2026 Southeast Regional

Muscadine Grape

INTEGRATED MANAGEMENT GUIDE

2026 Southeast Regional Muscadine Grape Integrated Management Guide

A product of the Southern Region Small Fruit Consortium

Commodity Editor

Bill Cline, North Carolina State University

Senior Editors

Phil Brannen, University of Georgia
Bill Cline, North Carolina State University

Section Editors

Pathology

Bill Cline, North Carolina State University
Caleb Bollenbacher, North Carolina State University
Phil Brannen, University of Georgia
Rebecca Melanson, Mississippi State University
Mary Helen Ferguson, Louisiana State University

Entomology

Brett Blaauw, University of Georgia
Lorena Lopez, North Carolina State University
Aaron Cato, University of Arkansas

Vertebrate Management

David Lockwood, University of Tennessee

Weed Science

Wayne Mitchem, North Carolina State University
Hannah Wright-Smith, University of Arkansas

Viticulture

Eric Stafne, Mississippi State University
Elina Coneva, Auburn University
Mark Hoffmann, North Carolina State University
Sarah Lowder, University of Georgia

Pesticide Stewardship and Safety

Ash Sial, University of Georgia

Table of Contents

Southeastern Region University Small Fruits IPM Contacts

Auburn University
Extension website:
www.aces.edu
Elina Coneva,
Edgar Vinson
(*Horticulture*)
Paulo Cremonez
(*Entomology*)
Ed Sikora
(Plant Pathology)

University of Arkansas
Extension website:
uaex.uada.edu
Matt Bertucci
(*Weed Science*)
Aaron Cato
(*Entomology)*
Aaron Cato, Ioannis
Tzanetakis (virology)
(*Plant Pathology*)
Amanda McWhirt
(*Horticulture*)
Renee Threlfall
(*Food Science [Post Harvest]*)

Clemson University
Extension website:
clemson.edu/extension
Tom Bilbo (strawberry),
Brett Blaauw
(*Entomology*)
Elizabeth Cieniewic
(virology), Guido
Schnabel, Lindsey
Thiessen
(*Plant Pathology*)
Juan Carlos Melgar,
Melissa Muñoz
(*Horticulture*)
Wayne Mitchem
(*Weed Science*)

University of Florida
Extension website:
sfyl.ifas.ufl.edu
Nathan Boyd
(*Weed Science*)
Johan Desaeger
(nematology), Phil
Harmon, Natalie Peres
(strawberry)
(*Plant Pathology*)
Oscar Liburd
(*Entomology*)
Jeff Williamson
(*Horticulture*)

University of Georgia
Extension website:
extension.uga.edu
Zilfina Rubio Ames,
Sarah Lowder
(*Plant Pathology*)
Brett Blaauw, Glen
Rains, Ash Sial
(*Entomology*)
Phil Brannen, Jonathan
Oliver
(*Pathology*)
Mark Czarnota, Wayne
Mitchem
(*Weed Science*)

University of Kentucky
Extension website:
extension.ca.uky.edu
Brent Arnoldussen, Daniel
Becker, Patsy Wilson
(grapes), Shawn Wright
(*Horticulture*)
Ric Bessin
(*Entomology*)
Nicole Gauthier
(*Pathology*)
Shawn Wright
(*Weed Science*)

Louisiana State University
Extension website:
lsuagcenter.com
Mary Helen Ferguson,
Raghuwinder (Raj) Singh
(*Pathology*)
Michael Polozola
(*Horticulture*)

Mississippi State University
Extension website:
extension.msstate.edu
John Byrd
(*Weed Science*)
Rebecca A. Melanson
(*Pathology*)
Jermaine Perier
(*Entomology*)
Eric Stafne
(*Horticulture*)

North Carolina State University
Extension website:
www.ces.ncsu.edu
Ryan Adams
(*IPM*)
Caleb Bollenbacher,
Bill Cline, Sara Villani
(*Plant Pathology*)
Mark Hoffmann, Alexa
McDaniel (viticulture)
(*Horticulture*)
Katie Jennings,
Wayne Mitchem
(*Weed Science*)
Lorena Lopez
(*Entomology*)

Oklahoma State University
Extension website:
extension.okstate.edu
Mustafa Jibrin
(*Plant Pathology*)

University of Tennessee
Extension website:
utextension.tennessee.edu
David Lockwood, Annie
Vogel
(*Horticulture*)
Jensen Hayter
(*Plant Pathology*)
Hannah Wright-Smith
(*Weed Science*)

Virginia Tech
Extension website:
ext.vt.edu
Jeff Derr
(*Weed Science*)
Drew Harner (viticulture),
Jayesh Samtani
(*Horticulture*)
Mizuho Nita (grapes),
Yuan Zeng
(*Plant Pathology*)
Doug Pfeiffer
(*Entomology*)

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 (*47) (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 on-farm spills in which assistance is needed, contact your local 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 http://pesticidestewardship.org/Pages/default.aspx. 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.

***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 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.

Pesticide Liability and Stewardship (Cont'd)

***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.

Bulletin Live! Two

This tool displays Pesticide Use Limitation Areas (PULAs) for products with active Endangered Species Protection Bulletins. To generate a printable bulletin, please follow these steps:

1. Navigate to your intended pesticide application area by using the "Location Search" tool or panning and zooming on the map itself.
2. Select your Application Month from the Application Date dropdown.
3. Search specific pesticide product(s) by entering the EPA product registration number(s). If you need assistance finding the EPA product registration number, consult the guide on the Bulletins Live! Two webpage. Once you have entered your selection, the Pesticide Use Limitation Areas (PULAs) associated with the product(s) will be displayed on the map. To remove any product(s) you selected, click on the "X" button on the right side of the product box(es).
4. If there are no limitations in the map area for the selected application date and product, a "Printable Bulletin" button will appear in the top right corner of the map pane. Click this button to generate a printable bulletin in PDF format which you can print or save.
5. If a PULA that matches your search criteria does overlap your intended application area, click on the PULA polygon on the map to select it and activate the Limitations pane with the associated limitations. A yellow border surrounding the PULA indicates that it has been selected. Click on the "Printable Bulletin" button on the results pane to generate a printable bulletin in PDF format which you can print or save.

To view the PULA details prior to printing, click the "Full Details" button. To complete an additional search, use the "Clear Selected" button to clear your current results. If no product is selected, the details or printable bulletin will show all limitations for all products in that PULA polygon.

General Pesticide Information

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

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.

Organically Accepted Materials

Products that are listed by the Organic Materials Review Institute (OMRI; www.omri.org) 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.

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

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.

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	http://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]	http://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.

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 in-field 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. Consider mowing ground cover if plants are flowering prior to pesticide application.
4. Follow 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.

New Pest Alert (Spotted lanternfly, SLF)

A new insect pest, spotted lanternfly (SLF), has entered the Southeastern region. This insect is spreading through Virginia and has been found in NC, SC, GA and TN. 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. The early instars (nymphal stages) are black with white spots. These are the stages most likely to be found on strawberry. 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 feeding includes accumulation of honeydew on leaf surfaces, supporting the growth of black sooty mold. Nymphs can be controlled by many insecticides that are used for other early-season grape pests, e.g. bifenthrin, fenpropathrin and carbaryl. In crops 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. More information on SLF can be found online, including updated maps of reported sightings. 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.

Efficacy of selected fungicides against diseases of muscadine grape (E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown) These ratings are benchmarks, actual performance will vary.

Fungicide	PHI (days)	FRAC MOA	Bitter rot	Powdery mildew	Ripe rot	Macro-phoma rot	Black rot	Sooty blotch	Dead arm	Angular leaf spot
Thiophanate-methyl **(Topsin- M)**	7 days	1	G	G	F	G	G	G	F	G
Myclobutanil **(Rally)**	14 days	3	VG	VG	NA	G	VG	G	UN	VG
Triflumizole **(Procure)**	7 days	3	VG	VG	UN	VG	VG	UN	UN	VG
Fluopyram + tebuconazole **(Luna Experience)**	14 days	3+7	VG	VG	UN	G	VG	UN	UN	E
Benzovendiflupyr **(Aprovia)**	21 days	7	VG	UN	F	VG	VG	UN	UN	VG
Isofetamid **(Kenja)**	14 days	7	VG	VG	F-G	E	VG	UN	UN	VG
Azoxystrobin + flutriafol **(Topguard EQ)**	14 days	3+11	E	VG	G	VG	VG	UN	UN	E
Fluxapyroxad + pyraclostrobin **(Merivon)**	14 days	7+11	E	VG	VG	VG	VG	UN	UN	E
Pyraclostrobin + boscalid **(Pristine)**	14 days	7+11	G	VG	VG	E	VG	E	F	VG
Kresoxim-methyl **(Sovran)**	14 days	11	G	G	G	G	G	G	F	G
Azoxystrobin **(Quadris)**	14 days	11	G	VG	VG	VG	VG	VG	F	VG
Trifloxystrobin **(Flint Extra)**	14 days	11	G	VG	VG	E	VG	E	F	G
cyprodinil + fludioxonil **(Switch)**	7 days	9+12	E	VG	VG	E	VG	UN	UN	G
pydiflumetofen + fludioxonil (**Miravis Prime**)	14 days	7+12	E	VG	VG	E	VG	UN	UN	VG
Copper oxychloride + Copper hydroxide **(Badge)**	0 day (48 hr re-entry)	M 1	NA	G	NA	NA	G	UN	UN	VG
Wettable Sulfur (**Microthiol** and other trade names)	0 day (24 hr re-entry)	M 2	NA	VG	NA	NA	NA	F	NA	NA
Mancozeb + Zoxamide **(Gavel)**	66 days	22+M3	G	NA	NA	G	G	UN	UN	G
Ziram **(Ziram)**	21 days	M 3	G	NA	G	G	G	G	UN	G
Captan **(Captan, Captec)**	0 days (72 hr re-entry)	M 4	G	NA	VG	G	G	G	UN	G
EBDCs (includes **Maneb, Manex, Penncozeb, Manzate, Dithane M-45**)	66 days	M 3	G	NA	G	G	G	G	UN	G

Seasonal 'at a glance' fungicidal spray schedule -- options for muscadine grape

Do not rely on a single product -- use alternating modes of action (MOA) shown below in brackets [FRAC Code]. EARLY SPRAYS are more effective than late-season sprays. This table is only a guide – read and follow the label prior to making applications.

Develop-mental Stage →	Dormant	Pre-bloom—new shoots to 6 in.	Second pre-bloom	Bloom–50% open flowers (1–2 sprays)	First Cover—small green fruit	Subsequent Cover sprays (second, third, fourth)	Can be used up to 14 days preharvest	Can be used up to 7 days preharvest
Diseases (bold) Fungicide [FRAC Code]	**Dieback "dead arm" Eutypa, Botryosphaeria and similar organisms** Topsin M [1] or Pristine [7+11] applied at pruning time to fresh cuts	**These products can be used to manage fruit rots and leaf diseases (Black rot, Bitter rot, Angular leaf spot, Macrophoma rot)**						
		Topsin M [1] Rally [3] Procure [3] Luna Experience [3+7] Aprovia [7] Kenja [7] Topguard EQ [3+11] Merivon [7+11] Pristine [7+11] Sovran [11] Quadris [11] Flint Extra [11] Switch [9+12] Miravis Prime [7+12] Ziram [M3] Captan [M4] EBDCs (66-day preharvest interval) -- includes Maneb, Manex, Penncozeb, Manzate, Dithane M-45 [M3] and Gavel [22+M3]				Topsin M [1] Rally [3] Procure [3] Luna Experience [3+7] Aprovia [7] Kenja [7] Topguard EQ [3+11] Merivon [7+11] Pristine [7+11] Sovran [11] Quadris [11] Flint Extra [11] Switch [9+12] Miravis Prime [7+12] Ziram [M3] Captan [M4] **(Note—Do not use EBDCs within 66 days of harvest)**	Topsin M [1] Rally [3] Procure [3] Luna Experience [3+7] Kenja [7] Topguard EQ [3+11] Merivon [7+11] Pristine [7+11] Sovran [11] Quadris [11] Flint Extra [11] Switch [9 +12] Miravis Prime [7 +12] Captan [M4] **(Note—fungicides will leave a visible residue on harvested fruit when used close to harvest)**	Topsin M [1] Procure [3] Switch [9+12] Captan [M4] **(Note—fungicides will leave a visible residue on harvested fruit when used close to harvest)**
		Powdery mildew						
		To also control powdery mildew, use the products above that contain FRAC groups [1], [3], [7], [11] or [9+12]. Alternatively, you can add Wettable Sulfur [M2] with products above that do not control powdery mildew (e.g. [M3] or [M4]).						
		Ripe rot (*Colletotrichum* sp.)						
		To also control ripe rot, use the products above containing [M3], [M4], [11], [7+12] or [9+12] FRAC groups.					Use products containing [M4], [11], [7+12] or [9+12] FRAC groups above.	Use products containing [M4] or [9+12] FRAC groups above.

Muscadine Grape Integrated Management Guide

Introduction

The muscadine grape (*Vitis rotundifolia,* syn. *Muscadinia rotundifolia*) is a thick-skinned native grape species found in the southeastern United States. The fruit ripens in late summer/early fall and is generally harvested as single berries rather than in bunches. In the wild, muscadine vines are usually either male or female, while cultivated varieties (cultivars) are usually either female or perfect-flowered (having both male and female flower parts). Most wild vines have dark fruit, while cultivated (improved) cultivars are also available in many shades of bronze, purple or red. Several cultivars have been specifically developed for both fresh fruit and for winemaking. As the species name implies, the leaves are round and unlobed, though serrated at the edge. NOTE: For purposes of pesticide labeling, muscadines are included with all other grapes.

Diseases—Muscadines can be grown in warm, humid areas where bunch grapes cannot, and have been grown organically for local markets. Muscadines are tolerant of the Pierce's disease bacterium (*Xylella fastidiosa*) that limits bunch grape production and are not affected by some major fungal diseases like grape downy mildew or botrytis bunch rot. However, muscadines can still suffer extensive losses if diseases like powdery mildew, bitter rot, black rot and ripe rot are left unchecked. Fruit rotting diseases reduce yields and make berries unmarketable for either wine or fresh sales. **Spray volume—**Muscadines form a dense canopy that is difficult to penetrate with spray solution. Directed nozzles and spray volumes of 100 gallons per acre or more may be needed to ensure adequate coverage. Test your sprayer by using water-sensitive spray indicator cards suspended in the fruiting zone of the cordon to determine whether spray coverage is adequate.

Nematodes—The impact of nematodes on muscadines remains undetermined. A survey in NC and GA determined the prevalent species associated with muscadines but found no correlation with plant health. Muscadines are likely less susceptible than other grape species, however testing for nematodes is advisable when replanting old vineyard sites.

Insects—See text in each section below for specific comments. Grape root borers are an important pest of muscadine vines. Aphids occur on new shoots but often do not require control. Grape berry moth occurs sporadically. Japanese beetles may feed on foliage and flowers in early summer. Insects feeding on ripe fruit include green June beetles, as well as wasps, yellowjackets and other stinging insects that can pose a risk to pickers. The risk of infestation by spotted wing drosophila (SWD) is considered low due to the thick skins of muscadine grapes; however, SWD and other vinegar flies can be found in damaged fruit such as rain-splits.

Weeds—See comments beginning on page 43.

Cultural Practices

For comprehensive information on establishing vines and other muscadine production practices, see the ***Muscadine Grape Production Guide for the Southeast***: https://smallfruits.org/files/2020/07/muscadine-grape-production-guide-southeast.pdf

Cultivar selection—Most muscadines grown for wine are high-yielding, medium to small size grapes that detach easily and thus are suitable for machine harvest. The cultivar Carlos is the most commonly used bronze muscadine for white wine, and Noble is the most common dark fruited cultivar for red wine. Fresh market and pick-your-own cultivars have grapes that are larger in size, with firmer flesh, and a more edible skin. Examples of fresh-market cultivars include dark-fruited Lane, Supreme, Paulk and Nesbitt, and the bronze-fruited cultivars Hall, Triumph, Early Fry, Summit, Fry and Late Fry.

Site selection and establishment—The most productive muscadine vineyards are on sites that have well-drained soils. Soils that stay wet during the winter months or that flood regularly are not satisfactory for muscadines. Sites where tobacco has been grown successfully are generally suitable for muscadines. Where needed to improve drainage, plant in raised rows. Provisions for drainage must be made prior to planting.

Land preparation should begin the year before planting; have the soil tested, correct any deficiencies in P and K levels, and adjust the pH to 6.5 with dolomitic limestone. Use contact or systemic herbicides to clean up infestations of johnsongrass, bermudagrass, or nutsedge in the year *before* vines are set. Use a single-wire trellis, (single high wire bilateral cordon trellis), space rows 10 to 12 ft apart, and set posts 20 ft apart within rows. Plant one vine beside each post (rather than halfway between posts). This positioning will help protect the vine and minimize fruit loss during harvest, especially if mechanical harvest is planned.

Plant in late April or early May (NC and GA/SC Piedmont) after danger of spring freezes has passed, or during the winter in South Georgia. Commercial vine shelters ("grow tubes"; 24–36 in. long and 3–4 in. in diameter) should be used in the first two years after establishment, as they will protect vines from herbicide applications, animal damage, and accelerate growth in the first year. The use of vine shelters (grow tubes) will also delay the development of vine cold hardiness in the fall. For this reason, they should be removed at the end of each growing season, in late September/early October. Planting depth is critical. Plant at the same depth as in the pot or nursery, in a wide, shallow hole slightly deeper than the depth of the pot. Avoid using an auger to dig planting holes, as augered holes tend to be too deep and the soil will settle (subside) over time, resulting in a vine that is planted too deep.

Pruning (training new vines)

Trellising young vines—During the first two or three years, vines need regular training once a week throughout the growing season. Training establishes the optimal shape and position of the vine. Proper training is accomplished by selecting a single shoot and training it up a bamboo stake or string. Remove any side shoots that appear in the leaf axils by pinching them out as soon as possible, leaving the leaf intact. The objective is to have a single growing point rather than multiple shoots. Plastic vineyard tape is used for attaching vines to the bamboo stake and later to the trellis wire. Train the young vines up the stake or string to the wire, then pinch the tip back to approximately 10–12 in. below the wire. This will encourage a V-shaped branching. Choose two of these lateral branches and begin training them in opposite directions along the wire, as future "main arms" or cordons. Continually remove lateral suckers along the trunk in order to direct all the plant's growth into the growing tips of the cordons. For cultivars that are prone to uneven shoot and spur development, or for growers on not very well drained soils, cordons should be trained to their full length in 2 years, rather than in one. Until the cordons reach full length, cut back side shoots along the cordon to approximately 4 to 6 in. during the growing season. Likewise, remove all fruit at the earliest possible stage on young vines, in order to direct growth to the desired shoots.

Dormant

Winter pruning—Proper pruning aids in disease management and is the main tool for a grower to ensure vineyard longevity. Hedge or hand prune vines, leaving only 2–3-inch stubs (spurs) of 1-yr-old wood protruding from the main cordon or previous season's wood. Selectively thin these spurs or spur clusters to space them approximately 4–6 in. along the cordon. High bearing wine grape cultivars such as Carlos can be pruned to 30–35 buds per foot of cordon, while some fresh-fruit cultivars (e.g., Supreme) require bud counts between 20-25 buds per foot of cordon. Crowded spur clusters should be thinned out in the first 3–4 years after planting. Young vines (1–4 yrs old) require special attention to remove grape tendrils that wrap around the new cordon. If not removed, these tendrils will girdle and kill the newly trained arm. After the 3rd or 4th year, the cordon becomes too thick for tendrils to wrap around it, and this girdling ceases to be a threat. Late winter (before bud swell) is the best time to prune muscadines in areas subject to winter injury. **Mechanical pruning**—Many growers use hand-held or tractor-mounted sickle bar hedge trimmers for the first rough pass in winter pruning, followed by hand pruning.

Dieback "dead arm" diseases—Fungal dieback diseases (trunk diseases, caused by *Botryosphaeria, Phomopsis, Fusicoccum* and *Eutypa*) can quickly kill even mature plants. The disease organisms enter wood through open wounds (pruning, cold damage), often facilitated by rain splash. These diseases are often observed as plants come out of dormancy or following initial fruit swell. While slowly developing, trunk diseases are detrimental for the longevity of a vineyard. Symptoms are slow vine decline, "dead" arms and sometimes even rapid death from the growing cordon tips back towards the main trunk. These fungi reside in pruning or other wounds and are present on all muscadines. Training and pruning are the main trunk disease management strategies. It is crucial to apply proper training and pruning strategies over the lifetime of a vineyard to minimize open wounds to the permanent wood of a muscadine vine. Additional plant stress can also trigger disease. Any actions to reduce plant stress throughout the year will be helpful in mitigating disease symptoms (irrigation, proper fertilization). Cold injury to the wood can predispose vines to trunk diseases by causing large, slow-healing wounds to trunks and cordons. In addition to the application of good pruning techniques, fungicides can also be applied on pruning wounds. Wound treatment products (VitaSeal, B-lock, and others) have been shown to be beneficial on bunch grapes and may also have benefit for muscadines. Topsin M [1] or Pristine [7+11] applied the day of pruning will help to prevent fungal ingress and long-term issues with dieback.

Effectiveness Ratings. The efficacy or importance of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, NA= not applicable, and UN = unknown or no data. These ratings are benchmarks; actual performance will vary.

Dormant							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Fruit rots and foliage diseases	Sanitation and pruning, canopy management		G				Prune to remove dead wood and old fruit pedicels that can harbor diseases. Control weeds under vines with chemicals or mowing; trim vines if needed, so shoots terminate at least 18–24 in. from the ground. This will promote air movement and drying under vines.
Dieback "dead arm" diseases (Botryosphaeria and other similar organisms)	Training, sanitation and pruning,		G				Prune to remove dead wood. Monitor vines for injury and prune to remove/replace cold-damaged or insect-damaged cordons.
	myclobutanil (Rally 40W)	5 oz	UN	FRAC 3	24 hr	14 days	May be applied in 50 gal of water per acre to protect pruning wounds. This treatment has not been evaluated on muscadines but has shown benefit on other grape species. Apply within 24 hr of pruning. Do not apply more than 1.5 lb of Rally 40W per acre per year. Interval for repeat applications should not exceed 14 days.
	thiophanate methyl (Topsin M WSB)	1.5 lb or	G	FRAC 1	2 days	7 days	Apply as a directed spray with power operated ground application equipment to thoroughly wet cordons, spurs, and all cut wood surfaces within 24 hr of pruning.
		Paint-On 1 lb Topsin M WSB per 5 gallons water	G				Apply as a paint to cut or pruned surfaces immediately after cutting and before rain, dew, fog, and fungal spores encounter wood. See label for additional instructions.
	pyraclostrobin + boscalid (Pristine WG)	8 to 12.5 oz	G	FRAC 11+7	12 hr (5 days for vine turning, tying)	14 days	Do not make more than three applications of Pristine or related fungicides (strobilurin or carboxamide) per season. Do not make more than two sequential applications before alternating with a fungicide with a different mode of action. If other grape species are nearby, do not use on CONCORD and related grapes (Worden, Fredonia, Niagara).

Prebloom (Bud break till bloom)

Angular leafspot is a fungal disease caused by the pathogen *Mycosphaerella angulata*. Leaf spotting leads to premature defoliation. When a muscadine vine defoliates prior to harvest, development of fruit ceases and grapes may fail to ripen. Total crop loss may occur. Fortunately, angular leafspot is easy to control with fungicides. In wet seasons, however, control may be expensive due to the need for repeated fungicide applications.

Black rot is a fungal disease caused by the pathogen *Guignardia bidwellii* f. sp. *Muscadinii.* Black rot can cause numerous necrotic round (ca, 10 mm) leaf spots early in the season beginning in May to June and causes scabby black lesions on fruit that do not penetrate the skin. Fungicides applied prior to, during and after bloom are effective in controlling black rot.

Aphids in muscadines are typically cool-season, spring pests. Natural enemies often moderate aphid numbers as the weather warms. Treat only if aphids are abundant and new shoot tips or foliage are becoming malformed.

Grape leafhoppers are sucking pests that may be very abundant, causing colorless, cleared stippling on leaves; heavy infestations can cause defoliation. Leafhoppers may be present through much of the growing season, but often in numbers that appear to do no harm. Provisional treatment thresholds are 10 leafhopper nymphs or adults per leaf based on samples from 10 vines per acre, or when leafhoppers and injury are seen (stippling and weak, unthrifty growth).

Flea beetles and May or June beetles are occasional bud and foliage feeders. The primary concern is Spring bud and shoot damage. Treat if beetles are abundant and injury is evident. Suggested treatment threshold is 5% damaged buds in a sample of 10 vines per acre. Less than 10% foliar injury is unlikely to be harmful. Beetles often feed at dusk or at night and may not be present during the day.

Prebloom (Bud break till bloom)

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-iveness	Mode of Action	REI	PHI	Comments and Precautions
Black rot Bitter rot Angular leaf spot Powdery mildew	myclobutanil (Rally 40W)	3 to 5 oz	VG	FRAC 3	24 hr	14 days	Do not apply more than 1.5 lb of Rally 40W per acre per year. Interval for repeat applications should not exceed 14 days. This is not specifically labeled for ALS.
Macrophoma rot *(Continued on next page)*	thiophanate-methyl (Topsin M 70WSB)	0.75 to 1.5 lb	G	FRAC 1	2 days	7 days	Apply when foliage first develops and repeat at 14 to 21 day intervals or as needed. Do not apply more than 6 lb product (4.2 lb ai)/acre/season.

Prebloom (Bud break till bloom) -- *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Black rot Bitter rot Angular leaf spot Powdery mildew Macrophoma rot *(continued)*	azoxystrobin (Quadris)	10 to 15.5 fl oz	VG-E	FRAC 11	4 hr	14 days	Do not make more than five applications per acre per year, or more than two sequential sprays before alternating with other fungicides having a different mode of action.
	trifloxystrobin (Flint Extra)	3.5 to 3.8 fl oz see label	VG-E	FRAC 11	12 hr	14 days	Do not apply more than 23 oz of Flint per acre per season, or more than six times per season. Do not apply more than two applications of Flint before switching to a non-strobilurin fungicide. If other grape species are nearby, DO NOT APPLY to CONCORD GRAPES or crop injury may occur.
	pyraclostrobin + boscalid (Pristine WG)	8 to 12.5 oz	VG-E	FRAC 11+7	12 hr (5 days for vine turning, tying)	14 days	Do not make more than three applications of Pristine or related fungicides (strobilurin or carboxamide) per season. Do not make more than two sequential applications before alternating with a fungicide with a different mode of action. If other grape species are nearby, do not use on CONCORD and related grapes (Worden, Fredonia, Niagara).
	kresoxim-methyl (Sovran 50 WG)	3.2 to 4.8 oz	VG-E	FRAC 11	12 hr	14 days	Do not make more than four applications of Sovran per acre per year, or more than two sequential sprays before alternating with other fungicides having a different mode of action.
(Continued on next page)	EBDCs (ethylene-bis-dithiocarbamates) (Dithane M45 Manzate ProStick Maneb 75DF Penncozeb 75DF) EBDC + Zoxamide (Gavel)	1.5 to 4 lb see label	G	FRAC M3 GAVEL FRAC 22+M3	24 hr	66 days	Do not apply more than 24 lb of Dithane M45, Manzate 200DF, Maneb 80WP or Penncozeb 75DF per acre per season. Repeat applications at 7-to-10-day intervals. EBDCs alone do not control powdery mildew—where powdery mildew is a problem, alternate or tank mix with FRAC 3 products.

Prebloom (Bud break till bloom) – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Black rot Bitter rot Angular leaf spot Powdery mildew Macrophoma rot *(continued)*	ziram (Ziram 76 DF)	3 to 4 lb	G	FRAC M3	48 hr	21 days	Limited to a maximum of 28 lb per acre per year. Ziram alone does not control powdery mildew.
	captan (Captan 50WP)	4 lb	G		48 hr	0 day	Repeat Captan applications at 7 to 14 day intervals. Apply using ground equipment in 20 to 200 gallons of water per acre. High volume dilute sprays are most effective. Captan alone does not control powdery mildew.
	captan (Captan 4L)	0.75 to 2 qt	G	FRAC M4	48 hr	0 day	
	Triflumizole (Procure 480SC)	4 to 8 fl oz	VG	FRAC 3	12 hr	7 days	Do not apply more than a total of 4 applications of Procure 480SC per crop per year. Do not apply more than a total of 32 fl oz (1 .0 lb ai) per crop per year. Apply in a minimum of 50 GPA.
	Fluopyram + tebuconazole (Luna Experience)	6 to 8.6 fl oz	G-E	FRAC 3+7	12 hr*	14 days	*Re-entry interval is 5 days for cane tying and training activities. Rotate to a different MOA after two applications.
	Benzovendiflupyr (Aprovia)	10.5 fl oz	VG	FRAC 7	12 hr	21 days	Do not exceed three applications per year.
	Isofetamid (Kenja 400SC)	20 to 22 fl oz	G-E	FRAC 7	12 hr	14 days	Rotate to a different MOA after two applications. Do not apply a third application within 28 days of the second application.
	Azoxystrobin + flutriafol (Topguard EQ)	5 to 8 fl oz	G-E	FRAC 3+11	12 hr*	14 days	Re-entry interval if 5 days for cane tying and girdling activities.
	Fluxapyroxad + pyraclostrobin (Merivon)	4 to 5.5 fl oz	VG-E	FRAC 7+11	12 hr	14 days	Do not tank mix with any other product. May cause injury on certain bunch grape cultivars, see label.
	cyprodinil + fludioxonil (Switch 62.5WG)	11 to 14 oz	G-E	FRAC 9+12	12 hr	7 days	Do not make more than two applications by air.
	pydiflumetofen + fludioxonil (Miravis Prime)	9.213 to .4 fl oz	VG-E	FRAC 7+12	12 hr	14 days	Apply on a 21-day interval. Do not make more than two applications at the maximum rate.

Prebloom (Bud break till bloom) – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Powdery mildew ONLY	wettable sulfur (Microthiol, various brands, 80 to 92% S)	3 to 10 lb	VG	FRAC M2	24 hr	--	Must be applied every 7–10 days. Dilute in 100 gal of water per acre. Corrosive to sprayers and trellis wires. OMRI listed for organic growers. Do not apply within two weeks of oil or oil-based products, or at temperatures above 90 °F. May injure Concord and other *Vitis labrusca* cultivars.
Aphids	malathion 57EC	1.5 pt	VG	IRAC 1B	24 hr (72 hr for vine tying)	3 days	Treat if aphids are abundant and terminals or foliage are becoming malformed. Aphids rarely reach damaging levels.
	imidacloprid (Admire Pro)	7 to 14 fl oz (soil) 1 to 1.4 fl oz (foliar)	VG	IRAC 4A	12 hr	30 days (soil) 0 days (foliar)	
	fenpropathrin (Danitol 2.4EC)	5.33 to 10.66 fl oz	G	IRAC 3A	24 hr	21 days	Restricted use pesticide. Limited to two applications per season.
	acetamiprid (Assail 30SG)	2.5 oz	G	IRAC 4A	12 hr	3 days	Do not make more than two applications per season.
Grape leafhoppers	Grape leafhopper injury is seen as colorless, cleared stippling on leaves; heavy infestations can cause defoliation. Provisional treatment thresholds suggest treating for 10 leafhopper nymphs or adults per leaf or when grape leafhoppers and injury are evident (weak, unthrifty growth.)						
	malathion 57EC	1.5 pt	VG	IRAC 1B	24 hr (72 hr for vine tying)	3 days	
(Continued on next page)	carbaryl (Sevin XLR Plus)	1 to 2 qt	G	IRAC 1A	See label	7 days	

Prebloom (Bud break till bloom) – *continued from previous page*

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-iveness	Mode of Action	REI	PHI	Comments and Precautions
Grape leafhoppers *(continued)*	phosmet (Imidan 70W)	1.33 to 2.12 lb	VG	IRAC 1B	14 days	14 days	
	acetamiprid (Assail 30 SG)	2.5 oz	G	IRAC 4A	12 hr	3 days	
	bifenthrin (Brigade 2 EC)	3.2 to 6.4 oz	G	IRAC 3	12 urs	30 days	
	fenpropathrin (Danitol 2.4EC)	5.33 to 10.66 fl oz	G	IRAC 3A	24 hr	21 days	Restricted use pesticide. Limited to two applications per season.
	imidacloprid (Admire Pro)	7 to 14 fl oz (soil) 1 to 1.4 fl oz (foliar)	VG G	IRAC 4A	12 hr	30 days (soil) 0 days (foliar)	
	thiamethoxam (Platinum) (Actara)	8 to 17 oz 1.5 to 3 oz	G		12 hr	60 days 5 days	Platinum is soil applied, Actara by foliar spray. Actara can be applied by ground or air.
	dinotefuran (Venom)	5 to 6 oz soil 1 to 3 oz foliar	G	IRAC 4A	12 hr	28 days 1 day	Only one soil application allowed per season.
Grape flea beetles	carbaryl (Sevin XLR Plus)	1 to 2 qt	VG	IRAC 1A	See label	7 days	Flea beetles chew holes in the foliage. Less than 10% foliar injury is unlikely to be harmful. Treat if flea beetles are abundant and injury is evident.
	Malathion 57EC	1.5 pt	G	IRAC 1B	24 hr (72 hr for vine tying)	3 days	Grape flea beetle larvae also feed on buds. Treatment is recommended if 5% of vines exhibit bud damage.
(Continued on next page)	cyfluthrin (Baythroid 2 EC)	2.4 to 3.2 fl oz	G	IRAC 3A	12 hr	3 days	

Prebloom (Bud break till bloom) – *continued from previous page*

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-iveness	Mode of Action	REI	PHI	Comments and Precautions
Grape flea beetles *(continued)*	phosmet (Imidan 70-W)	1.3 to 2.125 1b	G	IRAC 1B	14 days	14 days	The 14-day REI may make this product impractical to use for most growers.
	fenpropathrin (Danitol 2.4EC)	5.3 to 10.66 fl oz	G	IRAC 3A	24 hr	21 days	Restricted use pesticide. Limited to two applications per season.
Climbing cutworms	fenpropathrin (Danitol 2.4EC)	5.33 to 10.66 fl oz	G	IRAC 3A	24 hr	21 days	Restricted use pesticide. Limited to two applications per season.
	carbaryl (Sevin XLR Plus)	2 qt	VG	IRAC 1A	See label	7 days	Use of Sevin may encourage mites. Do not concentrate spray on clusters or visible residue may result. Repeat applications as necessary up to a total of five times but not more often than once every 7 days. Do not apply more than 10 qt/acre per year.
	cyfluthrin (Baythroid 2EC)	2.4 to 3.2 fl oz	G	IRAC 3A	12 hr	3 days	
(Continued on next page)	methoxyfenozide (Intrepid 2F)	12 to 16 fl oz	G	IRAC 18	4 hr	30 days	

Prebloom (Bud break till bloom) – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Climbing Cutworms *(continued)*	spinetoram (Delegate 25 WG)	3 to 5 oz	G	IRAC 5	4 hr	7 days	
	flubendiamide + buprofezin (Tourismo 12.5)	10 to 14 fl oz	F	IRAC 16+28	12 hr	7 days	
	spinosad (Entrust 80W)	1.25 to 2.5 oz	G	IRAC 5	4 hr	7 days	OMRI approved.
	Bacillus thuringiensis [Bt] (Dipel DF and others)	0.5 to 1 lb	F	IRAC 11	4 hr	0 days	OMRI approved.
	rynaxypyr (Altacor)	2.0 to 4.5 oz	G	IRAC 28	4 hr	14 days	Use between 100–200 gal per acre total spray volume.

Bloom *(Do Not Apply Insecticides During Bloom)*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Black rot Bitter rot Angular leaf spot Powdery mildew Macrophoma rot	myclobutanil (Rally 40W)	3 to 5 oz	VG	FRAC 3	24 hr	14 days	Do not apply more than 1.5 lb of Rally 40W per acre per year. Interval for repeat applications should not exceed 14 days.
	thiophanate-methyl (Topsin M 70WSB)	0.75 to 1.5 lb	G	FRAC 1	2 days	7 days	Apply when foliage first develops and repeat at 14-to-21-day intervals or as needed. Do not apply more than 6 lb product (4.2 lb ai)/acre/season. Use only in combination or in an alternating application program with a labeled non-benzimidazole fungicide.
	azoxystrobin (Quadris)	10 to15.5 fl oz	VG-E	FRAC 11	4 hr	14 days	Do not make more than five applications per acre per year. Do not apply more than two sequential sprays. Alternate applications with other fungicides which have a different mode of action.
	trifloxystrobin (Flint Extra)	3.5 to 3.8 fl oz see label	VG-E	FRAC 11	12 hr	14 days	Do not apply more than 23 oz of Flint per acre per season, or more than six times per season. Do not apply more than two applications of Flint before switching to a non-strobilurin fungicide. If other grape species are nearby, DO NOT APPLY to CONCORD GRAPES or crop injury may occur.
(Continued on next page)	pyraclostrobin + boscalid (Pristine WG)	8 to12.5 oz	VG-E	FRAC 11+7	12 hr (5 days for vine turning, tying)	14 days	Do not make more than five applications of Pristine or related fungicides (strobilurin or carboxamide) per season. Do not make more than two sequential applications of Pristine before alternating with a fungicide with a different mode of action (neither strobilurin nor carboxamide).
	kresoxim-methyl (Sovran 50 WG)	3.2 to 4.8 oz	VG	FRAC 11	12 hr	14 days	Do not make more than four applications of Sovran per acre per year. Do not apply more than two sequential sprays of Sovran. Alternate applications with other fungicides which have a different mode of action.

Bloom *(Do Not Apply Insecticides During Bloom)* – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action Code**	**REI**	**PHI**	**Comments and Precautions**
The disease **Ripe rot** (caused by *Colletotrichum* sp. fungi) is one of the most difficult fungal pathogens to control on muscadine grapes. Most bronze-fruited cultivars are susceptible, while most purple-fruited muscadines are resistant. Fungicidal control has been most successful when strobilurin-type fungicides [FRAC code 11] are combined or alternated with fungicides having a different mode of action—pathogen resistance to FRAC 11 fungicides is likely to develop where these products are used exclusively. Sprays should begin at bloom or immediately following bloom (first cover). Ripe rot is most severe in wet harvest seasons and when fruit is left hanging too long on the vine. Timely harvest and rapid cooling of harvested fruit aids in control.							
Black rot Bitter rot Angular leaf spot Powdery mildew Macrophoma rot *(continued)*	EBDCs (ethylene-bis-dithiocarbamates) Dithane M45 Manzate ProStick Maneb 75DF Penncozeb 75DF	1.5 to 4 lb see label	G	FRAC M3	24 hr	66 days	Do not apply more than 24 lb Dithane M45, Manzate 200DF, Maneb 80WP or Penncozeb 75DF per acre per season. Repeat applications at 7-to-10-day intervals.
	EBDC + Zoxamide (Gavel)			GAVEL FRAC 22+M3			
	ziram (Ziram 76 DF)	3 to 4 lb	G	FRAC M3	48 hr	21 days	Limited to a maximum of 28 lb per acre per year. Ziram alone does not control powdery mildew.
	captan (Captan 50WP) 80 WP Various	4 lb see label	G	FRAC M4	48 hr	0 day	Repeat Captan applications at 7-to-14-day intervals. Do not apply 50WP by air.
	captan (Captan 4L)	0.75 to 2 qt	G		48 hr	0 day	
	Triflumizole (Procure 480SC)	4 to 8 fl oz	VG	FRAC 3	12 hr	7 days	Do not apply more than a total of 4 applications of Procure 480SC per crop per year. Do not apply more than a total of 32 fl oz (1 .0 lb ai) per crop per year. Apply in a minimum of 50 GPA.
	Fluopyram + tebuconazole (Luna Experience)	6 to 8.6 fl oz	G-E	FRAC 3+7	12 hr*	14 days	*Re-entry interval is 5 days for cane tying and training activities. Rotate to a different MOA after two applications.
	Benzovendiflupyr (Aprovia)	10.5 fl oz	VG	FRAC 7	12 hr	21 days	Do not exceed three applications per year.
(Continued on next page)	Isofetamid (Kenja 400SC)	20 to 22 fl oz	G-E	FRAC 7	12 hr	14 days	Rotate to a different MOA after two applications. Do not apply a third application within 28 days of the second application.

Bloom ***(Do Not Apply Insecticides During Bloom)*** – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action Code**	**REI**	**PHI**	**Comments and Precautions**
Black rot Bitter rot Angular leaf spot Powdery mildew Macrophoma rot *(continued)*	Azoxystrobin + flutriafol (Topguard EQ)	5 to 8 fl oz	G-E	FRAC 3+11	12 hr*	14 days	Re-entry interval if 5 days for cane tying and girdling activities.
	Fluxapyroxad + pyraclostrobin (Merivon)	4 to 5.5 fl oz	VG-E	FRAC 7+11	12 hr	14 days	Do not tank mix with any other product. May cause injury on certain bunch grape cultivars, see label.
	cyprodinil + fludioxonil (Switch 62.5WG)	11 to 14 oz	G-E	FRAC 9+12	12 hr	7 days	Do not make more than two applications by air.
	pydiflumetofen + fludioxonil (Miravis Prime)	9.2 to 13.4 fl oz	VG-E	FRAC 7+12	12 hr	14 days	Apply on a 21-day interval. Do not make more than two applications at the maximum rate.
Ripe rot	Benzovendiflupyr (Aprovia)	10.5 fl oz	F	FRAC 7	12 hr	21 days	Do not exceed three applications per year.
	Isofetamid (Kenja 400SC)	20 to 22 fl oz	F-G	FRAC 7	12 hr	14 days	Rotate to a different MOA after two applications. Do not apply a third application within 28 days of the second application.
	Azoxystrobin + flutriafol (Topguard EQ)	5 to 8 fl oz	G-E	FRAC 3+11	12 hr*	14 days	Re-entry interval if 5 days for cane tying and girdling activities.
	Fluxapyroxad + pyraclostrobin (Merivon)	4 to 5.5 fl oz	VG-E	FRAC 7+11	12 hr	14 days	Do not tank mix with any other product. May cause injury on certain bunch grape cultivars, see label.
	cyprodinil + fludioxonil (Switch 62.5WG)	11 to 14 oz	G-E	FRAC 9+12	12 hr	7 days	Do not make more than two applications by air.
(Continued on next page)	pydiflumetofen + fludioxonil (Miravis Prime)	9.2 to 13.4 fl oz	VG-E	FRAC 7+12	12 hr	14 days	Apply on a 21-day interval. Do not make more than two applications at the maximum rate.

Bloom ***(Do Not Apply Insecticides During Bloom)*** – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action Code**	**REI**	**PHI**	**Comments and Precautions**
Ripe rot (*continued)*	EBDCs (ethylene-bis-dithiocarbamates) Dithane M45 Manzate ProStick Maneb 75DF Penncozeb 75DF EBDC + Zoxamide (Gavel)	1.5 to 4 lb see label	G	FRAC M3 GAVEL FRAC 22+M3	24 hr	66 days	Do not exceed 24 lb Dithane M45, Manzate 200DF, Maneb 80WP or Penncozeb 75DF per acre per season. Repeat applications at 7-to-10-day intervals.
	ziram (Ziram 76 DF)	3 to 4 lb	G	FRAC M3	48 hr	21 days	Limited to a maximum of 28 lb per acre per year. Ziram alone does not control powdery mildew.
	captan (Captan 50WP) 80 WP Various	4 lb see label	G	FRAC M4	48 hr	0 day	Repeat Captan applications at 7-to-14-day intervals. Do not apply 50WP by air.
	captan (Captan 4L)	0.75 to 2 qt	G		48 hr	0 day*	
Powdery mildew ONLY	wettable sulfur (Microthiol, various brands, 80 to 92% S)	3 to 10 lb	VG	FRAC M2	24 hr	--	Must be applied every 7–10 days. Dilute sulfur in 100 gal of water per acre. Sulfur is corrosive to sprayers and trellis wires. Do not apply within two weeks of oil or oil-based products, or at temperatures above 90 °F. May injure Concord and other *Vitis labrusca* cultivars. Some but not all sulfur products are OMRI listed for use in organic production. Check the label!

First Cover (post-bloom)							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Aphids Leafhoppers Flea beetles Japanese beetles	Same as sprays for **Prebloom**						Base treatments on scouting and scout regularly in areas with a history of injury.
Black rot Bitter rot Angular leaf spot Powdery mildew	myclobutanil (Rally 40W)	3 to 5 oz	VG	FRAC 3	24 hr	14 days	Do not apply more than 1.5 lb of Rally 40W per acre per year. Interval for repeat applications should not exceed 14 days.
Macrophoma rot	thiophanate-methyl (Topsin M 70WSB) Various	0.75 to 1.5 lb	G	FRAC 1	2 days	7 days	Apply when foliage first develops and repeat at 14-to-21-day intervals or as needed. Do not apply more than 6 lb product (4.2 lb ai)/acre/season. Use only in combination or in an alternating application program with a labeled non-benzimidazole fungicide.
	azoxystrobin (Quadris) Various	10 to 15.5 fl oz	E	FRAC 11	4 hr	14 days	Do not make more than five applicationsper acre per year. Do not apply more than two sequential sprays. Alternate applications with other fungicides with a different mode of action.
	trifloxystrobin (Flint Extra)	3.5 to 3.8 oz	E	FRAC 11	12 hr	14 days	Do not apply more than 23 oz of Flint Extra per acre per season. Do not make more than six applications of Flint per season. Do not apply more than two applications of Flint before switching to a non-strobilurin fungicide.
(Continued on next page)	pyraclostrobin + boscalid (Pristine WG)	8 to 12.5 oz	E	FRAC 11+7	12 hr (5 days for vine turning, tying)	14 days	Do not make more than five applications of Pristine or related fungicides (strobilurin or carboxamide) per season. Do not make more than two sequential applications of Pristine before alternating with a fungicide with a different mode of action (neither strobilurin or carboxamide).

First Cover (post-bloom) – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Black rot Bitter rot Angular leaf spot Powdery mildew Macrophoma rot *(continued)*	kresoxim-methyl (Sovran 50 WG)	3.2 to 4.8 oz	VG	FRAC 11	12 hr	14 days	Do not make more than four applications of Sovran per acre per year. Do not apply more than two sequential sprays of Sovran. Alternate applications with other fungicides which have a different mode of action.
	EBDCs (ethylene-bis-dithiocarbamates) Mancozeb, Dithane M45 Manzate ProStick Maneb 75DF Penncozeb 75DF EBDC + Zoxamide (Gavel)	1.5 to 4 lb	G	FRAC M3 GAVEL FRAC 22+M3	24 hr	66 days	Do not apply more than 24 lb of Dithane M45, Manzate 200DF, Maneb 80WP or Penncozeb 75DF per acre per season. Repeat applications at 7-to-10-day intervals. ****Note PHI of 66 days cannot be used post-bloom for early-ripening cultivars.**
	Ziram 76DF	3 to 4 lb	G	FRAC M3	48 hr	21 days	Limited to a maximum of 28 lb per acre per year. Ziram alone does not control powdery mildew.
	captan (Captan 50WP)	4 lb	G	FRAC M4	48 hr	0 day*	Repeat Captan applications at 7-to-14-day intervals. Label allows application up to day of harvest; however, note 48 hr re-entry interval.
	captan (Captan 4L)	0.75 to 2 qt	G		48 hr	0 day*	
	Triflumizole (Procure 480SC)	4 to 8 fl oz	VG	FRAC 3	12 hr	7 days	Do not apply more than a total of 4 applications of Procure 480SC per crop per year. Do not apply more than a total of 32 fl oz (1.0 lb ai) per crop per year. Apply in a minimum of 50 GPA.
	Fluopyram + tebuconazole (Luna Experience)	6 to 8.6 fl oz	G-E	FRAC 3+7	12 hr*	14 days	*Re-entry interval is 5 days for cane tying and training activities. Rotate to a different MOA after two applications.
	Benzovendiflupyr (Aprovia)	10.5 fl oz	VG	FRAC 7	12 hr	21 days	Do not exceed three applications per year.
	Isofetamid (Kenja 400SC)	20 to 22 fl oz	G-E	FRAC 7	12 hr	14 days	Rotate to a different MOA after two applications. Do not make a third application within 28 days of the second application.
(Continued on next page)	Azoxystrobin + flutriafol (Topguard EQ)	5 to 8 fl oz	G-E	FRAC 3+11	12 hr*	14 days	Re-entry interval if 5 days for cane tying and girdling activities.

First Cover (post-bloom) – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action Code**	**REI**	**PHI**	**Comments and Precautions**
Black rot Bitter rot Angular leaf spot Powdery mildew Macrophoma rot *(continued)*	Fluxapyroxad + pyraclostrobin (Merivon)	4 to 5.5 fl oz	VG-E	FRAC 7+11	12 hr	14 days	Do not tank mix with any other product. May cause injury on certain bunch grape cultivars, see label.
	cyprodinil + fludioxonil (Switch 62.5WG)	11 to 14 oz	G-E	FRAC 9+12	12 hr	7 days	Do not make more than two applications by air.
	pydiflumetofen + fludioxonil (Miravis Prime)	9.2 to 13.4 fl oz	VG-E	FRAC 7+12	12 hr	14 days	Apply on a 21-day interval. Do not make more than two applications at the maximum rate.
Ripe rot	Benzovendiflupyr (Aprovia)	10.5 fl oz	F	FRAC 7	12 hr	21 days	Do not exceed three applications per year.
	Isofetamid (Kenja 400SC)	20 to 22 fl oz	F-G	FRAC 7	12 hr	14 days	Rotate to a different MOA after two applications. Do not apply a third application within 28 days of the second application.
	Azoxystrobin + flutriafol (Topguard EQ)	5 to 8 fl oz	G-E	FRAC 3+11	12 hr*	14 days	Re-entry interval if 5 days for cane tying and girdling activities.
	Fluxapyroxad + pyraclostrobin (Merivon)	4 to 5.5 fl oz	VG-E	FRAC 7+11	12 hr	14 days	Do not tank mix with any other product. May cause injury on certain bunch grape cultivars, see label.
	cyprodinil + fludioxonil (Switch 62.5WG)	11 to 14 oz	G-E	FRAC 9+12	12 hr	7 days	Do not make more than two applications by air.
	pydiflumetofen + fludioxonil (Miravis Prime)	9.2 to 13.4 fl oz	VG-E	FRAC 7+12	12 hr	14 days	Apply on a 21-day interval. Do not make more than two applications at the maximum rate.
(Continued on next page)	EBDCs (ethylene-bis-dithiocarbamates) Dithane M45 Manzate ProStick Maneb 75DF Penncozeb 75DF various	1.5 to 4 lb see label	G	FRAC M3	24 hr	66 days	Do not exceed 24 lb Dithane M45, Manzate 200DF, Maneb 80WP or Penncozeb 75DF per acre per season. Repeat applications at 7-to-10-day intervals.

First Cover (post-bloom) – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action Code**	**REI**	**PHI**	**Comments and Precautions**
Ripe rot (*continued)*	ziram (Ziram 76 DF)	3 to 4 lb	G	FRAC M3	48 hr	21 days	Limited to a maximum of 28 lb per acre per year. Ziram alone does not control powdery mildew.
	captan (Captan 50WP) 80 WP Various	4 lb see label	G	FRAC M4	48 hr	0 day	Repeat Captan applications at 7-to-14-day intervals. Do not apply 50WP by air.
	captan (Captan 4L)	0.75 to 2 qt	G		48 hr	0 day*	
Powdery mildew ONLY *(Sulfur will not control other diseases)*	wettable sulfur (various brands, 80 to 92% S)	2 to 5 lb	VG	FRAC M2	24 hr	--	Must be applied every 7–10 days. Dilute sulfur in 100 gal of water per acre. Sulfur is corrosive to sprayers and trellis wires. Do not apply within 2 weeks of oil or oil-based products, or at temperatures above 90 °F. May injure Concord and other *Vitis labrusca* cultivars.
Sooty blotch *(Primarily seen on the cultivar 'Fry')*	captan (Captan 50WP) (Captan 4L)	2.0 to 4.0 lb 0.75 to 2.0 qt	G	FRAC M4	48 hr	0 days	*Label allows application up to the day of harvest; however; note 48 hr re-entry interval.
	azoxystrobin (Quadris)	10.0 to 15.5 fl oz	E	FRAC 11	4 hr	14 days	Do not make more than five applications per acre per year. Do not apply more than two sequential sprays. Alternate applications with other fungicides which have a different mode of action.
	trifloxystrobin (Flint Extra)	3.5 to 3.8 oz	E	FRAC 11	12 hr	14 days	Do not apply more than 23 oz of Flint Extra per acre per season. Do not make more than six applications of Flint per season. Do not apply more than two applications of Flint before switching to a non-strobilurin fungicide.
	pyraclostrobin + boscalid (Pristine)	8.0 to 12.5 oz	E	FRAC 11+7	12 hr (5 days for vine turning, tying)	14 days	Do not make more than five applications of Pristine or related fungicides (FRAC 7 or 11) per season. Do not make more than two sequential applications of Pristine before alternating with a fungicide with a different mode of action.

Summer cover (post-bloom) sprays until harvest

Fruit rots are best controlled by fungicide applications applied from pre-bloom to first cover. Proper pruning and removal of infected berries, leaves and old fruit stems from the previous winter may reduce disease. If **bitter rot** is very severe, fungicides can be applied at shoot emergence, 3-5 in., 8-10 in. and at 7–14-day intervals until fruit set. Spray intervals of 14 days are usually adequate for muscadine grape disease control, but shorter intervals may be needed where disease pressure is high. **Black rot**-susceptible cultivars can be sprayed with a fungicide every 14 days from the start of new growth until after bloom.
Ripe rot can be severe on susceptible cultivars such as Carlos, Dixieland, Fry, Higgins, Magnolia, Scuppernong, Summit, and Watergate. QoI fungicides are the materials of choice in vineyards where ripe rot is a problem. However, ripe rot resistance is likely developing to these chemicals. **Sooty blotch** causes a dark, superficial discoloration on the surface of otherwise healthy fruit; the disease is common on unsprayed vines of the cultivar Fry. **Macrophoma rot** control can be improved with early cover sprays of Captan, particularly on susceptible cultivars such as Cowart, Fry, Higgins, Summit, and Triumph.

Cover spray insecticides are often not needed in muscadines due to moderate insect pressure. Growers should rely on "as-needed" applications, while using the IPM approach of scouting frequently for insect damage, including detailed plant examination of 10 vines per acre for insect or mite pests.

Grape berry moth is somewhat sporadic, but if present can be very damaging. This moth has several generations per season, beginning around bloom. In muscadines, grape berry moth is normally a mid- to late-season pest. Eggs are laid on the berry clusters, and young larvae enter berries at the stem end; their feeding, webbing and frass can damage multiple berries within a cluster. Spray promptly if infested clusters are seen or if a vineyard has a history of grape berry moth infestations.

Grape curculio is a small weevil (snout beetle) that typically emerges in mid-June (in Georgia). Grape curculio initially feeds on the underside of leaves in a shallow zigzag pattern before beginning to lay eggs in the berries. Spray if grape curculio insects are present or if either foliar or fruit injury are seen. This is a sporadic pest that is sometimes a problem in unmanaged vineyards where weeds and wild hosts thrive.

Green June beetle and **Japanese beetle** populations can get out of hand rapidly. Moderate defoliation by Japanese beetles is seldom damaging, but in some years these insects can be found feeding on flowers, and this can greatly reduce the crop. Fruit feeding by green June beetles is serious, so do not allow these pests to feed heavily on and become abundant in blocks with ripe fruit. Beware of heavy emergence and migration to blocks with ripe fruit after rains. Multiple applications are often necessary to maintain control if populations are allowed to build up. Ripening fruit and aggregation pheromone may quickly attract 'new' beetles to your vineyard after successful applications.

Wasps, hornets, yellowjackets and imported fire ants may be attracted to ripening fruit. Feeding injury or the presence of insect debris in harvested fruit can be damaging, and stinging insects discourage pick-your-own customers. Pre-harvest insecticide options are limited; monitor and treat only as needed.

Spider mites and others – Mites are capable of explosive population growth. Treat if more than 10 mites per leaf are found or if mites are present and leaves are webbed or bronzed. Drought and heavy crop load aggravate mite injury, especially early in a growing season. Two treatments at one-week intervals may be needed if using a material that only kills adult mites. **Brevipalpid** mites (flat mites) cause russeting around leaf veins and at the stem end of berries in NC, and this mite may occasionally warrant control.

Stink bugs – The impact of stink bugs and other piercing/sucking insects in muscadine grapes is unclear, but their feeding may cause fruit to shrivel, spot or abort. No threshold has been developed for these pests.

Summer cover (post-bloom) sprays until harvest– *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Black rot Bitter rot Ripe rot Macrophoma rot Angular leaf spot Sooty blotch	Same as sprays for **FIRST COVER**, except EBDCs must now be excluded due to their 66-day preharvest interval						Exclude EBDCs (Maneb, Manex, Penncozeb, Dithane M-45, Gavel and similar). Other effective cover sprays should include tank mixes of Topsin M or Rally with Captan or Captec, OR products containing two active ingredients (two modes of action)
Stink bugs	phosmet (Imidan 70W)	1.33 to 2.125 lb	VG	IRAC 1B	14 days	14 days	Imidan seldom prompts outbreaks of secondary pests such as mites. The 14-day REI may make this product impractical for most growers.
	fenpropathrin (Danitol 2.4EC)	10 to 21 fl oz	VG	IRAC 3A	24 hr	21 days	Danitol is a pyrethroid, its use may prompt rebound of mite numbers later in the season.
Japanese beetle	carbaryl (Sevin XLR Plus)	1 to 2 qt	VG		See label	7 days	Use of Sevin may encourage mites. Spray applied to clusters may leave a visible residue. Repeat applications as necessary up to a total of five times but not more often than once every 7 days. Do not apply more than 10 qt/acre per year.
	fenpropathrin (Danitol 2.4EC)	10 to 21 fl oz	E	IRAC 3A	24 hr	21 days	Danitol is a pyrethroid, its use may prompt rebound of mite numbers later in the season.
	acetamiprid (Assail 30SG)	2.5 oz	G	IRAC 4A	12 hr	3 days	Do not make more than two applications per season.
	imidacloprid (Admire Pro)	1.3 to 1.4 fl oz	VG		12 hr	0 days	Do not apply by air.
(Continued on next page)	clothianidin (Clutch 50WDG)	3 oz	G		12 hr	0 days	Do not make more than two applications per season.

Summer cover (post-bloom) sprays until harvest – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Japanese beetle *(continued)*	phosmet (Imidan 70 WP)	1.33 to 2.125 lb	G	IRAC 1B	14 hr	7 or 14 days	Seven-day PHI at the lowest rate, 14-day PHI for rates above 1.33 lb. Do not apply more than 6.5 lb per acre per year.
	Surround	25 to 50 lb	G	none	4 hr	0 days	Surround coats leaves and fruit, rendering them unattractive to Japanese beetles. Surround may also decrease other pest activity. Surround is OMRI listed for use by organic growers. Visible residue may persist on fruit at harvest.
Grape berry moth	carbaryl (Sevin XLR Plus)	2 qt	VG		See label	7 days	Use of Sevin may encourage mites. Do not concentrate spray on clusters or visible residue may result. Do not apply more than 10 qt/acre per year. Repeat applications as necessary up to a total of 5 times but not more often than once every 7 days.
	clothianidin (Clutch 50 WDG)	3 oz	G	IRAC 4	12 hr	0 days	
	spinosad (Entrust 80W) (Entrust 2SC)	1.25 to 2.5 oz 4 to 8 fl oz	G	IRAC 5	4 hr	7 days	Treatments should be timed to egg hatch. Entrust is OMRI listed.
	spinetoram (Delegate)	3-5 oz	G		4 hr	3 days	
	methoxyfenozide (Intrepid 2F) (Intrepid Edge)	8 to 16 fl oz 6 to 12 fl oz	G	IRAC 18	4 hr	30 days*	Treatments should be timed to egg hatch. *Shorter preharvest intervals are permitted when reduced rates are used, see label.
	bifenthrin (Brigade 2 EC)	3.2 to 6.4 fl oz	G	IRAC 3	12 hr	30 days	
(Continued on next page)	indoxacarb (Avaunt)	5 to 6 oz	G	IRAC 22	12 hr	7 days	

Summer cover (post-bloom) sprays until harvest – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Grape berry moth (*continued)*	phosmet (Imidan 70 WP)	1.33 to 2.125 lb	G	IRAC 1B	14 hr	7 or 14 days	Seven-day PHI at the lowest rate, 14-day PHI for rates above 1.33 lb. Do not apply more than 6.5 lb per acre per year.
	fenpropathrin (Danitol 2.4 EC)	10.66 to 21.33 fl oz	G	IRAC 3	24 hr	21 days	Do not exceed 2.66 pints per acre per season. Make no more than two applications per season.
	pyriproxyfen (Esteem 0.83 EC)	16 fl oz	G	IRAC 7C	12 hr	21 days	
	Rynaxypyr (Altacor)	3 to 4.5 fl oz	G	IRAC 28	4 hr	14 days	Use between 100 and 200 gal per acre total spray volume.
Grape rootworm, Southern grape rootworm	Grape rootworm larvae feed on roots. Adults are small, black weevils that make distinctive chain-like feeding markings on leaves. Foliar feeding does not result in yield reduction, but root feeding may reduce plant vigor over time. Treatments should be timed to adult activity, which typically peaks in June or July. Grape rootworms are sporadic pests and should not be treated preventatively.						
	carbaryl (Sevin XLR Plus)	2 qt	VG		See label	7 days	Use of Sevin may encourage mites. Do not concentrate spray on clusters or visible residue may result. Do not apply more than 10 qt/acre per year. Repeat applications as necessary up to a total of five times but not more often than once every 7 days.
Scale insects	Scale insects are occasional pests of muscadine grapes.						
	buprofezin (Applaud 70 DF)	9 to 12 oz	G	IRAC 16	12 hr	7 days	Apply when crawlers are observed.
	spirotetramat (Movento 2 SC)	6 to 8 fl oz	G	IRAC 23	24 hr	7 days	

Summer cover (post-bloom) sprays until harvest – *continued from previous page*

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-iveness	Mode of Action	REI	PHI	Comments and Precautions
Spider mites	Sample for mites using a minimum 10x hand lens. There is no clearly defined threshold for mites in muscadine grapes. Treatment for vinifera grapes is recommended when greater than 50% of the leaves are infested. Fast-moving predatory mites can be distinguished from slower spider mites. Some insecticides such as carbaryl (Sevin), bifenthrin (Brigade), and fenpropathrin (Danitol) can flare mite populations. Use with caution when mites are present. Rotate acaricides (miticides) between modes of action (MOAs) to minimize selection for resistance.						
	pyridaben (Nexter 75WP)	4.4 oz	VG	IRAC 21	12 hr	7 days	Nexter is an excellent miticide for European red mite.
	bifenazate (Acramite 50WS)	0.75 to 1 lb	VG	IRAC 20D	12 hr to 5 days	14 days	Acramite kills eggs, larvae, and adult spider mites. Allow at least a week before considering a second application based on scouting.
	abamectin (Abba 0.15 EC, Agri-Mek 0.15EC and others) Agri-Mek SC	8 to 16 fl oz See Label for rates 1.75 to 3.5 fl oz	E	IRAC 6	12 hr to 4 days	28 days	Apply with a non-ionic surfactant. Test for possible cultivar-specific phytotoxicity prior to spraying entire blocks. Do not reapply within 21 days. Do not apply by air. Do not make more than two applications per season. This adulticide will not impact eggs or larvae. Restricted use pesticide.
	fenpyroximate (Portal XLO, Fujimite 5 EC)	2 pt	E	IRAC 21	12 hr	14 days	Portal and Fujimite kill eggs, larvae and adult spider mites. Allow at least a week before considering a second application based on scouting. Do not make more than two applications per season. Do not apply by air.
	etoxazole (Zeal)	3 oz	G	IRAC 10B	12 hr	28 days	Zeal is a growth regulator that kills eggs and young mites. It is most effective if applied when mite populations are low.
	cyflumetofen (Nealta)	13.7 fl oz	VG	IRAC 25	12 hr	14 days	Do not make more than two Nealta applications per season. Rotate to another mode of action between applications.

(Continued on next page)

Summer cover (post-bloom) sprays until harvest – *continued from previous page*							
Pest/Problem	**Management Options**	**Amount of Formulation per acre**	**Effect-iveness**	**Mode of Action**	**REI**	**PHI**	**Comments and Precautions**
Spider mites *(continued)*	Horticultural oils (many materials, including Glacial Spray Fluid)	1 to 2% by volume	G	UNK	4 hr	0 days	Some oils are OMRI listed. Do not use in combination or immediately before/after Captan or sulfur-containing products. 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 foliar fertilizers.
	spirodiclofen Envidor 2 SC	18 fl oz	G	IRAC 23	12 hr	14 days	
	fenbutatin-oxide (Vendex 50WP)	1 lb	F	IRAC 12B	48 hr	28 days	Do not retreat with Vendex for 21 days. Restricted Use Pesticide.
Grape tumid gallmaker	Grape tumid gallmaker adults are small flies. Their larvae, or maggots, infest clusters, leaves, or stems and cause the plant to create galls. Galls can be quite large and are often reddish. Infestations are usually localized and do not typically require chemical treatment.						
	Hand removal	NA	G	NA	NA	NA	Removal of affected plant parts is generally sufficient to prevent further infestation.
	spirotetramat (Movento 2 SC)	6 to 8 fl oz	G	IRAC 23	24 hr	7 days	

Grape Root Borer Control

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-iveness	Mode of Action	REI	PHI	Comments and Precautions
Grape root borer	Grape root borer is potentially the most significant pest of grapes in the southeastern US, but they are not present in all vineyards. Grape root borer moths should be monitored with pheromone baited traps. Traps or dispensers should be placed in mid-June and continue through September. If moths are confirmed within a vineyard, mating disruption is the most effective control tool. The new version of Isomate is under registration and will be available for the 2026 season in the Southeast region.						
	Mounding		G				Mounding is an organically acceptable practice. Mounds need to be knocked down before winter.
	Isomate GRB Z	100 Dispensers	VG	Mating dis-ruption			Pheromone-based mating disruption has provided 90% reduction of pupal counts on bunch grapes in Virginia. Growers in NC have reported near 100% disruption in muscadine vineyards. Works best on vineyards of 5 acres of vines or more. Note that is can take two years before mating disruption efficacy becomes evident in a vineyard.
	Entomopathogenic nematodes (EPN) *Steinernema feltiae* or *Heterorhabditis bacteriophora*	See label for rate 450,000 infective juveniles per vine	G	Biocontrol			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. Exact timing for application is still being worked out, but applications during May through June have been effective.

Fire ant control

Fire ants – Fire ants may be controlled through the use of bait products. These products are often not fast-acting but operate by sterilizing the colony (the queen lays sterile eggs). They must be applied when the ants are actively foraging -- test for foraging behavior by placing food (hot dog pieces, potato chips, sardines, etc.) and checking 30 min later for ant activity. Apply during dry weather; moisture reduces the effectiveness of bait products.
Insecticides applied for control of other insect pests will also aid in suppression of fire ants. Fire ant populations are at their highest in young vineyards, but the number of mounds drops rapidly after the vines develop a mature canopy that shades the vineyard floor

Red Imported Fire Ant	pyriproxyfen (Esteem Ant Bait)	1.5 to 2.0 lb	VG	IRAC 7C	12 hr	1 day	For grapes do not exceed 0.22 lb active ingredient (ai, pyriproxyfen) per season.
	methoprene (Extinguish Professional Fire Ant Bait)	1.0 to 1.5 lb	VG	IRAC 7A	4 hr	0 day	Labeled for use on cropland, including grape vineyards.

Weed Management
Muscadine Grape Vineyards

The primary goal of any weed management program is to minimize competition in order to direct as many resources, like water, nutrients, and light, as possible toward 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 and may increase vine mortality due to water stress. In older, established vineyards competition will 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. The utilization of herbicides with 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. As a means to assist growers with identifying herbicides having like MOA a number system identifying herbicides by MOA has been developed and is being utilized. In the table below there is a MOA 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.

Muscadine Vineyard Herbicide Options

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hr)	Comments
PREPLANT/ SITE PREPARATION					
PREPLANT/ SITE PREPARATION	**Glyphosate, MOA 9** 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.
PREEMERGENCE					
Annual grasses and small seeded broadleaf weeds *(continued on next page)*	**Pendimethalin MOA 3** Prowl H_2O or Satellite HydroCap	2 to 4 qt	Newly Planted (once soil has settled after transplanting) and established vineyards.	12	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.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hr)	Comments
PREEMERGENCE					
Annual broadleaf weeds	**Isoxaben, MOA 21** Trellis SC	16 to 31 fl. oz	Newly planted and established vineyards	12	In newly planted vineyards apply once soil has settled after transplanting. Total use rate 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.
Annual weeds and some perennial weeds	**Dichlobenil, MOA 20** Casoron 4G	100 to 150 lb	Newly planted (4 wks after transplanting) and established vineyards.	12	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 may be used as early as 4 weeks after transplanting young vines.
Broadleaf weeds and suppression of yellow nutsedge	**Rimsulfuron, MOA 2** Grapple 25 WG Matrix 25 WG Pruvin 25 WG Solida 25 WG	4 oz	Vines established at least 1 year.	4	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 in. tall).
Broadleaf weeds and some annual grasses	**Diuron, MOA 7** Karmex 80 XP Or Direx 80 DF	2 to 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.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hr)	Comments
PREEMERGENCE					
Broadleaf weeds and some annual grasses	**Simazine, MOA 5** Princep 4 L or Princep Cal 90 or various generic formulations	2 to 4 qt 2.2 to 4.4 lb	Vines established at least 3 years.	12	Tank mix with glyphosate, paraquat, or glufosinate for postemergence weed control. The addition of pendimethalin (Prowl H_2O or Satellite HydroCap) with simazine will extend residual grass control several weeks.
Annual broadleaf and grass weeds	**Flumioxazin, MOA 14** Chateau 51 SW Tuscany 51 WDG Tuscany SC Chateau EZ	6 to 12 oz 6 to 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.
Annual broadleaf and grass weeds *(continued)*	**Indaziflam, MOA 29** Alion 1.67 SC	5 oz	Vines established at least 5 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.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hr)	Comments
PREEMERGENCE					
Annual broadleaf, some grass weeds, and yellow nutsedge	**Carfentrazone + Sulfentrazone, MOA14** Zeus Prime	7.7 to 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 broad spectrum 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 inch 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.
Annual broadleaf and grass weeds	**indaziflam + rimsulfuron MOA 29 and 2** Centrus	3 to 4.3 oz	Vines established 3 years or more		Use in vineyards established 3 years or longer. Grapes 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.
POSTEMERGENCE DIRECTED					
POSTEMERGENCE DIRECTED Non-selective control *(Continued on next page)*	**Glyphosate, MOA 9** 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.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hr)	Comments
POSTEMERGENCE Annual and perennial grasses	**Clethodim, MOA 1** Select, and others 2EC SelectMax,	6 to 8 oz 12 to 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.
	Fluazifop, MOA 1 Fusilade DX	12 to 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.
	Sethoxydim, MOA 1 Poast	1 to 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/acre per year.

Suggested Herbicide Programs for Muscadine 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 yrs**) + 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)
Vines established 5 years or more	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)

Weed Response to Vineyard Herbicides

Herbicides	Annual Grasses					Annual Broadleaf Weeds																Perennial Weeds				
	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	Johnonsgrass	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
Rimsulfuron	F	F	P	P	P	G				G	G	E	G	G	F	E	G	F			G		F		F	
Pendimethlin	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
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 the 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 on time.

Appropriate Application Time for Perennial Grass Control

	Bermudagrass		Johnsongrass	
Herbicide	**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.

Wildlife Damage Prevention

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 finches 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 one method should be relied on for control.

Auditory repellents
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 closer than 3 min.
- Consider using more than one type of auditory device and possibly combine them with visual repellents.

Visual repellents
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 eyes 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.

Chemical repellents
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 regarding its effectiveness. It has also been reported to impart an undesirable foxy flavor to certain grape varieties. 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 a greater effect than when used alone. As with other types of deterrents, applications need to start before birds establish feeding patterns.

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 (preferred). 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.

Lasers:
Lasers are receiving more attention as a tool for preventing bird damage in crops. Although little scientifically sound research has been done looking at the use of lasers, testimonials touting their effectiveness abound. While costs may seem high, lasers might be less expensive to install and operate (with perhaps better results) than most other types of bird control.

A green laser light beam works better than a red light beam as birds can see the green 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 often to avoid habituation. Using other control techniques in combination with lasers may offer expanded bird damage control.

Deer

Deer can damage muscadine vineyards by foraging on succulent new growth during the growing season or by eating fruit. In fall, bucks can damage trunks by rubbing. Deer numbers are increasing and incidents of deer damaging crops are also increasing. Deer populations vary from year to year as a result of weather conditions, food supply and possibly hunting pressure. Locating the planting away from favorable habitat for deer will help to lessen losses. However, this is not always possible. 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.

Repellents
Both taste and smell repellents exist. Smell repellents include commercially available products or materials such as tankage, blood, putrified egg solids, certain soaps and human hair. 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. The fence needs to be at least 8 ft high or higher, as deer can easily clear this height. Wire mesh fences are more desirable than multiple strands of barbed wire.

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 at 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 which are 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 getting shocked and turning the deer away from the field being protected. The single-wire, baited fence is relatively inexpensive, easy to construct and often adequate to protect 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 fence often used to contain cattle and horses works 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.

Opossums and Raccoons

Small mammals such as opossums and raccoons are very commonly found feeding on ripe muscadines, especially at night. Muscadines are a native plant, and this is a natural food source for these animals. Crop losses are most severe at the edges of fields near the woods, and this should be a consideration when choosing a vineyard site. Opossums and raccoons climb the trellis and feed in the canopy, eating the flesh of the grapes and dropping the empty hulls on the ground underneath the vine. An electric fence strand at ground level (4-6 in. above the ground) will deter small animals at the field edge, and aluminum flashing can be wrapped around trunks and trellis poles to make them difficult to climb.

The permalink for this UGA Extension publication is fieldreport.caes.uga.edu/publications/AP126-5.

Annual Publication 126-5 **June 2026**

Published by the University of Georgia in cooperation with Fort Valley State University, the U.S. Department of Agriculture, and counties of the state. For more information, contact your local UGA Cooperative Extension office.