a mixture of zeta-cypermethrin (Mustang Maxx) and hydrogen dioxide (Oxidate) sprayed twice in seven to ten-day intervals after around 15-Brix provided excellent control of sour rot. Additionally, a University of Georgia study saw control with rotations of Mustang Maxx, Malathion, and Delegate, but only when leaf pulling was conducted in conjunction It is important to control the fruit fly, which is a vector of sour rot pathogens. Other insecticide classes are available for the management of fruit flies, and they have to be utilized to manage insecticide resistance. Applying kaolin (Surround) just before clusters close can reduce SWD fruit injury at harvest by 50%. For the other options for fruit flies, see next page.
Ripe rot Bitter rot	See bloom recommendations for chemical management options (Critical period for ripe rot management)
Downy mildew (specific)	See pre-bloom recommendations.
Powdery mildew (specific)	See pre-bloom recommendations.
Anthracnose (specific)	See pre-bloom recommendations.

Veraison

Insect pest management

Grape berry moth	See pre-bloom recommendations
Sharpshooter leafhoppers (Pierce's disease suppression)	See pre-bloom recommendations
Spotted lanternfly	See pre-bloom recommendations
Mealybugs	See post-bloom recommendations
European red mite Twospotted spider mite	See post-bloom recommendations
Japanese beetle Green June beetle	See first cover recommendations

Insect pest management

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Spotted-wing drosophila (SWD) is a recently introduced invasive insect pest of soft-skinned fruits. It is unclear how significant SWD will be as a grape pest. Growers should carefully monitor adult presence in vineyards (using a 60:40 blend of red wine and apple cider vinegar, other commercial lures (Scentry, Trece, etc., check weekly) and larval presence in fruit. Wine grapes may experience greater injury than fresh market table grapes; results are mixed on differential varietal susceptibility, and this is a current research area. If adult SWD are present soft fruit may be a risk. Larvae begin to infest fruit as they ripen, so insecticide treatments should be applied on a weekly basis and reapplied in the event of rain. Some recommended materials have longer than 14-day REI and/or PHI; thus, check the label. While risk begins at véraison, risk increases significantly when fruit reach 15 degrees Brix. Risk appears to be related to skin thickness and penetration pressure; this is an active area of investigation. Control decisions should be influenced by history, since vineyard blocks are not uniform in infestation. Infestation by SWD may increase incidence of sour rot. Research suggests the management of fruit fly can decrease the risk of sour rot.						
Spotted-wing drosophila	beta-cyfluthrin (Baythroid XL)	1.6–3.2 fl oz	VG	12 hr	3 days	**(IRAC = 3)**
	imidacloprid & cyfluthrin (Leverage 2.4)	3–8 fl oz	G	12 hr	3 days	**(IRAC = 4A & 3)**
	spinetoram (Delegate)	3–5 fl oz	G	4 hr	7 days	**(IRAC = 5)**

Veraison

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Spotted-wing drosophila (cont.)	malathion (Malathoin 8F or Malathion 5EC)	1.88 pt (8F) 3 pt (5EC)	F F	24 hr 24 hr	3 days 3 days	REI = 72 hr for girdling and tying. Rates based on 200 gal per acre spray volumes. As is common with most EC formulations, adverse effects, such as spotting or discoloration of the fruit or foliage may occur with high temperatures, poor drying conditions, excessive spray runoff, or certain tank mixes with other chemicals or pesticides. **(IRAC = 1B)**
	zeta-cypermethrin (Mustang Maxx)	4 fl oz	VG	12 hr	1 day	**(IRAC = 3)**
	spinosad (Entrust 80W, Entrust SC)	1.25–2.5 oz 4–8 fl oz	G G	4 hr 4 hr	7 days 3 days	Entrust is OMRI listed. **(IRAC = 5)**
	Cyclaniliprole (Verdepryn 100SL)	8.2–11 fl oz	G	4 hr	7 days	**(IRAC = 28)**

Post Veraison to Preharvest

Disease Management

Up to 10 to 14 days before harvest

During the preharvest interval, if diseases get out of hand, there are some actions to take, depending on the problem.

Downy mildew: There is a strong possibility that you can have a late-season outbreak of downy mildew, especially when a tropical storm or related rain comes to the area. You should keep eye on your younger foliage because it will be the first one to be infected. Once you observe symptoms on young leaves, apply phosphonates (*plus* captan, if you wish).

Powdery mildew: As with downy mildew, younger leaves are more susceptible; thus, once you start to see powdery on them, apply a powdery mildew material (Vivando, Quintec, Torino, DMI, etc.). The other option is the use of potassium salt (Kaligreen, Armicarb, etc) or JMS Stylet Oil.

Botrytis: We do not have any curative materials against Botrytis. Thus, protect your berries and use cultural control (leaf removal, bird and bee control). If Botrytis is an issue for you, rotate the modes of action and tank-mix a newer material with captan. Botrytis is known to develop resistance to chemicals rapidly.

Ripe rot: A combination of Switch *plus* captan or QoI (e.g., Quadris, Pristine, etc.) *plus* captan is probably the best material that you can use. Cultural control measures such as leaf removal can reduce the risk of infection as well.

The use of sulfur, captan, or copper within 30 days of harvest is often not preferred due to their potential negative effects on the fermentation process. For example, captan residue on grapes may delay fermentation and lead to cloudy wine that requires extra filtration. Consult with your winemaker.

Please remember that the best way to minimize the risk of an outbreak late in the season is to prevent disease development in the early part of the season. If you have a late-season outbreak, please re-examine your early-season spray schedule. Contact your local extension agents for suggestions.

Post-harvest

General comments

Interval from harvest until the first killing frost. Often time, there is enough time between harvest and the end of the season (i.e., hard frost event) for grapevines to be photosynthetically active to accumulate carbohydrates for the winter. In addition, grapevines may need extra care because some growers choose not to apply fungicides directly prior to harvest. Since a copper product can provide efficacy against both downy and powdery mildews, it can be a very convenient and economical tool at this time of the season on grapes that are not sensitive to copper applications.

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Disease management						
Downy mildew	copper compounds (various formulations)	see label	VG	24 hr	----	Premature defoliation may predispose vines to winter injury. Use shorter spray intervals when conditions are favorable for disease development. Copper may cause injury under cool slow drying conditions. Use mancozeb on copper sensitive cultivars for downy mildew control.
	mancozeb (various formulations)	see label	VG	4 hr	----	
	Phosphonates	see label	E	4 hr	----	
Powdery mildew	sulfur products	see label	E	24 hr	----	
	copper compounds (various formulations)	see label	G	24 hr	----	Copper product can provide enough protection against both downy and powdery mildew at this time of the season.
Fire ant control						
See pre-bloom recommendations						

Efficacy of selected fungicides against diseases of bunch grapes

Chemical name (Fungicide product name)	FRAC	Anthracnose	Black rot	Bitter rot	Botrytis rot	Downy mildew	Phomopsis cane and leaf spot	Powdery mildew
Azoxystrobin **(Quadris)**	11	nd.	E[a]	E	G[b]	E[b]	G	E[b]
Benzovindiflupyr **(Aprovia)**, Isofetamid **(Kenja)**	7	G[c]	VG	nd.	E[b]	nd.	nd.	VG[c]
Benzovindiflupyr *plus* Difenoconazole **(Aprovia Top)**	3 plus 7	VG[c]	VG	nd.	E[b]	nd.	nd.	VG[c]
Boscalid **(Endura)**	7	nd.	nd.	nd.	E[b]	nd.	nd.	VG[c]
Boscalid *plus* Pyraclostrobin **(Pristine)**	7 plus 11	VG	E	E	E[b]	E[b]	E	E
Captan (**Captan, Captec**, etc.)	M4	G	G	E	F	VG	VG	nd.
Fixed coppers and Bordeaux mixture (various)	M1	nd.	G	F	G	G	F	F
Cyazofamid **(Ranman)**	21	nd.	nd.	nd.	nd.	VG	nd.	nd.
Cyflufenamid (**Torino**)	U8	nd.	nd.	nd.	nd.	nd.	nd.	VG
Cyprodinil (**Vangard**)	9	nd.	nd.	nd.	E[b]	nd.	nd.	F
Cyprodinil *plus* Fludioxonil **(Switch)**	9 plus 12	nd.	nd.	nd.	VG[b]	nd.	nd.	nd.
Cyprodinil *plus* Difenoconazole **(Inspire Super)**	3 plus 9	G[c]	VG	nd.	VG[b]	nd.	nd.	VG
Famoxadone *plus* cymoxanil **(Tanos)**	11 plus 29	nd.	nd.	nd.	nd.	G[b]	nd.	nd.
Fenhexamid (**Elevate**)	17	nd.	nd.	nd.	E[b]	nd.	nd.	nd.
Ferbam (**Ferbam**)	M3	nd.	VG	G	nd.	F	F	nd.
Fenarimol (**Rubigan**)	3	nd.	F	nd.	nd.	nd.	nd.	E[b]
Fluopyram *plus* tebuconazole (**Luna Experience**)	3 plus 7	nd.	E	nd.	E[b]	nd.	nd.	E
Iprodione (**Rovral, Meteor**)	2	nd.	nd.	nd.	G[b]	nd.	nd.	nd.
Kresoxim-methyl **(Sovran)**	11	nd.	E	E	F[b]	G[b]	G	E[b]
Lime Sulfur (dormant application)	M2	G	nd.	nd.	nd.	nd.	G	F
Mancozeb (various: **Penncozeb, Dithane**, etc)	M3	nd.	E	E	nd.	E	E	nd.
Mandipropamid **(Revus),** Dimethomorph **(Forum),** Dimethomorph *plus* Ametoctradin **(Zampro)**	40	nd.	nd.	nd.	nd.	E	nd.	nd.

Efficacy of selected fungicides against diseases of bunch grapes

Chemical name (Fungicide product name)	FRAC	Anthracnose	Black rot	Bitter rot	Botrytis rot	Downy mildew	Phomopsis cane and leaf spot	Powdery mildew
Mandipropamid *plus* Difenoconazole **(Revus Top)**	40 plus 3	nd.	VG	VG [c]	nd.	E	G [c]	VG
Mefenoxam *plus* Copper **(Ridomil Gold Copper)**	4 plus M1	nd.	F	F	F	E	F	F
Mefenoxam *plus* Mancozeb **(Ridomil Gold MZ)**	4 plus M3	nd.	G	G	nd.	E	G	nd.
Mefentrifluconazole **(Cevya)**	3	nd.	VG	nd.	nd.	nd.	nd.	VG
Metrafenone **(Vivando)**	50	nd.	nd.	nd.	nd.	nd.	nd.	VG
Myclobutanil **(Rally)**	3	nd.	E	F	nd.	nd.	nd.	E [b]
Phosphonate (**ProPhyt, Phostrol**, etc.)	P07	nd.	nd.	nd.	nd.	VG	nd.	nd.
Pydiflumetofen *plus* fludioxonil **(Miravis Prime)**	7 plus 11	VG[c]	VG	nd.	VG	nd.	G[c]	VG
Sulfur [d] (various)	M2	nd.	nd.	nd.	nd.	nd.	F	E
Tebuconazole (**Elite**, etc.)	3	nd.	E	nd.	nd.	nd.	nd.	E [b]
Tetraconazole **(Mettle)**	3	nd.	nd.	nd.	nd.	nd.	nd.	VG [b]
Thiophanate-methyl **(Topsin-M WSB)**	1	nd.	F	G	nd.	nd.	G	E [b]
Trifloxystrobin **(Flint)**	3	nd.	E	E	VG	G	F	E [b]
Triflumizole (**Procure, Viticure, Trionic, etc.**)	3	nd.	G[b]	nd.	nd.	nd.	nd.	E
Ziram (**Ziram**)	M3	nd.	VG	nd.	F	VG	G	nd.

[a] The efficacy rating: nd. = no data; no significant activity or unknown; P = very limited activity, F = limited activity, G = moderate activity, VG = good activity, E = excellent activity. L = Labeled

[b] Resistance (or occasional failure of control) has been observed in some southeastern states, thus, if control failure occurs, it could indicate resistance has developed. The efficacy rating could be impacted by resistance development. If resistance has occurred, use of fungicides in the same class would likewise show resistance, and a substitute fungicide should be considered for pathogen management.

[c] Insufficient data for the pathogen-chemical combination. The rating was given based on the general knowledge on the material.

[d] Sulfur will cause burn on sensitive cultivars, especially on hot days when temperature reaches above 85F when foliage is wet.

Fungicide classes with high risk of resistance development (generally single sites of action)

Mode of action	Mode of action classification	Product (chemical(s))
Benzimidazoles	FRAC group 1	Topsin M (thiophanate methyl)
Dicarboximides	FRAC group 2	Rovral/Meteor (iprodione)
Demethylation Inhibitors (DMIs) or Sterol Inhibitors	FRAC group 3	Bayleton (triadimefon) Cevya (mefentrifluconazole) Elite and generics (tebuconazole) Inspire Super (cyprodinil plus difenoconazole) Luna Experience (tebuconazole plus Fluopyram) Mettle (tetraconazole) Procure/Viticure (triflumizole) Quadris Top (difenoconazole plus azoxystrobin) Rubigan/Vintage (fenarimol) Revus Top (mandipropamid plus difenoconazole) Rhyme (flutriafol) Rally/Nova (myclobutanil) Topguard EQ (flutriafol plus azoxystrobin)
Phenylamides	FRAC group 4	Ridomil Gold (mefenoxam)
SDHI: Succinate dehydrogenase inhibitors	FRAC group 7	Aprovia (benzovindiflupyr) Aprovia Top (benzovindiflupyr plus difenoconazole) Endura (boscalid) Luna Experience (fluopyram; one component of a two-part mixture) Luna Sensation (fluopyram; one component of a two-part mixture) Miravis Prime (Pydiflumetofen plus fludioxonil) Kenja (isofetamid) Pristine (boscalid plus pyraclostrobin)
Anilinopyrimidines	FRAC group 9	Vangard (cyprodinil) Switch (cyprodinil plus fludioxonil) Inspire Super (cyprodinil plus difenoconazole) Scala (pyrimethanil)
QoI: Quinone outside Inhibitors	FRAC group 11	Quadris (azoxystrobin) Flint (trifloxystrobin) Intuity (mandestrobin) Luna Sensation (trifloxystrobin plus fluopyram) Pristine (pyraclostrobin plus boscalid)

Fungicide classes with high risk of resistance development (generally single sites of action)

Mode of action	Mode of action classification	Product (chemical(s))
QoI: Quinone outside Inhibitors (cont.)	FRAC group 11 (cont.)	Quadris Top (azoxystrobin plus difenoconazole) Reason (famoxadone) Sovran (kresoxim-methyl) Tanos (famoxadone plus cymoxanil) Topguard EQ (azoxystrobin plus flutriafol)
Phenylpyrroles	FRAC group 12	Miravis Prime (Pydiflumetofen plus fludioxonil) Switch (fludioxonil plus cyprodinil)
Hydroxyanilides	FRAC group 17	Elevate (fenhexamid)
QiI: Quinone inside Inhibitors	FRAC group 21	Ranman (cyazofamid)
Carboxylic acid amides	FRAC group 40	Forum (dimethomorph) Revus (mandipropamid) Revus Top (mandipropamid plus difenoconazole) Zampro (dimethomorph plus ametocradin)
Quinone X Inhibitor	FRAC group 45	Zampro (dimethomorph plus ametocradin)
Aryl-phenyl-ketones	FRAC group 50	Vivando (metrafenone)
	FRAC group U13	Gatten (flutianil)

Fungicide classes with low risk of resistance development (generally multiple modes of action)

Several FRAC groups and classes	Captan (Captan or Captec) (M4) Coppers (numerous formulations) (M1) Carbamate (ferbam) (M3) Dithane, Manzate, Penncozeb (mancozeb) (M3) Maneb, Manex (maneb) (M3) Phosphonates (ProPhyt, etc.) (P07) Thiram (thiram) (M3) Sulfur (M2) Ziram (ziram) (M3)

Efficacy of selected insecticides against pests of bunch grapes PART 1

Active Ingredient	Insecticide Product	PHI	IRAC MOA	Climbing cut worms	Grape flea beetle	Mealy bug	Grape scale	Leafhopper / Sharpshooter	Grape berry moth	Grape tumid gallmaker
abamectin	**Agri-Mek 0.15C**	28 days	**6**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
acetamiprid	**Assail 30SG**	3 days	**4A**	nd.	nd.	**G**	**G**	nd.	nd.	nd.
Bacillus thuringiensis	**Dipel DF**	0 days	**11**	**F**	nd.	nd.	nd.	nd.	nd.	nd.
beta-cyfluthrin	**Baythroid XL**	3 days	**3A**	**G**	**G**	**G**	nd.	nd.	nd.	nd.
bifenazate	**Acramite 50WS**	14 days	**20D**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
bifenthrin	**Brigade eVo**	30 days	**3A**	**G**	nd.	nd.	nd.	**F**	nd.	nd.
buprofezin	**Applaud 70DF**	7 days	**16**	nd.	nd.	**G**	nd.	nd.	nd.	nd.
carbaryl	**Sevin XLR Plus**	7 days	**1A**	**G**	**G**	nd.	nd.	**F**	**G**	nd.
chlorantraniliprole	**Altacor eVo**	14 days	**28**	**G**	nd.	nd.	nd.	nd.	**VG**	nd.
clothianidin (foliar)	**Belay**	0 days	**4A**	nd.	nd.	**G**	nd.	nd.	**F**	nd.
clothianidin (soil)	**Belay**	30 days	**4A**	nd.	nd.	**VG**	nd.	**VG**	nd.	nd.
cyclaniliprole	**Verdepyn 100SL**	7 days	**28**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
dinotefuran (foliar)	**Venom**	1 day	**4A**	nd.	nd.	**G**	nd.	**G**	nd.	nd.
dinotefuran (soil)	**Venom**	28 days	**4A**	nd.	nd.	**VG**	nd.	**VG**	nd.	nd.
etoxazole	**Zeal**	14 days	**10B**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
fenpropathrin	**Danitol 2.4 EC**	21 days	**3A**	nd.	nd.	nd.	nd.	**F**	**F**	nd.
fenpyroximate	**Portal 5EC**	14 days	**21A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
fenutatatinoxide	**Vendex 50WP**	28 days	**12B**	nd.	nd.	nd.	nd.	nd.	nd.	nd.

Efficacy of selected insecticides against pests of bunch grapes PART 1

Active Ingredient	Insecticide Product	PHI	IRAC MOA	Climbing cut worms	Grape flea beetle	Mealy bug	Grape scale	Leafhopper / Sharpshooter	Grape berry moth	Grape tumid gallmaker
Heterorhabditis bacteriophora	**Nemasys G**	0 days	**N/A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
hexythiazox	**Onager 11.8EC**	28 days	**10A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
Imidacloprid (foliar)	**Admire Pro**	0 days	**4A**	nd.	nd.	**G**	nd.	nd.	nd.	nd.
Imidacloprid (soil)	**Admire Pro**	30 days	**4A**	nd.	nd.	**VG**	**G**	**VG**	nd.	nd.
imidacloprid + cyfluthrin	**Leverage 2.4**	3 days	**4A + 3A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
indoxacarb	**Avaunt eVo**	7 days	**22**	nd.	nd.	nd.	nd.	nd.	**G**	
malathion	**Malathion 8F**	3 days	**1B**	nd.	nd.	nd.	nd.	**F**	nd.	nd.
methoprene	**Extinguish Professional Fire Ant Bait**	0 days	**7A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
methoxyfenozide	**Intrepid 2F**	7 days	**1B**	**G**	nd.	nd.	nd.	nd.	**G**	nd.
pheromone	**Isomate-GRB**	0 days	**N/A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
phosmet	**Imidan 70-W**	14 days	**1B**	nd.	**G**	nd.	nd.	nd.	**G**	nd.
pyridaben	**Nexter 75WP**	7 days	**21A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
pyriproxyfen	**Esteem Ant Bait**	1 day	**7C**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
spinetoram	**Delegate 25 WG**	7 days	**5**	**G**	nd.	nd.	nd.	nd.	**VG**	nd.
spinosad	**Entrust SC**	7 days	**5**	**G**	nd.	nd.	nd.	nd.	**G**	nd.
spirodiclofen	**Envidor 2SC**	14 days	**23**	nd.	nd.	nd.	nd.	nd.	nd.	nd.

Efficacy of selected insecticides against pests of bunch grapes PART 1

Active Ingredient	Insecticide Product	PHI	IRAC MOA	Climbing cut worms	Grape flea beetle	Mealy bug	Grape scale	Leafhopper / Sharpshooter	Grape berry moth	Grape tumid gallmaker
spirotetramat	**Movento 2SC**	7 days	**23**	nd.	nd.	**G**	**G**	nd.	nd.	**G**
stylet oil	**JMS Stylet Oil**	0 days	**N/A**	nd.	nd.	**G**	nd.	nd.	nd.	nd.
superior spray oil	**Damoil**	0 days	**N/A**	nd.	nd.	**G**	nd.	nd.	nd.	nd.
zeta-cypermethrin	**Mustang Maxx**	1 day	**3A**	**G**	**G**	nd.	nd.	nd.	nd.	nd.

[a] The efficacy rating: *nd.* = no data; no significant activity or unknown; P = very limited activity, F = limited activity, G = moderate activity, VG = good activity, E = excellent activity.

Efficacy of selected insecticides against pests of bunch grapes PART 2

Active Ingredient	Insecticide Product	PHI	IRAC MOA	Phylloxera (foliar)	Grape rootworm	Mites	Japanese beetle / Green June beetle	Grape root borer	Red imported fire ant	Spotted-wing drosophila
abamectin	**Agri-Mek 0.15C**	28 days	**6**	nd.	nd.	**VG**	nd.	nd.	nd.	nd.
acetamiprid	**Assail 30SG**	3 days	**4A**	**G**	nd.	nd.	**G**	nd.	nd.	nd.
Bacillus thuringiensis	**Dipel DF**	0 days	**11**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
beta-cyfluthrin	**Baythroid XL**	3 days	**3A**	nd.	nd.	nd.	nd.	nd.	nd.	**VG**
bifenazate	**Acramite 50WS**	14 days	**20D**	nd.	nd.	**E**	nd.	nd.	nd.	nd.
bifenthrin	**Brigade eVo**	30 days	**3A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
buprofezin	**Applaud 70DF**	7 days	**16**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
carbaryl	**Sevin XLR Plus**	7 days	**1A**	nd.	**VG**	nd.	**VG**	nd.	nd.	nd.
chlorantraniliprole	**Altacor eVo**	14 days	**28**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
clothianidin (foliar)	**Belay**	0 days	**4A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
clothianidin (soil)	**Belay**	30 days	**4A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
cyclaniliprole	**Verdepyn 100SL**	7 days	**28**	nd.	nd.	nd.	nd.	nd.	nd.	**G**
dinotefuran (foliar)	**Venom**	1 day	**4A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
dinotefuran (soil)	**Venom**	28 days	**4A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
etoxazole	**Zeal**	14 days	**10B**	nd.	nd.	**VG**	nd.	nd.	nd.	nd.
fenpropathrin	**Danitol 2.4 EC**	21 days	**3A**	nd.	nd.	nd.	nd.	nd.	nd.	**VG**
fenpyroximate	**Portal 5EC**	14 days	**21A**	nd.	nd.	**VG**	nd.	nd.	nd.	nd.
fenutatatinoxide	**Vendex 50WP**	28 days	**12B**	nd.	nd.	**G**	nd.	nd.	nd.	nd.
Heterorhabditis bacteriophora	**Nemasys G**	0 days	**N/A**	nd.	nd.	nd.	nd.	**G**	nd.	nd.
hexythiazox	**Onager 11.8EC**	28 days	**10A**	nd.	nd.	**G**	nd.	nd.	nd.	nd.
Imidacloprid (foliar)	**Admire Pro**	0 days	**4A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
Imidacloprid (soil)	**Admire Pro**	30 days	**4A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
imidacloprid + cyfluthrin	**Leverage 2.4**	3 days	**4A + 3A**	nd.	nd.	nd.	nd.	nd.	nd.	**G**

Efficacy of selected insecticides against pests of bunch grapes PART 2

Active Ingredient	Insecticide Product	PHI	IRAC MOA	Phylloxera (foliar)	Grape rootworm	Mites	Japanese beetle / Green June beetle	Grape root borer	Red imported fire ant	Spotted-wing drosophila
indoxacarb	**Avaunt eVo**	7 days	**22**	nd.	nd.	nd.	**G**	nd.	nd.	nd.
malathion	**Malathion 8F**	3 days	**1B**	nd.	nd.	nd.	**F**	nd.	nd.	**VG**
methoprene	**Extinguish Professional Fire Ant Bait**	0 days	**7A**	nd.	nd.	nd.	nd.	nd.	**VG**	nd.
methoxyfenozide	**Intrepid 2F**	7 days	**1B**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
pheromone	**Isomate-GRB Z**	0 days	**N/A**	nd.	nd.	nd.	nd.	**VG**	nd.	nd.
phosmet	**Imidan 70-W**	14 days	**1B**	nd.	nd.	nd.	**G**	nd.	nd.	**G**
pyridaben	**Nexter 75WP**	7 days	**21A**	nd.	nd.	**G**	nd.	nd.	nd.	nd.
pyriproxyfen	**Esteem Ant Bait**	1 day	**7C**	nd.	nd.	nd.	nd.	nd.	**VG**	nd.
spinetoram	**Delegate 25 WG**	7 days	**5**	nd.	nd.	nd.	nd.	nd.	nd.	**G**
spinosad	**Entrust SC**	7 days	**5**	nd.	nd.	nd.	nd.	nd.	nd.	**G**
spirodiclofen	**Envidor 2SC**	14 days	**23**	nd.	nd.	**VG**	nd.	nd.	nd.	nd.
spirotetramat	**Movento 2SC**	7 days	**23**	**G**	nd.	nd.	nd.	nd.	nd.	nd.
stylet oil	**JMS Stylet Oil**	0 days	**N/A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.
superior spray oil	**Damoil**	0 days	**N/A**	nd.	nd.	nd.	nd.	nd.	nd.	nd.

[a] The efficacy rating: *Empty cell* = no significant activity or unknown; P = very limited activity, F = limited activity, G = moderate activity, VG = good activity, E = excellent activity.

Grape Vineyard Weed Management

The primary goal of any weed management program is to minimize competition to direct as many resources as possible, like water, nutrients, and light, toward vine and crop growth. It is essential to minimize or eliminate competition in newly planted and young vineyards so that vine growth can be maximized to bring that vineyard into productivity as soon as possible. Research has shown that failure to control weeds through July in newly planted vineyards will reduce vine growth, delay vine maturity, and may increase vine mortality due to water stress. In older, established vineyards competition can reduce grape yields. The weed management programs outlined in this publication are designed to control weeds at levels to prevent competition and maximize fruit yields.

Herbicide Resistance Management

The development of herbicide resistant weed species has increased significantly across the Southeast during the past few years. Lately weed resistance to glyphosate has been the most common resistance development which is largely related to the widespread planting of glyphosate resistant crops. Using herbicides that have differing modes of action (MOA) during the growing season or tank mixing herbicides with differing MOA are strategies that can be utilized to prevent the development of herbicide resistant weeds. A number system identifying herbicides by MOA has been developed and will be listed on the product label. In the table below there is a MOA group number for each herbicide active ingredient to aid growers in making management decisions that will prevent the development of herbicide resistance or address options for managing a known resistant weed population that may be in or near the vineyard.

Additionally, growers are encouraged to find at least two herbicide programs containing different herbicides to rotate on an annual basis. By rotating herbicide programs growers not only minimize the risk of herbicide resistance developing but they also minimize the likelihood of selecting for weeds that one herbicide program may not be particularly effective at controlling.

Vineyard Herbicide Options

Preplant/ Site preparation

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hr)	Comments
PREPLANT/ SITE PREPARATION	Glyphosate, (Various brands and formulations)	See label	Apply 30 days prior to planting for control of emerged weeds.	12	Use to kill strips through vineyard prior to planting. Generic formulations may require the addition of a surfactant. See label for details on controlling specific perennial weeds. (**HRAC = 9**)

Preemergence

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI	Comments (HRAC group)
Annual grasses and small seeded broadleaf weeds	Pendimethalin (Prowl H_2O, Satellite, HydroCap)	2–4 qt	Newly Planted (once soil has settled after transplanting) and established vineyards.	12 hr	In newly planted grapes allow soil to settle after transplanting before applying pendimethalin. Use only during dormancy (prior to bud swell) when applying around newly planted and 1-year-old vines. In bearing vineyards apply any time after harvest, during winter dormancy in spring, and in season before harvest. Use rate cannot exceed 6.3 quarts/acre per year. Pendimethalin has a 21-day PHI. Tank mix with Zeus Prime, simazine or rimsulfuron for expanded residual control of broadleaf weeds. Apply in combination with paraquat, glyphosate, or glufosinate for non-selective POST weed control. (**HRAC = 3**)
Annual broadleaf weeds	Isoxaben, (Trellis SC)	16–31 fl. oz	Newly planted and established vineyards	12 hr	In newly planted vineyards apply once soil has settled after transplanting. Total use per year (from harvest to harvest) cannot exceed 31 fl oz/A. Trellis SC has a 60-day PHI. For residual control of annual grasses, tank mix with pendimethalin. Tank-mix with glyphosate, paraquat, or glufosinate for non-selective POST weed control. (**HRAC = 21**)
Annual weeds and some perennial weeds	Dichlobenil, (Casoron 4G)	100–150 lb	Newly planted (4 wks after transplanting) and established vineyards.	12 hr	Apply in January or February for best results. Warm temperatures increase volatilization therefore overhead irrigation may be use for activation when applied in early spring. Casoron 4G formulation may be used as early as 4 weeks after transplanting young vines. (**HRAC = 20**)
Broadleaf weeds and suppression of yellow nutsedge	Rimsulfuron, (Grapple 25 WG, Matrix 25 WG, Pruvin 25 WG, Solida 25 WG)	4 oz	Vines established at least 1 year.	4 hr	Tank mix with pendimethalin, diuron, or simazine to broaden spectrum of residual control. **DO NOT** apply within 14 days of harvest. Rimsulfuron will provide POST weed control of certain species like horseweed, wild radish, pigweed, chickweed, and henbit. Tank mix with glufosinate, glyphosate, or paraquat for non-selective POST weed control. Tank mixes with glyphosate will provide partial control of yellow nutsedge (2 to 3" tall). (**HRAC = 2**)

Preemergence (cont.)

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hr)	Comments
PREEMERGENCE Broadleaf weeds and some annual grasses	Diuron, (Karmex 80 XP or Direx 80 DF)	2–3 lb	Vines established at least 3 years.	12	Heavy rainfall soon after application to grapes planted in soils low in clay and < 2% organic matter may result in severe injury and this risk is assumed by the user. Apply with glyphosate, paraquat or glufosinate for postemergence weed control. (**HRAC = 7**)
Broadleaf weeds and some annual grasses	Simazine, (Princep 4 L or Princep Cal 90 or various generic formulations)	2–4 qt 2.2–4.4 lb	Vines established at least 3 years.	12	Tank mix with glyphosate, paraquat, or glufosinate for postemergence weed control. The addition of norflurazon (Solicam) or pendimethalin (Prowl H_2O) with simazine will extend residual grass control several weeks. (**HRAC = 5**)
Annual broadleaf and grass weeds	Flumioxazin, (Chateau 51 SW Tuscany 51 WDG Chateau EZ Tuscany SC)	6–12 oz 6–12 fl oz	Newly planted and established vineyards	12	Apply with hooded or shielded application equipment. Grapes established less than 2 years must be shielded with grow tubes. Flumioxazin **may only be used in table grapes after completing harvest and before bud break. Flumioxazin may be applied in vineyards producing grapes used for wine or juice after bud break so long as hooded application equipment is used. DO NOT tank mix with glyphosate after bud break.** DO NOT apply more than 6 oz per acre to vines established less than 3 years planted on soils having a sand plus gravel content that exceeds 80%. Flumioxazin formulations have a 60-day PHI. (**HRAC = 14**)

Preemergence (cont.)					
Weed/Timing	**Material**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI (hr)**	**Comments**
Annual broadleaf and grass weeds*)*	Indaziflam, (Alion 1.67 SC)	3.5–5 oz	Vines established at least 3 years	12	**DO NOT apply to grapes grown in Georgia or Florida**. Alion may be used on soils having a texture of sandy loam or finer and less than 20% gravel content. Tank mix with paraquat, glyphosate, or glufosinate for non-selective POST weed control. DO NOT exceed 5 oz of Alion per acre within a 12-month period. If making more than one application per year allow at least 90 days between applications. Tank-mix with glufosinate, glyphosate or paraquat for non-selective POST weed control. (**HRAC = 29**)
	Indaziflam + Rimsulfuron (Centrus)	3–4.3 oz	Vines established 3 years or longer	12	Grapes must have a 6 in. barrier between the soil surface and a major portion of the vine's root system. DO NOT use on grapes planted in sand soils. Rate is soil-texture dependent. See label for details. Tank mix with paraquat, glufosinate, or glyphosate for non-selective POST weed control. (**HRAC = 29 + 2**)
Annual broadleaf, some grass weeds, and yellow nutsedge PRE and POST control of annual broadleaf and grass weeds, and yellow nutsedge	Carfentrazone + Sulfentrazone, (Zeus Prime)	7.7–15.2 fl oz	Vines established 2 years or more	12	**DO NOT** allow spray solution to contact green bark or desirable foliage. Zeus Prime XC should be tank mixed with pendimethalin for extended residual control of annual grass weeds. Sequential applications can be made so long as the herbicide strip width is 50% or less of the vineyard floor. Allow 60 days between applications. **DO NOT** tank mix with flumioxazin. A ½ in. of rainfall is needed within 14 days of application to insure herbicide activation. Tank mix with glyphosate, glufosinate or paraquat for non-selective POST weed control. (**HRAC = 14**)
	Flazasulfuron, (Mission 25DF)	2.14–2.85 oz	Vines established 3 years or more		The trunks of 3-year-old vines must be protected with a grow tube. Apply no more than 2.85 oz/A per application. Total use for the year cannot exceed 5.7 oz/A. Mission has a 75-day PHI. For expanded residual control of annual grasses and broadleaf weeds tank mix with simazine, pendimethalin, or diuron. Mission will provide PRE and POST control of grass and broadleaf weeds, as well as yellow nutsedge. For non-selective POST weed control tank mix with glyphosate, glufosinate, or paraquat. (**HRAC = 2**)

Postemergence Directed

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hr)	Comments
Non-selective control	Glyphosate, (Various Brands and Formulations 4 SL)	See Label	Vines established 1 year or more.	12	DO NOT allow spray solution to contact green bark, foliage, or suckers. Tank mix with preemergence herbicides for residual control. **Do not apply within 14 days of harvest.** Generic formulations may require the addition of a surfactant. Refer to label for application directions for hard to control perennial species. (**HRAC = 9**)
	Glufosinate, (Cheetah Lifeline, Reckon 280 Rely 280 Surmise)	48–82 oz	Newly planted (shielded) and established vineyards	12	Do not allow herbicide to contact desirable foliage or immature, uncallused bark. Apply in a minimum spray volume of 20 gal./A. **Do not apply within 14 days of harvest.** (**HRAC = 10**)
	Paraquat, (Gramoxone Parazone, or Paraquat Concentrate 3SL)	1.7–2.7 pt	Newly planted (shielded) to established vineyards	12	Do not allow herbicide to contact desirable foliage or immature, uncallused bark. Young vines must be shielded. Apply in a minimum spray volume of 20 gal/A with non-ionic surfactant at 0.25 % v/v (1qt per 100 gal of spray solution). Please note additional training requirements for applicators. (**HRAC = 22**)
Certain broadleaf weeds and yellow nutsedge	Bentazon, (Broadloom)	1.5–2 pt	Newly planted (shielded) and NON-BEARING ONLY!	48	Do not apply more than 2 pt per acre per application and total use for the year cannot exceed 4 pt per acre. Do not allow herbicide to contact green stems, bark or foliage. For yellow nutsedge control apply 2 pt per acre when nutsedge is 6 to 8 in. tall and make a second application of the same rate 7 to 10 days later. Use in combination with a crop oil concentrate at 1% v/v (1 gal per 100 gal of spray solution). (**HRAC = 6**)

Postemergence (cont.)					
Weed/Timing	**Material**	**Amount of Formulation per Acre**	**Crop Age Restrictions**	**REI (hr)**	**Comments**
Certain broadleaf weeds	Carfentrazone (Aim)	1–2 fl. oz	Vines established 1 year or longer.	12	Do not allow herbicide to contact desirable fruit or foliage. The addition of a non-ionic surfactant at 0.25 % v/v (1 qt per 100 gal of solution) or crop oil concentrate at 1% v/v (1gal per 100 gal. of solution) is necessary for optimum herbicide performance. Ammonium sulfate may be used in addition to a non-ionic surfactant, refer to label for details. Aim may be tank mixed with glyphosate or glufosinate (Rely) or various preemergence herbicides. For chemical removal of suckers use the maximum rate and refer to label for details. Aim has a 3-day PHI. (**HRAC = 14**)
Annual and perennial grasses	Clethodim, (Select, and others 2EC SelectMax)	6–8 oz 12–16 oz	Newly planted or non-bearing vineyards	12	Sequential applications are for perennial grasses (bermudagrass or johnsongrass). The addition of a non-ionic surfactant at 0.25 % v/v (1 qt/100 gal. of spray solution) is required. Do not apply within 1 year of harvest. (**HRAC = 1**)
	Fluazifop, (Fusilade DX)	12–24 oz	Newly planted and non-bearing vineyards	12	Sequential applications will be necessary for perennial grass (bermudagrass, etc.) control. The addition of a non-ionic surfactant (1 qt/100 gal of spray solution) or crop oil concentrate (1 gal./100 gal. of spray solution) is necessary for optimum results. Do not apply within 1 year of harvest. (**HRAC = 1**)
	Sethoxydim, (Poast)	1–2.5 pt	Newly planted and established vineyards	12	Sequential applications will be necessary for perennial grass (bermudagrass, etc.) control. The addition of a non-ionic surfactant (1 qt/100 gal of spray solution) or crop oil concentrate (1 gal./100 gal. of spray solution) is necessary for optimum results**. Do not apply within 50 days of harvest.** Total use cannot exceed 5 pt/A per year. (**HRAC = 1**)

Weed Response to Vineyard Herbicides

	Annual Grasses					Annual Broadleaf Weeds																Perennial Weeds				
Herbicides	Crabgrass	Foxtails	Goosegrass	Panicum, Fall	Ryegrass, Annual	Chickweed	Dock	Galinsoga	Geranium, Carolina	Groundsel, Common	Henbit	Horseweed	Lambsquarters	Morningglory, Annual	Nightshades	Pigweed	Radish, Wild	Ragweed	Sida, Prickly	Smartweed	Spotted Spurge	Bermudagrass	Dandelion	Johnsongrass	Nutsedge, Yellow	Virginia Creeper
Preemergence																										
Alion	E	E	E	G	G	E		E	E		E	G	E	E	E	E	G	E	G	G	E	N	G		P	N
Casoron	G	G	G	G	G	G	G	F	G	G	G	G	G	F	F	G	G	G		G	G	N	G		N	N
Flumioxazin	E	E	E	G	G	E		G	G		E	G	E	E	E	E	G	G	E	G	E	N	G		N	N
Diuron	G	G	G	F	G	G		G	F		G	G	G	G	G	G	G	G	G	G	N	N	N		N	N
Mission	F	G	P	P	G	G	-	-	G	G	G	F	G	-	-	G	-	G	-	-	G	N	G	N	G	N
Rimsulfuron	F	F	P	P	P	G				G	G	E	G	G	F	E	G	F			G		F		F	
Pendimethalin	E	G	G	G	G	G			G		G		G	F	F	E	G			G	G					
Simazine	F	G	G	F	G	G		G	F	F	G	G	E	F	G	G	E	G	F	G	P	N	P		N	N
Zeus Prime	F	F	F	F	F	G	G	G	G	G	G	F	E	E	E	E	E	F	E	E	E	N		N	E	N
Postemergence																										
Aim	N	N	N	N	N							P	G	E	G	G	F			G		N	N	N	N	N
Clethodim	E	E	E	E	E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	E	N		N	N
Fusilade	G	G	G	G	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	E	N		N	N
Glyphosate	E	E	E	E	E	E	G	G	G	E	F	E	E	G	E	E	G	E	G	F	G	F	G		F	G
Mission	G	G	-	-	G	G	-	-	G	G	G	G	G	-	-	G	-	G	-	-	G	N	F	N	G	N
Paraquat	G	G	G	G	G	G		G	F	F	F	P	G	G	G	G	F	G	G	G	G	P	P		P	P
Poast	E	E	E	E	G	N	F	N	N	N	N	N	N	N	N	N	N	N	N	N	N	E	N		N	N
Glufosinate	F	G	G	G	G	G	N	F	F	F	F	E	G	E	G	G	G	G	F	G	G	F	G		F	P

E = excellent, G = good, F = fair, P = poor, N = no activity

Postemergence Control of Bermudagrass and Johnsongrass

Perennial grasses like bermudagrass and Johnsongrass can be controlled with Poast, Fusilade, and clethodim. Successful use of grass-specific herbicides (Poast, Fusilade DX, clethodim) depends on several factors however the most critical is application timing relative to weed growth stage. Application timing varies with grass species and somewhat with the herbicide choice which is outlined in table below. Additional factors influencing the performance of these herbicides on perennial grasses include spray volume and soil moisture. Graminicides are systemic herbicides, they enter the plant and move through the vascular system to their targeted site of action. Systemic herbicides need to be applied in spray volumes that do not exceed 25 gal. of spray solution per acre. Higher volumes dilute the herbicide and may reduce their effectiveness. Weeds free of stress (drought, etc.) also respond best to systemic herbicides because the herbicide moves into plant and through its vascular system more readily. All of these herbicides require a second application for them to be effective. It is important that the second application be timed appropriately and when the weed has regrown from the initial herbicide application. The time between the first and second application can vary depending upon environmental conditions, so this requires monitoring in order to get the second application applied timely.

Appropriate Application Time for Perennial Grass Control

Herbicide	Bermudagrass		Johnsongrass	
	1st Application	2nd Application	1st Application	2nd Application
Poast	6 in.	4 in.	25 in.	12 in.
Clethodim	3–6 in.	3–6 in.	12–24 in.	6–18 in.
Fusilade	4–8 in.	4–8 in.	8–16 in.	6–12 in.

Refer to product label for spray additive recommendations.

Suggested Herbicide Programs for Grape Vineyards

Crop Age	Fall	Winter	Spring	Summer
Newly Planted	Glyphosate (Pre-Plant to kill weeds in herbicide strip)		Flumioxazin (Once soil settles after transplanting)	Flumioxazin + Paraquat (June or July); Fusilade, or Poast, or Clethodim (as needed).
Vines Established 1 to 2 years or more	Glyphosate (spot treat for perennial weeds)	Glyphosate (Mid-March)		
	Glyphosate (spot treat for perennial weeds)	Flumioxazin + glyphosate, paraquat or Glufosinate (mid to late March)	Flumioxazin* + Paraquat or Glufosinate (early June)	Poast (as needed for POST grass control) *See Flumioxazin restrictions for applications made after bud break.
	Glyphosate (spot treat for perennial weeds)	Zeus Prime + Pendimethalin (**vines est. 2 years**) + glyphosate, paraquat, or Glufosinate	Zeus Prime + Pendimethalin + glyphosate, paraquat, or Glufosinate	Glyphosate, Paraquat, Glufosinate, or Poast (as needed)
	Glyphosate (spot treat for perennial weeds); Flumioxazin + Glufosinate (after harvest)		Flumioxazin* + Paraquat, or Glufosinate (late May)	Glufosinate or Paraquat or Poast (as needed) *See Flumioxazin restrictions for applications made after bud break.
	Glyphosate (spot treat for perennial weeds)	Flumioxazin + Glyphosate (prior to bud break)		Glufosinate or Paraquat or Poast (as needed)
Vines Established at least 3 years or more	Glyphosate (spot treat for perennial weeds)	Glyphosate (mid-March)	Simazine + Pendimethalin + Glyphosate	Paraquat, Glufosinate, or Poast (as needed)
	Glyphosate (spot treat for perennial weeds)	Glyphosate (mid-March)	Karmex + Rimsulfuron (Matrix and others) + Glyphosate or Glufosinate	Paraquat, Glufosinate, or Poast (as needed)

Suggested Herbicide Programs for Grape Vineyards

Crop Age	Fall	Winter	Spring	Summer
Vines Established at least 3 years or more (cont.)	Glyphosate (spot treat for perennial weeds); Simazine + Glufosinate or Paraquat		Alion + Glyphosate or Glufosinate (Late May to early June)	Paraquat, Glufosinate, or Poast (as needed)
	Glyphosate (spot treat for perennial weeds); Flumioxazin + Glufosinate or Paraquat		Alion + Glyphosate or Glufosinate (late May to early June)	Paraquat, Glufosinate, or Poast (as needed)
	Glyphosate (spot treat for perennial weeds)	Glyphosate (mid-March)	Alion + Glyphosate or Glufosinate (early to mid-May)	Paraquat, Glufosinate, or Poast (as needed)

Wildlife Damage Prevention

Pest/Problem	Management Options
Efforts to control birds and other wildlife that damage fruit crops should be focused on the perimeter of the planting first, especially on the side(s) facing favorable wildlife habitat. This is where the first damage will be observed and, in some cases, it may be sufficient to head off the problem. However, don't discontinue monitoring for wildlife damage throughout the planting.	
Birds	Crop losses to birds appear to be increasing in small fruit crops. Not only do birds consume fruit, but the damage they cause can result in increased problems with fruit rots and other pests such as bees and yellow jackets. Several different types of birds can cause problems. Robins, starlings, and mockingbirds are among the more common ones, but orioles, cedar waxwings and fin. may also feed on small fruit crops. Feeding pressure will be heavier in fields that are close to roosting or nesting sites such as woodlands, hedgerows, grassy fields, power lines and individual trees. Birds may feed, fly to these resting sites, and then return to the crop later in the day. While birds can and do fly fairly long distances to feed, the further they have to fly, the more apt they are to not find the fruit crop or to be distracted by another food source. The presence of a pond, creek or other water source nearby is another factor that may lead to increased feeding pressure. Typically, bird damage tends to be more severe in the earlier parts of the growing season, and damage lessens as the season progresses. There are several control techniques which may be of value in decreasing losses to birds. They include visual, auditory and chemical repellents and exclusion (netting). For any method to be successful, it must be instituted before birds establish a feeding pattern, which generally means that they should be in place and operating at the time that color change occurs in the fruit. With the exception of exclusion, no single method should be relied on for control. Birds are federally protected and lethal control methods are not generally available to growers. Non-lethal methods such as exclusion (netting) are often sufficient when properly installed. Visual deterrents can be beneficial in short durations but usually become ineffective when used over longer periods of time because birds quickly learn to ignore these stimuli. Auditory distress calls and chemical repellents can be more effective. Chemical repellents may impart an off flavor to the fruit crop.
	Auditory repellants Auditory scare devices such as propane cannons, noise makers or distress calls may offer temporary relief for some types of birds. Regardless of which one or ones is/are used, the following points should be considered to attain the best results: - Assess the potential for objections to the noise from your neighbors. - Start before birds establish a feeding pattern. - Operate control devices beginning shortly before sunrise and continuing until just after sunset, as early and late in the day may be the most intense feeding times. - Vary the frequency, the direction and the timing in which auditory devices are operated. Propane cannons should not be fired at intervals

Wildlife Damage Prevention

Pest/Problem	Management Options
Birds (Cont.)	**Auditory repellants** (cont.) closer than 3 min. - Consider using more than one type of auditory device and possibly combine them with visual repellents. - If using distress calls, it is essential to identify the type(s) of birds you want to discourage and get distress calls specific to them. - Reinforce the sense of danger by shooting (if allowed). **Visual repellants** Visual repellents include such things as scare eyes suspended above the crop, mylar tape on the canopy of the crop, aluminum pie pans, plastic owls, and plastic snakes. These range from ineffective to moderately effective for a short period of time. Birds will get used to them quickly if they are not moved around or if another type of repellent is not used along with it. Yellow scare crows suspended above the crop and allowed to move freely have been reported to have some impact on blackbirds, however, robins do not seem to be affected.
	Lasers Lasers are the newest technology in bird deterrence. Although current research is limited, lasers are a promising tool that can be used to deter birds. Laser options range from small, hand-held units that require an active operator to automated systems that are less labor-intensive and provide full field coverage but are much more expensive. Because lasers can damage both human and bird eyes, extreme caution should be used when using this tool. Laser placement should always avoid roadways or airways. Although costly, lasers may increase crop yields and decrease labor costs associated with other deterrent methods. A green laser light beam works better than a red-light beam as birds can see it throughout the day. Birds perceive the light beam as a physical object, triggering a flight response as it moves toward them. Depending on topography, one automated laser system may cover several acres. Like all other methods of bird damage control, lasers work best when they are started before birds establish a feeding pattern in the crop. They should run from at least an hour before sunrise, throughout the day, and for an hour or longer past sunset as these two extremities are the most intense bird feeding times. The pattern and frequency of beam discharge should be changed frequently to avoid habituation, but directing the laser toward the top of the crop can serve as a laser lid of sorts, preventing birds from wanting to enter the crop. Using other control techniques in combination with lasers may offer expanded bird damage control. **Chemical repellants** Methyl anthranilate is registered as a bird repellent. While it is sometimes advertised as a taste repellent, this is not exactly correct. When sprayed on a crop, it causes an unpleasant sensation in the bird's mouth. Methyl anthranilate is a naturally occurring material used in the food service industry. Early reports have been inconsistent in regard to its effectiveness. It has also been reported to impart an undesirable foxy flavor to certain grape cultivars. Methyl anthranilate has a short residual, so frequent reapplication will be necessary to achieve lasting results. Results may vary depending on the type of birds. Combining with another type of deterrent may result in greater effect than when used alone. As with other types of deterrents, applications need to start before birds establish feeding patterns.

Wildlife Damage Prevention

Pest/Problem	Management Options
Birds (Cont.)	**Exclusion** Exclusion (netting) is the only consistently effective method of reducing bird damage. Netting is more expensive than other types of deterrents and can require fair amounts of labor, so it may not be an economically viable alternative in all situations. Nets are either laid on the canopy of the crop or suspended from a framework over the crop. The fruiting area of the plant needs to be completely protected. Birds will enter the canopy of the plant from below the net if it is open under the plant. If used with care, nets can be maintained for use over several years. For crops requiring multiple harvests such as blueberry, suspending the netting over the crop and around the sides of the field will allow easier access to the crop. If nets are placed directly on the crop canopy, birds can perch on it and feed on berries below them. Wild turkeys are becoming more of a problem in many areas of the country. While there is no doubt that they do consume some fruit, some research has shown that the turkeys are often after insects instead of the fruit. They do not appear to like loud and/or distressing sounds. While netting will work, turkeys can tear holes in it for access to the fruit.
Deer	Deer can damage small fruit plantings by foraging on succulent new growth during the growing season or by eating fruit. In fall, bucks can damage plants by rubbing their antlers on stems and stalks. This is more of a problem in tree fruits than small fruits. Deer can also puncture plastic mulch and possibly the irrigation tape underneath, resulting in loss of weed control. Deer numbers are increasing and incidents of deer damaging crops are also increasing. Deer populations are increasing across most of their range. Hunting on neighboring properties can reduce local damage but neighboring hunting clubs may be actively working to increase deer populations. Locating the planting area away from a favorable deer habitat will help lessen losses. However, this is not generally possible; deer travel 1 to 1.5 miles, and it is highly unlikely that anyone can locate plantings sufficiently far from suitable habitat. Several control options do exist. Determining which one or ones to use depends on the deer population, availability of other food sources, location of favorable habitat, the duration for which protection is needed, and the value of the crop to be protected.
	Repellants Both taste and smell repellents exist. Smell repellents include commercially available products or materials such as tankage, blood, putrified egg solids, and certain soaps. Repellants will not provide long-term control and will not provide control when populations are high or alternate food sources are scarce. **Exclusion** Exclusion (fencing) is the only truly effective long-term control for deer damage prevention. Fences can be electrified or not. Deer will try to go under a fence, through a fence, or over it. For non-electrified fences, the lowest wire needs to be within 10 in. or less of the lowest point in the ground around the fruit crop planting and tight enough to prevent deer from pushing under it. Do not neglect ditches or other low spots in the ground around the field, because the deer will find them. While some deer can easily clear an 8-ft fence, generally, 6 ft will be sufficient to deter most deer. Wire mesh fences are more desirable than multiple strands of barbed wire. Wire mesh fence up to 5 ft high with 3 single strand wires for a total of 8 ft will reduce costs.

Wildlife Damage Prevention

Pest/Problem	Management Options
Deer (cont.)	For electric fences, several different designs have been used, and under certain conditions, each can be effective. The simplest and least expensive electric fence uses a single high-tensile wire about 30 in. above ground level. A solar charger can be used if access to electricity is not an option. Peanut butter can either be smeared on the wire or on aluminum foil strips and then draped over the wire. Plastic flagging may also be tied to the fence to make it more visible to the deer. Deer are curious animals and will investigate the fence if they are not being chased. Touching the fence results in being shocked and turning the deer away from the protected field. The single-wire, baited fence is relatively inexpensive, easy to construct, and often adequate for protecting the crop. With high deer populations, when available alternate food sources are scarce or when deer have already established a feeding pattern in the area being protected, this fence may not be adequate. More substantial electric fences for deer control have multiple wires, with the alternate wires being electrified. One design uses 5 wires and is constructed at a 45-degree angle facing away from the area to be protected. The bottom wire is within 10 in. of the ground and is electrified to keep deer from going under the fence. The middle wire is also electrified to prevent deer from going through the fence, and the top wire, which may be only about 5 ft above ground, is electrified to keep deer from going over the fence. A fence constructed in this manner presents a barrier to the deer that has height and depth, a combination that generally will discourage the deer from trying to enter the field. Poly Tape electric fences, often used to contain cattle and horses, work well for deer fences. Numerous other fence designs exist, including a non-electrified mesh fence with a hot wire on top. If electric fences are used, it is important to keep weeds, grasses, and other materials away from the fence to prevent it from shorting out and to increase its visibility. Contact your local county agent and/or state extension wildlife specialist for additional information.

Wildlife Damage Prevention

Pest/Problem	Management Options
Black bears	Black bears can damage fruit trees by breaking the trunk of young trees or by breaking off limbs to obtain fruit. Bear damage will be most easily identified by broken branches at the base of the tree, bear scat at the site, and visible claw marks on the tree from climbing. To minimize loss, plant orchards at least 50 yards from forest and shrub cover. Remove any fallen fruit from the ground and harvest fruit as soon as allowable to minimize attractants. Black bears are considered a game species in most states and protected in others (e.g., Mississippi). Thus, some states may only allow nonlethal or less than lethal methods of management. Also, lethal control is only available during legal hunting seasons and in following state-specific regulations. States may provide additional options for reducing agricultural depredation (e.g., lethal control, trap and relocate) so you can check you're your state wildlife agency for details. **Deterrents** Hazing black bears can temporarily deter bears from accessing fruit crops. Deterrents include motion activated sprinklers or alarms but may be generally ineffective once bears have successfully accessed the fruit crop. Bears will also become quickly become desensitized to these deterrents. **Exclusion** Electrical fencing is the only effective long-term control method for preventing black bear damage, but can be cost-prohibitive to protect large areas with. To successfully deter bears, the power source needs to deliver 45–60 electric pulses per minute. They also need to deliver enough energy to sufficiently shock the animal. Current research recommends approximately 5,000–6,000 volts are needed to effectively shock a bear. At least 5 electrified wires are recommended with the lowest wire placed at about 8 in. above the ground, with each additional wire placed 8" above the last so that a bear cannot pass through or go over without touching at least one electric line. Gates into the fenced area must also be electrified or else bears will quickly find this location to access the fruit crop. You may also use prefabricated electrified netting fence for quick and easy temporary fences. See bearwise.org for specific guidance on fencing.

Wildlife Damage Prevention

Pest/Problem	Management Options
Feral swine	Feral swine (also referred to as wild boar, Eurasian wild boar, wild hogs, and wild pigs) are an invasive species found throughout the southeastern United States. Much of their biology—rapid reproduction rates, rooting behavior, wide-ranging diet, and large family groups—all compound leading to potentially significant impacts to producers. Feral swine pose a significant threat to agricultural lands, including grapes, due to consumption and trampling of crops. They can also negatively impact agricultural infrastructure such as irritation ditches. Additionally, rubbing, tusking, and depredation of tree seedlings by feral swine can negatively impact fruit orchards. Feral swine carry a high number of diseases and parasites that can spread to people, so preventative measures (e.g., gloves) need to be taken when encountering carcasses. Human food and water contamination (e.g., E. Coli) is also a risk and concern. Feral swine are often nocturnal, especially in areas of high hunting pressure, so direct observations are often not a good indicator of presence. Instead, appearance of swine tracks and sign (crop damage) will indicate they are in the area. Numerous lethal and nonlethal control methods are available for managing feral swine damage, however lethal control using coral-style traps is most effective. Lethal control (e.g., shooting) may be restricted in certain areas (e.g., urban areas) so it is best to contact USDA Wildlife Services or your state wildlife agency for guidance if you have concerns about allowable management techniques. Excluding animals from high-valued crops is possible but can be very expensive and is not always effective. **Lethal Removal Trapping** Repeated and intensive removal of feral swine is often needed to control the population at low numbers. Removal should use corral-style traps that focus on whole-sounder (i.e., family group) removal. Trapping success varies seasonally with most success during the winter months when natural food resources are limited. **Recreational hunting** A common and popular management approach but is generally considered ineffective at reducing populations. Recreational hunting creates incentives to maintain feral swine on the landscape. Additionally, the use of bait to attract feral swing for hunting purposes increases reproduction and population growth despite hunter harvest. **Hunting with dogs** Most effective in areas where densities are low and you are attempting to remove the last remaining individuals of a population. Best used with in combination with other techniques. CAVEAT: It is not recommended to use dog hunting with trapping efforts as it is very difficult to trap pigs that have been harassed. **Toxicants** There is no toxicant currently available on the market for most states. A warfarin-based toxicant (commercial name: Kaput Feral Hog Bait) is registered for use by the U.S. Environmental Protection Agency and was recently made available to licensed pesticide applicators in Texas and Oklahoma in spring 2024. Concerns about animal welfare and effects to non-target species has largely limited the availability of toxicants so it is unclear when more wide-spread availability will occur.

Wildlife Damage Prevention

Pest/Problem	Management Options
Feral swine (cont.)	**Exclusion Fencing** Temporary fencing can provide a short-term solution to mitigate feral swine damage. A 2-strand electric fence with wires at 8” and 18” from the ground is a relatively inexpensive option that can temporally protect agricultural crops. Hog panel fencing (5 ft x 16ft) can also exclude animals and may provide a long-term solution for high-value crops. Regardless of fence type, its effectiveness will likely depend on the motivation of swine to access the resources. Deterrents Frightening devices may provide relief from feral swine damage; however effectiveness is often limited, and temporary. Feral swine quickly become habituated to devices so it **Fertility control** There are no fertility control options currently available on the market, although research into this area has increased.

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