2021 Southeast Regional Bunch Grape Integrated Management Guide

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Contents

PESTICIDE EMERGENCIES: 1-800-222-1222

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

- **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 Data Safety Sheet (MSDS) 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.*

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*.
- If the pesticide was not swallowed, *rinse mouth thoroughly with clean water*. If mouth is burned or irritated, consult a physician.

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.*

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.
- 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 OR OTHER EMERGENCIES

Spills on public roads *(Usually call the state police/state highway patrol.* In many cases you can call CHEMTREK at 1-800-424-9300 or 911.)

STATE	AGENCY	PHONE NUMBER
Georgia	Georgia State Patrol	Cell: call ***GSP** *or* **911**
Louisiana	LDAF Emergency Hotline	1-855-452-5323
Mississippi	Mississippi Emergency Management Agency	1-800-222-6362
North Carolina	Regional Response Team (RRT): For spills not on public road ways, 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 or 1-888-481-0125** (Toll Free)
Tennessee	Tennessee Emergency Management Agency (TEMA) State Emergency Operations Center	**1-800-262-3300**
Virginia	Virginia Emergency Operations Center	**1-804-674-2400**

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

STATE	AGENCY	PHONE NUMBER
Georgia	Georgia Department of Natural Resources Response Team	**1-800-241-4113**
Mississippi	Mississippi Emergency Management Agency	**1-866-519-6362**
North Carolina	North Carolina Div. of Water Quality	**1-800-858-0368**
South Carolina	South Carolina DHEC	**1-888-481-0125** (Toll Free)

Tennessee	Tennessee Wildlife Resources Agency (West)	**1-800-372-3928**
	Tennessee Wildlife Resources Agency (Middle)	**1-800-624-7406**
	Tennessee Wildlife Resources Agency (Cumberland Plateau)	**1-800-262-6704**
	Tennessee Wildlife Resources Agency (East)	**1-800-332-0900**
Virginia	Virginia Emergency Operations Center	**1-804-674-2400**

PESTICIDE LIABILITY and STEWARDSHIP

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.

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 local county Extension agent or an appropriate state Extension specialist.

Database	Web Address
Agrian Label Database	https://home.agrian.com/
Crop Data Management Systems	http://www.cdms.net/Label-Database
EPA Pesticide Product and Label System	https://iaspub.epa.gov/apex/pesticides/f?p=PPLS:1
Greenbook Data Solutions	https://www.greenbook.net/
Kelly Registration Systems[1]	http://www.kellysolutions.com

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

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 an 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 Worker Protection Standard requires applicators to wear the label required PPE and requires 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*; http://www.epa.gov/agriculture/twor.html) 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 *and* general use pesticides used in agricultural plant production.

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.

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 MSDS away from the area where pesticides are stored. Provide copies of product MSDSs to your community first responders. Consult your local Extension office and insurance company for assistance.

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.

PESTICIDE APPLICATION

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.

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 pesticide mode of action (MOA) between treatments.

FRAC/IRAC codes – These acronyms refer to industry-sponsored committees addressing resistance to crop protection materials; Fungicide Resistance and Insecticides Resistance Action Committees. Pesticides affect their target pest 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 FRAC/IRAC have grouped crop protection materials into groups with shared MoAs and given them numerical designations, which appear on pesticide labels. The code **UN** means the MoA is unknown. *When selecting pesticides, avoid successive applications of materials in the same MoA group to minimize potential resistance development*. More information about this topic can be found at **www.irac-online.org** and **www.frac.info.**

POLLINATOR PROTECTION

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

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

Bunch Grape Integrated Management Guide (Insect and Disease Management)

Bunch Grape

Establishment

General comments

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

Site development – Once a site has been selected, ample time should be devoted to preparing the site well in advance of planting. Hedgerows, overgrown fencerows or any other obstacles to good air drainage out of the vineyard site should be removed. Certain non-persistent herbicides that are not labeled for vineyards can be used in advance of planting to eliminate noxious weeds. **Soil testing** should be done to determine the nutritional status of the soil. Collect one sample in the upper 8 inches of soil (discard the top inch) and a second sample in the 8 to 16-inch depth. If needed, fertilizer and lime should be applied and incorporated into the soil well in advance of planting. Where magnesium levels are low, use dolomitic limestone. The desired amount of phosphorus should be incorporated during preplant soil preparation and should provide adequate phosphorus for the life of the vineyard. If the field is rough, it should be tilled to provide a smoother vineyard floor and reseeded to a desirable sod. If this is not necessary, 4 to 6-foot wide strips where the rows will be located should be sprayed with a suitable herbicide in advance of planting to eliminate competition for moisture, nutrients and sunlight between young vines and grasses or weeds. Tilling these strips once the herbicide has had time to act will help to incorporate lime and fertilizers. If the field to be planted is flat or very gently sloping, orienting rows north and south may result in more uniform exposure of clusters and leaves throughout the life of the vineyard, especially with certain trellis designs and training systems. However, if the site is not level, or close to level, consider orienting rows across the slope. The ideal floor management system for most southern vineyards involves maintaining a 3 to 4 foot wide strip under the trellis free of grasses and weeds through the use of appropriate herbicides. The area between rows should be maintained in sod which serves as a deceleration and diffusion strip for runoff water to lessen erosion problems. The sod strip also provides support for equipment travel. The precision in pesticide application and the ease in designing and operating an irrigation system is better when working across slopes as opposed to up and down them. Constructing and maintaining trellises on a contour can be very difficult. Operating a mechanical harvester on contoured rows is also difficult. Instead, plant straight rows more or less across the slope. Where the direction

Bunch Grape

Establishment

General comments

of the slope changes, stop the trellis and start anew on the different slope. This will facilitate construction and maintenance of the trellis, provide a drainage path for air out of the vineyard and give a place to turn equipment. Use a trellis design and a training system that keeps the vine up off the ground to allow for good air drainage under the trellis. The function of a trellis is to support the vine and the crop, orient the foliage and fruit for maximum sunlight exposure and to facilitate ease of working in the vineyard. The trellis should be designed and constructed to last a long time. These concepts will not only allow for better quality fruit production, but also serve to lessen pest pressure by good sunlight penetration, wind movement and spray coverage throughout the canopy.

Plant selection

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

Rootstock selection

Without a doubt, the primary factor in deciding whether a grapevine needs to be grafted or not is its resistance to grape phylloxera. Muscadine is considered to be resistant, or at least highly tolerant, of phylloxera, while resistance of Native American and French-American hybrid cultivars is variable. All vinifera grapes and hybrid grapes with 50% or more vinifera in their parentage should be grafted to a rootstock that provides resistance to phylloxera and nematode-transmitted viruses, such as tomato ringspot virus (Wolf, 2008).

There are advantages and disadvantages for own-rooted cuttings vs grafted vines. Own-rooted cuttings, plants tend to be less expensive. If their trunks are damaged or destroyed, new shoots will grow from buds located at or below the soil line whereas grafted vines will develop shoots from the rootstock that will either need to be regrafted or the vine will need to be removed. Also, the graft union is generally the weakest part of the vine and the incidence of crown gall is apt to become a problem at that point.

When replanting a vineyard, choose a rootstock having a different genetic composition than the one being replaced to lessen the chances of resistance development. If, for example, the original vineyard was on 3309 C rootstock, avoid planting 101-14 Mgt.

Bunch Grape

Establishment

General comments

List of common rootstocks in Southeastern US and their resistance level to soilborne pests and diseases.

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

Footnote: The contents of the table was adapted from the Wine Grape Production Guide for Eastern North America (Wolf, 2008), Growing Grapes in Texas (Kamas, 2014), and Grape Rootstocks for Michigan (Perry and Sabbatini, 2015), and reproduced with a permission from Double A vineyards.

Bunch Grape

Establishment

General comments

Fumigant risk mitigation. There are now numerous risk mitigation regulations for all fumigants. See https://www.epa.gov/soil-fumigants/implementing-safety-measures or specific regulations associated with risk mitigation. Follow all mitigation measurements carefully.

Fumigation with Telone products. Telone products are highly toxic. Carefully abide by all label precautions and review the label before each application. Telone II may be used when soil temperatures are from 40˚-80˚F at the prescribed injection depth (a minimum of 12 inches). Thorough soil preparation is required and soil moisture is a critical consideration. If it is too dry, the soil surface will not seal enough to prevent premature dissipation. If the soil is too wet, the product is less effective because it will not move as well in the soil, which will decrease product effectiveness. Excessive soil moisture can also prolong desired dissipation from the soil, which forces delay of planting to avoid phytotoxicity. Soil temperatures of 40˚-80˚F are required for use of Telone. However, the product is more active at the upper end of this temperature range. In the Southeast, applications should generally be made in the fall prior to mid-November. October soil temperatures often provide the best opportunity for efficacy, due to adequate soil temperatures. Plants can be easily killed by Telone if planting takes place too soon after application. At a minimum, the 27 GPA rate would require 4 weeks from application to planting, and the 35 GPA rate would require 5 weeks. If soils are wet or they have a clay component, dissipation will be much slower. Plan for at least 6-8 weeks between fumigation and planting. Even more time may be necessary. Before planting, use a post-hole digger or shovel to smell of the soil at the full depth of injection; if the almond-like odor of Telone is present, dissipation is not complete, and it is too early to plant. Cultivation, at a depth not to exceed the depth of Telone application, with subsoil shanks, a middle buster or other implements, will hasten dissipation of Telone. More than one cultivation may be required to get Telone out of the ground pre-plant.

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

Labeling used in the guide

In the following sections, the efficacy or importance of a management options is indicated by **E = excellent, VG = very good, G = good, F = fair, and P = poor**. These ratings are benchmarks, actual performance will vary.

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

Bunch Grape (continued)

Dormant

General comments

Dormant pruning – Pruning has several functions: removal of non-productive or marginally productive wood, encouraging the growth of new wood where fruiting will occur the following year, opening up the canopy to sunlight, air and spray penetration, adjusting crop load and eliminating dead, diseased or insect-infested wood. Annual pruning is essential to the consistent production of high quality fruit. Pruned wood materials should be removed from the vineyard or finely chopped using a flail mower to lessen the chances of perpetuating a disease problem that might have existed on the pruned woods. The time to prune depends on the amount of labor available, the size of the vineyards, fruitfulness of the cultivar on secondary buds and conflicting demands for time. Generally, the later in the dormant season that pruning can be done, the better it is. In fact, pruning after growth has started can be used as a way to delay bud break in the area where the crop is wanted, thus possibly escaping damage from a late frost. Double pruning (a rough pruning in the fall or in winter, then a final pruning in the spring) can reduce the risk of some of woody/vascular diseases, such as *Botryosphaeria* canker, Eutypa dieback, etc.

Soil testing – Soil tests should be conducted every 2 to 3 years after planting. Samples should be collected from 1 to 8 and 8 to 16 inches in depth. Results from soil tests may be useful in understanding results from petiole testing.

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

Dormant application of fungicides – A high rate of lime sulfur (10 gal per acre using 100 gal of water) is known to be effective against anthracnose, in addition, it should suppress Phomopsis and powdery mildew; however, the dormant season application will not be a substitute for in-season protective fungicide application. Thus, use the dormant season application in conjunction with in-season applications for target pathogen(s).

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

Bunch Grape (continued)						
Dormant						
Diseases						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Black rot Bitter rot Phomopsis Ripe rot	Prune out mummies, cankers, dead wood		**Very important**			Removal of mummies, rachises, and cankered and dead wood (including pruning woods) from the vineyard is very important to reduce the inoculum of rot fungi. (separate black rot)
Downy mildew	Shred, remove or bury leaves		**Very important**			By shredding leaves with a flail mower, burying them by cultivation, or removing them, the inoculum of the downy mildew fungus will be reduced. (application of urea can aid in breakdown of leaves at ¾ defoliation, spray on canopy and the ground at 4-5 lb/A)
Anthracnose and Phomopsis	lime sulfur Sulforix	10.0 gal 1.0 gal	G (no data)	48 hrs	0 days	A dormant spray of lime sulfur is very effective on anthracnose. Sufficient water should be used to thoroughly wet the vines. This spray helps reduce the overwintering inoculum of the Phomopsis and it may reduce powdery mildew fungus inoculum. A newer product Sulforix claims that it can be effective as low as 1 gal per acre, but we are lacking data to validate the efficacy.
Botryosphaeria canker Eutypa dieback ESCA	thiophanate-methyl (Topsin-M) (other products)	 0.75-1.5 lb see label	G	7 days		Obtain the new 2020 label for dormant application. Make sure the new label has been approved by you state. If not, contact local extension office. (**FRAC = 1**)
	myclobutanil (Rally 40WSP) (other products)	 5 oz see label	G			**Requires a supplemental label** (obtain from the manufacture's website). Often recommended to alternate with Topsin-M. (**FRAC = 3**)
	Latex paint with boron (B-lock)		G			Protective paint for wound protection
	Double pruning					Please see the comment section above

Bunch Grape (continued)						
Bud swell (bud is visibly swollen but no green or pink tissue is observed)						
Insect pests						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC Code)**
Climbing Cutworms	carbaryl (Sevin XLR Plus)	2 qt	G	48 hrs	7 days	REI is 6 days for grape girdling and cane turning **(IRAC=1A)**
	zeta-cypermethrin (Mustang Maxx)	2-4 oz	G	12 hrs	1 day	**(IRAC=3A)**
	bifenthrin (Brigade 10WSB)	8-16 oz	G	12 hrs	30 days	**(IRAC=3A)**
	beta-cyfluthrin (Baythroid XL)	2.4-3.2 fl oz	G	12 hrs	3 days	**(IRAC=3A)**
	methoxyfenozide (Intrepid 2F)	12-16 fl oz	G	4 hrs	30 days	**(IRAC=18)**
	spinetoram (Delegate 25 WG)	3-5 oz	G	4 hrs	7 days	**(IRAC=5)**
	spinosad (Entrust 80W, Entrust SC)	1.25-2.5 oz 4-8 fl oz	G	4 hrs	7 days	OMRI approved. **(IRAC=5)**
	Bacillus thuringiensis [Bt] (Dipel DF and others)	0.5-1 lb	F	4 hrs	0 days	OMRI approved. **(IRAC=11)**
	chlorantraniliprole (Altacor)	3.0-4.5 oz	G	4 hrs	14 days	Use between 100-200 gallons per acre total spray volume. **(IRAC=28)**

Bunch Grape (continued)						
Bud swell (bud is visibly swollen but no green or pink tissue is observed)						
Insect pests						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC Code)**
Grape flea beetle	carbaryl (Sevin XLR Plus)	1-2 qt	G	48 hrs	7 days	REI is 6 days for grape girdling and cane turning **(IRAC=1A)**
	zeta-cypermethrin (Mustang Maxx)	4.0 oz	G	12 hrs	1 day	**(IRAC=3A)**
	beta-cyfluthrin (Baythroid XL)	2.4-3.2 fl oz	G	12 hrs	3 days	**(IRAC=3A)**
	phosmet (Imidan 70-W)	1.33-2.125 1b	G	14 days	14 days	The 14-day REI may make this product impractical to use for most growers. **(IRAC=1B)**
Mealybugs	superior spray oil	2 gallons per 100 gallons, apply 200-300 gallons of water per acre	G	4 hrs	NA	Also helps control European red mites and scale. **(IRAC=NA)**
	clothianidin (Belay)	6 fl oz (foliar) 6-12 fl oz (soil)	G VG	12 hrs 12 hrs	0 days 30 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. For foliar application, do not make more than one application per year. Choose the lower rate for light infestation, and the lower rate for heavy infestation. **(IRAC=4A)**
	JMS Stylet Oil and Organic JMS Stylet Oil	1-2 gallons per 100 gallons of water**,** apply 200-300 gallons per acre	G	4 hrs	NA	The Organic JMS Stylet Oil is OMRI approved. **(IRAC=NA)**
	buprofezin (Applaud 70DF)	24 oz	G	12 hrs	7 days	**(IRAC=16)**

Bunch Grape (continued)

Bud swell (bud is visibly swollen but no green or pink tissue is observed)

Insect pests

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC Code)
Mealybugs (continued)	dinotefuran (Venom) (Scorpion 35SL)	1-3 fl oz (foliar) 5-7.5 oz (soil) 2-5 fl oz (foliar) 9-10.5 fl oz (soil)	G G G VG	12 hrs	1 day 28 days 1 day 28 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. **(IRAC=4A)**
	imidacloprid (Admire Pro)	7-14 fl oz (soil)	VG	12 hrs	30 days (soil)	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. **(IRAC=4A)**
	acetamiprid (Assail 30SG)	2.5-5.3 oz	G	12 hrs	3 days	(**IRAC=4A**)
	beta-cyfluthrin (Baythroid XL)	2.4-3.2 fl oz	G	12 hrs	3 days	**(IRAC=3)**

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

Bunch Grape (continued)

Bud break and new shoot sprays (7-10 day interval from 1-inch shoot growth until pre-bloom)

General comments

Fertilizing the vineyard – Annual, modest fertilization applications to the vineyard are best for maintaining consistent yields of high quality grapes. Nitrogen is the element most apt to be limiting in vineyards. About 0.1 pound of actual nitrogen per vine, is preferred for consistently good yields of high quality fruit. This amount may need to be adjusted depending on vine growth and fruiting. Petiole analysis should be utilized each year to determine whether nitrogen fertilization is needed. The best time to apply nitrogen to the soil in vineyards is shortly after bloom. It is important in growing grapes for wine to realize that fertilization not only affects vine growth and productivity, but also impacts the wine. Symptom development may happen late in the season. Thus, you may need to test the symptomatic vines or the soil 6-7 months in advance.

The ideal nutrient management plan for vineyards takes into account the following factors: (1) **Soil testing** – soil tests should be conducted every year. Samples should be collected from 1 to 8 and 8 to16 inches in depth. Results from soil tests will be useful in understanding results from petiole testing. (2) **Tissue analysis** – Collect petioles at full bloom from leaves opposite the first or second bloom cluster from the bottom of a shoot. Do not collect over 2 petioles per vine. Randomly sample vines of the same cultivar and age in a vineyard accumulating a minimum of 50 petioles for analysis. Routine petiole analysis from the same vineyard over a period of years can help detect trends in nutrient levels thus helping avoid nutritional problems that may adversely affect yields and quality. Vines having different growth characteristics should be sampled separately from normal vines. Contact your county extension office for more details on collecting and sending samples for analysis. (3) **Observations on growth and fruiting** – note any abnormalities in leaf or shoot growth, leaf color and crop development. (4) **Records on vineyard performance over previous years** – notes on yields and fruit quality plus any unusual weather conditions that may have impacted vine performance may be of value in refining the fertility program.

Shoot positioning – With increasing shoot growth, light penetration, air movement and spray coverage throughout the canopy will be reduced resulting in reduced fruit quality and increased pest pressure. Leaves in heavily shaded portions of the canopy do not contribute much, if anything, beneficial to the development of the crop and sustenance of the vine while pathogen like powdery mildew thrive under the shade. The potential for next year's crop can also be adversely affected if the leaves at the nodes to be retained for that crop are shaded. Shoot positioning involves moving shoots on the top of the canopy and those that overlap other shoots on the sides to a vertical position on each side of the canopy to allow better sunlight interception by all the leaves and to promote better air circulation throughout the canopy. Shoot positioning may need to be done several times during the growing season beginning before bloom.

Diseases

During the early season, Phomopsis cane and leaf spot is a primary disease of concern, as it can be active in relatively low temperature ranges (can cause infection in the mid-40's). Also, when there are unseasonably warm rain events, both downy and black rot can appear early as well. Mancozeb products, when applied for Phomopsis, will be effective against downy mildew and black rot as well. A powdery mildew fungicide is generally not needed in the first spray (1-inch shoot growth) unless the disease has been a problem in previous years. However, sulfur can be a relatively cheap and effective material that can be tank-mixed as insurance.

Notes on the use of sulfur products: Avoid sulfur on sulfur-sensitive cultivars. Do not use it within 2 weeks of an oil application. Sulfur injury may occur if temperatures are greater than 85°F at the time of application or when temperature exceeds 85°F while leaf surface is still wet from the application.

Bunch Grape (continued)						
Bud break and new shoot sprays (7-10 day interval from 1-inch shoot growth until pre-bloom)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Diseases						
Phomopsis Black rot Powdery mildew Downy mildew	mancozeb (various formulations) *plus* sulfur (various formulations)	see label see label	VG	24 hrs	66 days (The REI and PHI refer to the most stringent aspect of the combined spray)	This should be the backbone of your fungicide program, especially early in the season. Mancozeb targets Phomopsis, downy mildew, and black rot, while sulfur targets powdery mildew. **FRAC = M3** for mancozeb and **M2** for sulfur Note: sulfur may not be as effective at low temperature < 65ºF.
Insect pests						
Sharpshooter leafhoppers (Pierce's disease suppression)	imidacloprid (Admire Pro)	7-14 fl oz (soil)	VG	12 hrs	30 days (soil)	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. Only apply 14 fl oz per season. **(IRAC=4A). Imidacloprid may be applied in two half-rate applications 30 days apart to good effect.**
	dinotefuran (Venom) (Scorpion 35SL)	5-7.5 oz (soil) 9-10.5 fl oz (soil)	G VG	12 hrs	28 days 28 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. **(IRAC=4A)**

Bunch Grape (continued)						
Bud break and new shoot sprays (7-10 day interval from 1-inch shoot growth until pre-bloom)						
Sharpshooter leafhoppers (cont.)	clothianidin (Belay)	6-12 fl oz (soil)	VG	12 hrs	30 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. For foliar application, do not make more than one application per year. Choose the lower rate for light infestation, and the lower rate for heavy infestation. **(IRAC=4A)**
Mealybugs	clothianidin (Belay)	6 fl oz (foliar) 6-12 fl oz (soil)	G VG	12 hrs 12 hrs	0 days 30 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. For foliar application, do not make more than one application per year. Choose the lower rate for light infestation, and the lower rate for heavy infestation. (**IRAC=4A**)
	JMS Stylet Oil and Organic JMS Stylet Oil	1-2 gallons per 100 gallons of water, apply 200-300 gallons per acre	G	4 hrs	NA	The Organic JMS Stylet Oil is OMRI approved. (**IRAC=NA**). Do not apply within 14 days of a Captan or sulfur application.
	buprofezin (Applaud 70DF)	9-12 oz	G	12 hrs	7 days	(**IRAC=16**)
	dinotefuran (Venom) dinotefuran (Scorpion 35SL)	1-3 fl oz (foliar) 5-7.5 oz (soil) 1-5.25 fl oz (foliar) 9-13.25 fl oz (soil)	G VG G VG	12 hrs 12 hrs 12 hrs 12 hrs	1 day 28 days 1 day 28 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. (**IRAC=4A**)
Mealybugs (cont.)	imidacloprid (Admire Pro)	7-14 fl oz (soil)	VG	12 hrs	30 days (soil)	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. (**IRAC=4A**)
	acetamiprid (Assail 30SG)	2.5-5.3 oz	G	12 hrs	3 days	(IRAC=4A)

Bunch Grape (continued)						
Bud break and new shoot sprays (7-10 day interval from 1-inch shoot growth until pre-bloom)						
	beta-cyfluthrin (Baythroid XL)	2.4-3.2 fl oz	G	12 hrs	3 days	(**IRAC=3**)
Cutworms	*See bud swell recommendations*					
Grape flea beetle	*See bud swell recommendations*					

Bunch Grape (continued)
Pre-bloom
General comments
Cluster thinning – Cluster thinning may be done to further refine crop load adjustment on the vine. Overproduction on a vine can result in poor cluster size and quality and reduced shoot growth, which under extreme situations, may mean that there will be too few buds formed to give a good crop the following year. Cluster thinning should be done early – before bloom up to no later than 2 weeks after bloom to achieve the best results however, some response will be received even when thinning is delayed as late as veraison. The earlier that it is done, the more pronounced the effects would be; however, many people wait until bunch closure or late to have an "insurance" for accidental loss of yield. Excess clusters should be removed from shoots, as there may not be sufficient leaf area to ripen the fruit. Third clusters on a shoot should be removed and, in some cases, the second cluster may be removed as well. When thinning to one cluster per shoot, yields will be reduced which may be desirable only in cases where a premium price will be received for the crop. When thinning at veraison, it is possible to remove clusters that appear to be lagging in their development. **Shoot thinning and positioning** – It is important to thing excess shoots and position remaining shoots while it is still flexible, also, in terms of disease management, open canopy will provide a good airflow to reduce the risk of disease development, and allow fungicides to reach the fruiting zone. Please refer to Wine Grape Production Guides (example: https://content.ces.ncsu.edu/north-carolina-winegrape-growers-guide, https://blogs.cornell.edu/grapes/production/) for more detailed information on vine management.

Bunch Grape (continued)

Pre-bloom

Diseases

This is where the most important sprays for downy mildew, powdery mildew, Phomopsis, and black rot starts for the season.
From this stage, grape berries become susceptible to infection by black rot, downy mildew, and powdery mildew, and all of these pathogens become active due to warmer temperature. Once again, mancozeb and sulfur combination is the backbone of the spray program at this stage. Mancozeb materials are effective against, Phomopsis, black rot, downy mildew, and sulfur materials are effective against powdery mildew. If you decide to use captan instead of a mancozeb product, make sure to tank mix it with a material with efficacy against black rot.

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

- If **black rot** is the target, combine mancozeb with a QoI (Abound, Flint, Pristine, etc.) or DMI fungicide. Among DMIs (FRAC = 3), Rally and Elite are more active on black rot than Procure or Rubigan. (Note: Rubigan/Vintage has been removed from the market. It is OK to use the ones you have, but make sure to keep your label.) If there is a rain event, which can be black rot infection, and your vines are not protected by previous application, Rally should provide a good curative or kick-back activities as long as you apply within a few days after the infection event.
- For **downy mildew**, materials that contain FRAC group 40 (Revus, Forum, and Zampro), and Ranman (FRAC = 21) are very good protective materials. Phosphonate materials (Prophyt, Phostrol, etc. FRAC = P07), and Ridomil products have curative activities; however, please note that the protective application provides much better efficacy than the curative application of fungicide. Unfortunately, the efficacy of QoI fungicides against powdery mildew has been questionable due to the existence of fungicide resistant strains.
- For **powdery mildew**, Vivando (FRAC = 50), Quintec (FRAC = 13), Torino (FRAC=U6), and DMI (FRAC = 3) fungicides are good protective materials. SDHI materials such as Aprovia and Luna Experience can be used too; however, the SDHI is often used as a material for Botrytis, thus, at bloom or other growth stages when Botrytis management is also needed maybe the best timing to use the SDHI. Unfortunately, the efficacy of QoI fungicides against powdery mildew has been questionable due to the existence of fungicide resistant strains. Also, there are some cases of powdery mildew isolate with DMI resistance have been reported in VA.

Make sure to rotate FRAC groups, and limit the use of these disease specific materials to less than three times a season (two or less is ideal), because all of these materials are prone to the development of fungicide resistance. It is best to come up with a plan prior to the season so that you do not have to make a decision on the fly.

Please visit VA grape disease updates http://grapepathology.blogspot.com/ for more information about infection conditions for major grape diseases.

Fungicide resistance – Fungicide resistance is a very serious and real matter. There are several mechanisms that fungal pathogens can develop resistance, but in general, after a certain period of use of a particular mode of action, we select fungal population(s) that is resistance to the mode of action. In some cases, there is a cost associated with having resistance and the population may not survive for a long period; however, in many other cases, resistant population will thrive. Thus, once resistance population is found at your vineyard, chances are, it will stay with you for a long time.

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

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

- Resistance against benzimidazoles, FRAC = 1 and QoIs (**Q**uinone **o**utside **I**nhibitor, or also known as strobilurin), FRAC = 11, by powdery mildew, downy mildew and Botrytis are widespread.
- Several cases of QoI resistance with ripe rot pathogens have been reported in VA
- Abound is more active on downy mildew than Flint or Sovran; however, in some areas of southeast, both powdery mildew and downy mildew pathogens have already developed resistance against Abound and other QoI fungicides (FRAC = 11).
- Reduced efficacy of DMI (FRAC =3) against powdery mildew has been observed in VA and suspected in other states in southeast
- Quintec (FRAC = 13) resistant strains of powdery mildew have been observed in VA (Note: Only one case reported, not widespread as of 2020)
- Pristine (QoI plus SDHI FRAC = 7) resistance has been documented on Botrytis in multiple crops including wine grapes, several cases reported in VA.
- Revus (FRAC = 40) resistance to downy mildew has been reported in several vineyards in VA and NC.
- Effectiveness of Vanguard, Elevate, and Topsin M is at risk in GA and NC for Botrytis

Bunch Grape (continued)						
Pre-bloom						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Diseases						
Phomopsis Black rot Powdery mildew Downy mildew ***The backbone program***	mancozeb (various formulations) *plus* sulfur (various formulations**)** When conditions are not favoring disease development, these two materials are sufficient.	see label see label	VG	24 hrs	66 days (The REI and PHI refer to the most stringent aspect of the combined spray)	(10-7 days before bloom) **This should be the backbone of your fungicide program, especially early in the season.** Mancozeb targets for Phomopsis, downy mildew, and black rot management, and sulfur targets for powdery mildew management. Both mancozeb and sulfur are low risk for fungicide resistance development **FRAC = M3** for mancozeb and **M2** for sulfur

Bunch Grape (continued)						
Pre-bloom						
Phomopsis Black rot Powdery mildew Downy mildew ***DMI options for better black rot and powdery mildew control*** *The backbone program (mancozeb plus sulfur) may be sufficient, but if the season is really wet, or if you have chronic issue with powdery mildew, adding a DMI or QoI fungicide during this period may be beneficial.*	mancozeb *plus* sulfur *plus* a DMI *DMI fungicide:* myclobutanil (Rally 40WSP) (other products) or tebuconazole (Elite 45DF) (Tebuzole 45DF) (Orius 45DF) or triflumizole (Procure 480WS) or tetraconazole (Mettle 1ME) or fenarimol (Rubigan 1E) (Vintage SC) or flutriafol (Rhyme) or mefentrifluconazole (Cevya) or triflumizole (Torionic)	see label 3-5 oz see label 4 oz 4 oz 8.6 oz 4-8 oz 3-5 fl oz 4-6 fl oz 4-5 fl oz 3-4 fl oz 4-8 fl oz	VG	24 hrs	66 days	DMI stands for **D**e**M**ethylation **I**nhibitors or sometimes some of chemicals in this group are called Sterol Inhibitors (SI) because they inhibit biosynthesis of sterol in fungi. (**FRAC = 3**) DMI fungicides works well against powdery mildew and black rot; however, loss of efficacy among powdery mildew isolates have been documented in VA. Fenarimol can cause phytotoxicity to some cultivars. Please refer to the label. For generic myclobutanil products, please see the label for rates and other instructions.

Bunch Grape (continued)						
Pre-bloom						
Phomopsis Black rot Powdery mildew Downy mildew ***QoI options for better black rot and Phomopsis control***	mancozeb *plus* sulfur *plus* a QoI fungicide *QoI fungicide*: azoxystrobin (Abound 2SC) or kresoxim-methyl (Sovran 50WG) or trifloxystrobin (Flint 50WG) or mandestrobin (Intuity)	See label 10-15.5 fl oz 3.2-4.0 oz (PM) 4-6.4 oz (DM) 1.5-2.0 oz 6.0 fl oz	 E VG VG VG	24 hrs	66 days	This class of fungicides often called QoI (**Q**uinone **o**utside **I**nhibitor) is prone to resistance. (**FRAC = 11**) The use of less resistant prone chemistries, such as mancozeb, captan, and sulfur, provide good management during this timeframe, while allowing the class 11 materials to be utilized better. Do not use Flint (or other QoIs) on Concords. This class of fungicides is prone to resistance.
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Phomopsis Downy mildew Black rot	Mancozeb *plus* Zoxamide (Gavel 75DF)	2.0 – 2.5 (1.33 – 1.67 lb mancozeb and 0.16 – 0.20 lb zoxamide)	VG	48 hrs	66 days	Gavel contains zoxamide that provides an extra protection against downy mildew. (**FRAC M3 *plus* 22**)
Anthracnose (Bird's-eye rot)	boscalid *plus* paraclostrobin (Pristine 38WG)	8.0-10.5 oz	E	24 hrs	14 days	Mancozeb and captan both has efficacy against anthracnose, but additional Pristine application may be needed for severe infection. Do not apply Pristine to Concord, Worden, Fredonia, Niagara or related grape cultivars due to possible injury. This class of fungicides is prone to resistance. (**FRAC = 7 *plus* 11**)
	captan (various formulations)	see label	E	48 hrs	0 days	Please check your label for REI since it differs with the product. (**FRAC = M4**, low resistance risk)

Bunch Grape (continued)						
Pre-bloom						
Downy mildew (specific)	mefenoxam *plus* copper (Ridomil Gold Copper) or mefenoxam *plus* mancozeb (Ridomil Gold MZ)	2.0 lbs 2.5 lbs	E E	48 hrs 48 hrs	42 days 66 days	Ridomil products provide excellent curative activity against downy mildew. However, only one or two applications are recommended per year, due to potential resistance issues. Use these products conservatively. In general, other products should be utilized till downy mildew symptoms are first observed or environmental conditions are very conducive for this disease; if observed, use Ridomil immediately. (**FRAC** = **4**)
	mandipropamid (Revus) or dimethomorph (Forum)	8.0 fl oz 6 fl oz	E E	4 hrs 12 hrs	14 days 14 days	Make no more than 2 consecutive applications before switching to a non-Group 40 fungicide. The addition of a spreading/penetrating type adjuvant such as a nonionic based surfactant or crop oil concentrate or blend is recommended. (**FRAC = 40**) This is a protective material. Several cases of mandipropamid resistant downy mildew isolates have been reported in VA and NC.
	ametocradin *plus* dimethomorph (Zampro SC)	14 fl oz	E	12 hrs	14 days	Please see the comment above. (**FRAC = 40 *plus* 45**)
	phosphonate (e.g., Prophyt, Phostrol, etc.)	See label	VG	4 hrs	0 days	High dose of a phosphonate material may cause phytotoxicity, please see label for rate information. **(FRAC = P07)** A mixture of a phosphonate and copper can cause phytotoxicity. It is best to avoid spray copper and phosphonate within two weeks.

Bunch Grape (continued)						
Pre-bloom						
Downy mildew (Cont.)	cyazofamid (Ranman) *plus* phosphonate (e.g. Prophyt, Phostrol, etc.)	2.1-2.75 fl oz	VG	12 hrs	30 days	Do not use Ranman with surfactant **(FRAC = 21).** Combine with phosphonates for best efficacy.
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Powdery mildew (specific) If your vineyard suffers chronic powdery mildew issue add one of these to "mancozeb *plus* sulfur" OR if you could not use sulfur (e.g., under high heat, growing sulfur sensitive hybrid), consider these options to replace sulfur) Best to be applied before symptom development. Do not make more than 2 sequential applications.	metrafenone (Vivando SC) or pyriofenone (Prolivo 300SC)	10.3-15.4 fl oz 4-5 fl oz	VG	12 hrs 4 hrs	14 days 0 days	(**FRAC = 50**)
	quinoxyfen (Quintec SC)	3-4 fl oz	VG	12 hrs	14 days	No more than 3 applications per season. Please see the label for higher rate usages (**FRAC = 13**)
	cyflufenamid (Torino SC)	3.4 fl oz	G	4 hrs	3 days	Do not make more than 2 applications per year. (**FRAC = U6)**
	Armicarb and Kaligreen	See label	G			These materials can suppress on-going powdery mildew infection; however, the product cost tends to be high. (**FRAC = M**)

Bunch Grape (continued)						
Pre-bloom						
Insect Pests						
Sharpshooter leafhoppers (Pierce's disease suppression) Initiation of foliar treatments should be based on trap captures.	carbaryl (Sevin XLR Plus)	1-2 qt	F	48 hrs	7 days	REI is 6 days for grape girdling and cane turning **(IRAC=1A)**
	malathion (Malathion 8F or Malathion 5EC)	1.88 pt (8F) 3 pt (5EC)	F	12hrs	3 days	Rates are based on 200 gal per acre spray volumes. As is common with most EC formulations, adverse effects, such as spotting or discoloration of the fruit or foliage may occur with high temperatures, poor drying conditions, excessive spray runoff, or certain tank mixes with other chemicals or pesticides. **(IRAC=1B)**
	fenpropathrin (Danitol 2.4 EC)	5.33-10.66 fl oz	F	24 hrs	21 days	**(IRAC=3A)**
	beta-cyfluthrin (Baythroid XL)	1.6-3.2 fl oz	F	12 hrs	3 days	**(IRAC=3A)**
	bifenthrin (Brigade 10 WSB) (Sniper 2EC)	16 oz 6.4 fl oz	F F	12 hrs	30 days	**(IRAC=3A)**
	imidacloprid (Admire Pro)	1-1.4 fl oz (foliar) 7-14 fl oz (soil)	G VG	12 hrs	0 days (foliar) 30 days (soil)	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. Only apply 14 fl oz per season. **(IRAC=4A)**
	dinotefuran (Venom) dinotefuran (Scorpion 35SL)	1-3 fl oz (foliar) 5-7.5 oz (soil) 1.75 fl oz (foliar) 9-13.25 fl oz (soil)	G VG G VG	12 hrs	1 day 28 days 1 day 28 days	If a soil application of a Group 4 is made, at least one foliar application of a different mode of action should be made before a foliar application of a Group 4A material is made. (**IRAC=4A**)

Bunch Grape (continued)						
Pre-bloom						
Sharpshooter leafhoppers (continued)	acetamiprid (Assail 30SG)	2.5 oz	G	12 hrs	7 days	
Grape berry moth Only treat for grape berry moth if adults are captured in pheromone traps. For the first three flights, expect 50% emergence at 187, 869, and 1094 Degree Days above a base of 47 F after first male catch.	fenpropathrin (Danitol 2.4 EC)	10.66-21.33 fl oz	F	24 hrs	21 days	Use caution in the use of postbloom pyrethroids; they may flare mealybug populations with resulting issues with leafroll virus **(IRAC=3)**
	methoxyfenozide (Intrepid 2F)	12-16 fl oz	G	4 hrs	30 days	Minimum application volume for airblast sprayers of 40 gallons per acre. See supplemental label for this use rate. **(IRAC=18)**
	spinosad (Entrust 80W, Entrust SC)	1.25-2.5 oz 4- 8 fl oz	G	4 hrs	7 days	OMRI approved. **(IRAC=5)**
	rynaxypyr (Altacor)	2.0-4.5 oz	VG	4 hrs	14 days	Use between 100-200 gallons per acre total spray volume. **(IRAC=28)**
	phosmet (Imidan 70-W)	1.33-2.125 1b	G	14 days	14 days	The 14-day REI may make this product impractical to use for most growers. **(IRAC=1B)**
	spinetoram (Delegate)	3-5 oz	VG	4 hrs	7 days	**(IRAC=5)**
	indoxacarb (Avaunt 30DG)	5-6 oz	**G**	12 hrs	7 days	**(IRAC=22)**
	clothianidin (Belay)	6.0 fl oz	F	12 hrs	0 days	Foliar application only; do not make more than one application per year. **(IRAC=4A)**
	carbaryl (Sevin XLR Plus)	1-2 qt	G	48 hrs	7 days	REI is 6 days for grape girdling and cane turning **(IRAC=1A)**

Bunch Grape (continued)						
Pre-bloom						
Grape flea beetle	phosmet (Imidan 70-W)	1.33-2.125 1b	G	14 days	14 days	The 14-day REI may make this product impractical to use for most growers. **(IRAC=1B)**
	buprofezin (Applaud 70DF)	9.0-12.0 oz	G	12 hrs	7 days	Apply when crawlers are active, or at 493 and 990 degree-days (base 50 F), starting at April 1 (early and peak activity of first generation). **(IRAC=16)**
Grape scale	spirotetramat (Movento 2SC)	6.0-8.0 fl oz	G	24 hrs	7 days	**(IRAC=23)**
	acetamiprid (Assail 30SG)	2.5-5.3 oz	G	12 hrs	3 days	**(IRAC=4A)**
	imidacloprid (Admire Pro)	7-14 fl oz	G	12 hrs	30 days	Soil application **(IRAC=4A)**
Grape tumid gallmaker	spirotetramat (Movento 2SC)	6.0-8.0 fl oz	G	24 hrs	7 days	Apply when galls first appear in blocks with a history of high populations of grape tumid gallmaker. Certain cultivars are more susceptible (e.g. Traminette, Niagara)

Bunch Grapes (continued)

Bloom (1 – 2 sprays)

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

Bunch Grapes (continued)						
Bloom (1 – 2 sprays)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Botrytis (cont.)	cyprodinil *plus* difenoconazole (Inspire Super)	16-20 fl oz	VG	12 hrs	14 days	Please note that many of pre-mixed materials contain the same mode of action of other products. (**FRAC = 9 *plus* 3**) Note 2: Some of products may not have the same percentage and rate combination to make it equal application rate to the non-pre-mixed material
	boscalid *plus* pyraclostrobin (Pristine 38WG)	18.5-23 oz	E	12 hrs *plus 5 days for vine handling*	14 days	Pristine also has activity on black rot, Phomopsis, downy mildew, and powdery mildew. Do not apply to Concord, Worden, Fredonia, or Niagara. (**FRAC = 7 *plus* 11**) Botrytis isolate that are resistant to both a.i. of Pristine is common in VA.
	boscalid (Endura 30WG)	8 oz	E	12 hrs	14 days	Endura will also control powdery mildew. (**FRAC = 7**) (High resistance development risk.)
	isofedamid (Kenja 400SC)	20-22 fl oz	E	12 hrs	14 days	Kenja will also control powdery mildew, and list anthracnose on the label (**FRAC = 7**)
	Pydiflumetofen *plus* Fludioxonil (Miravis Prime)	10.3-13.4 fl oz	E	12 hrs	14 days	Miravis Prime also control black rot and list other fungal diseases including anthracnose (rate varies: see the label for more details) (**FRAC = 7 *plus* 12**)
	fluopyram *plus* tebuconazole (Luna Experience) [It also has good efficacy against powdery mildew]	6.0-8.6 fl oz	E	12 hrs *plus 5 days for vine handing*	14 days	Do not apply more than 34 fl oz of Luna Experience per acre per season (**FRAC = 7 *plus* 3**). Due to its 5-day cane work REI, this product may be suited more for late season applications. Luna Experience also works against powdery mildew (Note: Grape has been removed from Luna Tranquility's label in 2016. If you purchased the product prior to the change, you can still use it as long as you have the label.)

Bunch Grapes (continued)						
Bloom (1 – 2 sprays)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Phomopsis Black rot Powdery mildew	azoxystrobin *plus* flutriafol (Topguard EQ)	5 – 6 fl oz	E	24 hrs	66 days	Topgard EQ is a mixed product of **FRAC=11 *plus* 3**. It should be very effective against black rot and powdery mildew. (The use of 11 and 3 in one application may limit the rotation choices.)
Black rot Powdery mildew Downy mildew	mandipropamid *plus* difenoconazole (Revus Top)	7.0 fl oz	VG	12 hrs	14 days	Because it is a mixed material, Revus Top can be applied by itself for protection against black rot, powdery mildew, and downy mildew; however, this class of fungicides is prone to resistance. Thus, use it with other materials, and do not use more than two times a season. Do not use on Concords and Fredonia due to phytotoxicity. (**FRAC = 3 *plus* 40**)
Black rot Ripe rot Bitter rot	boscalid *plus* paraclostrobin (Pristine 38WG) or other QoI materials (refer to pre-bloom QoI section)	8.0-10.5 oz	E	24 hrs *and 5 days for vine handling*	14 days	QoI is known to be effective against ripe rot and black rot. However, a high percentage of QoI-resistant ripe rot pathogens was reported in VA and suspected elsewhere.

Bunch Grapes (continued)

Bloom (1 – 2 sprays)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Powdery mildew Black rot	benzovindiflupyr (Aprovia) or benzovindiflupyr *plus* difenoconazole (Aprovia Top) or azoxystrobin plus difenoconazole (Quadris Top)	8.6-10.5 fl oz 8.5-13.3 fl oz 12-14 fl oz	E E E	12 hrs 12 hrs 12 hrs	21 days 21 days 14 days	Please check the label for application near aquatic areas. Aprovia, Aprovia Top, and Quadris Top list anthracnose on the label. Note that FRAC is 7 is also recommended for Botrytis management (but not listed on Aprovia label) **(Aprovia: FRAC = 7) (Aprovia Top: FRAC 7 *plus* 3) (Quardris Top: FRAC = 3 plus 11)**
Downy mildew (specific)	Please refer to pre-bloom recommendations					
Powdery mildew (specific)	Please refer to pre-bloom recommendations					
Black rot (specific)	In addition to QoI fungicides (listed above), DMI fungicides are effective against black rot. Please refer to pre-bloom DMI recommendations.					

General comments

Petiole analysis There are three ways to determine grapevine's nutrient needs: visual symptoms; soil tests (mentioned earlier); and tissue (petiole) analysis. Each method has advantages and limitations, thus, all three methods needs to be used on a regular basis. Petiole analysis is typically done around bloom, and it can help you determine the nutrient status of the vine, rather than what is available in the soil. Please see the nutrient section for more information.

Bunch Grape (continued)

Post-bloom (7-10 days after the bloom spray)

General comments

Canopy management -- Proper canopy management initiated at this time is very important to ensure that conditions are least favorable for disease development later in the season. Often times, leaf removal on the east side of a north – south oriented row or the north side of an east – west oriented row is recommended in early season, then leaf removal will be performed again on western or southern side in late in the season to avoid sunburn on berries. However, pulling leaves from both sides of the canopy to expose fruit clusters for better spray penetrations and shortening drying time is probably a good approach in the southeast due to prolific shoot growth under southeastern environments. If you pull leaves early (= soon after bloom), there will be lower risk of sunburn. Shoot positioning and tucking shoots are required for many training systems, and for the VSP-trained vines top and hedge as needed 18 to 24 inches above the top wire.

Bunch Grape (continued)

Post-bloom (7-10 days after the bloom spray)

Diseases

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

Since this is the middle of the critical time to protect your berries from downy mildew, powdery mildew, and black rot infection, newer materials should be used in a conjunction with mancozeb *plus* sulfur backbone. A DMI or QoI fungicide should provide an extra efficacy. The main idea here is trying to prevent infection to take place while berries are susceptible to infection.

If black rot is a problem, combine mancozeb with Rally or Elite. Rally and Elite are more active on black rot than Procure or Rubigan. If there is a rain event that can be black rot infection and your vines are not protected by previous application, Rally should provide a good curative or kick-back activities as long as you apply within a few days after the infection event.

If downy mildew is a problem, substitute Ridomil Gold MZ at 2.5 lb/acre for mancozeb (or use a reduced rate of mancozeb) or add phosphonates (Prophyt etc). Do not make more than three applications per season of Pristine or 2-3 applications of the QoI fungicides (Flint, Sovran, or Abound). Do not make more than two sequential applications of Flint, Sovran, Abound, or Pristine.

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

In addition, both ripe rot and bitter rot pathogens can infect flower parts to cause disease later in the season. Thus, if you have history of bitter rot or ripe rot, consider protecting flowers using mancozeb, QoI, captan, or ziram.

Bunch Grape (continued)						
Post-bloom (7-10 days after the bloom spray)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Diseases						
Phomopsis Black rot Powdery mildew Downy mildew Anthracnose	See pre-bloom backbone spray recommendations					
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Downy mildew (specific)	See pre-bloom recommendations					
Powdery mildew (specific)	See pre-bloom recommendations					
Black rot (specific)	See pre-bloom DMI recommendations or pre-bloom QoI recommendations					
Bitter rot Ripe rot	See bloom recommendations					
Insect pests						
Grape berry moth	See pre-bloom recommendations					
Sharpshooter leafhoppers (Pierce's disease suppression)	See pre-bloom recommendations					
Mealybugs	See bud break recommendations					
Periodical cicadas	Brood XIX of the 13-year periodical cicada will appear in much of the Southeast in 2024. Growers should be aware of timing, potential impacts, and potential control measures (https://www.virginiafruit.ento.vt.edu/cicada.html).					

Bunch Grape (continued)						
Post-bloom (7-10 days after the bloom spray)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Phylloxera (foliar)	Grape phylloxera has root feeding and foliar feeding forms. Rootstocks used in grape propagation are resistant to root feeding forms and do not require treatment. Foliar phylloxera may be problematic in European-American hybrid cultivars (i.e., Vidal, Seyval, Chambourcin, etc.) and cause distinctive, wart-like galls on leaves. The mobile crawler stage of phylloxera is susceptible to insecticide treatment, but closed galls are not. Scouting for galls and crawlers should begin once leaves are expanded. If infested leaves are found in susceptible cultivars, insecticide treatments should be timed to crawler emergence. The more damaging root form is controlled by resistant rootstocks.					
	acetamiprid (Assail 30SG)	2.5 oz	G	12 hrs	7 days	**(IRAC=4A)**
	spirotetramat (Movento 2 SC)	6-8 fl oz	G	24 hrs	7 days	Minimum application interval 30 days. **Movento also provides control of root infestations. (IRAC=23)**
Grape rootworm	carbaryl (Sevin XLR Plus)	2 qt	VG	12 hrs	7 days	Apply when beetles first appear, usually in mid-June or early July. A second application may be necessary 10 days later. **(IRAC 1A**)
European red mite Twospotted spider mite	bifenazate (Acramite 50WS)	1 lb	E	12 hrs	14 days	The reentry interval is 1 day for pruning, thinning, or leaf pulling and 5 days for cane turning, tying, and girdling. Minimum of 50 gallons per acre spray volume. **(IRAC=UN)**
	etoxazole (Zeal)	2-3 oz	VG	12 hrs	14 days	This is an ovicide/larvicide, so it has be used early in the life-cycle of the mites. Use this once per season. **(IRAC=10B)**
	fenpyroximate (Portal 5EC)	2 pt	VG	12 hrs	14 days	Nonbearing use only. Do not apply more than 2 pints per acre per season. Use a minimum of 50 gallon spray volume per acre. **(IRAC=21A)**
	abamectin (Agri-Mek 0.15EC)	16 fl oz	VG	12 hrs	28 days	With Agri-Mek, add a nonionic surfactant. **(IRAC=6)**
	pyridaben (Nexter 75WP)	10.67 oz	G	12 hrs	7 days	Do not make more than two applications per season. **May be fatal if inhaled (IRAC=21A)**

Bunch Grape (continued)						
Post-bloom (7-10 days after the bloom spray)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
European red mite Twospotted spider mite (Cont.)	fenbutatin-oxide (Vendex 50WP)	2.5 lb	G	48 hrs	28 days	Do not make more than two applications per season. **(IRAC=12B)**
	spirodiclofen (Envidor 2SC)	18 fl oz	VG	12 hrs	14 days	The reentry interval is 6 days for cane turning, tying, and girdling of table grapes. **(IRAC=23)**
	hexythiazox (Onager 11.8EC)	12-24 fl oz	G	12 hrs	28 days	Ovicide only: if adults or larva are present use another miticide with activity against active stages **(IRAC=10A)**
	TriTek or Glacial Spray Fluid	1-2 gal per 100 gal water	G (performs better with 2-3 sequential 7-10 day applications)	4 hrs	0 days	OMRI approved. **DO NOT use in combination with or immediately before or after spraying with fungicides such as captan or any product containing sulfur. DO NOT use with carbaryl or dimethoate. DO NOT use with any product whose label recommends the use of no oils. Do not use in combination with NPK foliar fertilizer applications. (IRAC=UN)**

Bunch Grape (continued)

Fruit set

General comments

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

Diseases

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

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

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

Bunch Grape (continued)						
Early cover (7-10 days after the post-bloom spray) and Second cover (7-10 days after first cover)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Diseases						
Phomopsis Black rot Powdery mildew Downy mildew	mancozeb (various formulations) *plus* sulfur (various formulations**)**	see label see label	VG	24 hrs	**66 days**	**With early cultivars, you may need to substitute mancozeb with captan (see below).** Mancozeb targets for Phomopsis, downy mildew, and black rot management, and sulfur targets for powdery mildew management. Both mancozeb and sulfur are low risk for fungicide resistance development **FRAC = M3** for mancozeb and **M2** for sulfur
Phomopsis Powdery mildew Downy mildew ***Backbone program after the 66-day PHI***	captan (various formulations) *plus* sulfur (various formulations**)**	see label see label	VG	24 hrs	0 days	**This should be the backbone of your fungicide program during the second half of the season.** Captan targets for Phomopsis, and downy mildew, and sulfur targets for powdery mildew management. (Note: captan cannot control black rot.) Both mancozeb and sulfur are low risk for fungicide resistance development **FRAC = M4** for captan and **M2** for sulfur
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Downy mildew (specific)	See pre-bloom recommendations.					
Powdery mildew (specific)	See pre-bloom recommendations.					
Anthracnose (specific)	See pre-bloom recommendations.					
Black rot (specific)	See pre-bloom DMI recommendations or pre-loom QoI recommendations.					

Bunch Grape (continued)						
Early cover (7-10 days after the post-bloom spray) and Second cover (7-10 days after first cover)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Black rot Bitter rot Ripe rot	See bloom recommendations.					
Insect pests						
Japanese beetle Green June beetle	carbaryl (Sevin XLR Plus)	1-2 qt	VG	48 hrs	7 days	REI is 6 days for grape girdling and cane turning **(IRAC=1A)** *Management for Japanese beetles are warranted when feeding damage reaches below the top trellis wire.*
	phosmet (Imidan 70-W)	1.33-2.125 1b	G	14 days	14 days	The 14-day REI may make this product impractical to use for most growers. **(IRAC=1B)**
	azadirachtin (Neemix 4.5) *plus* neem oil (Trilogy)	7-16 fl oz *plus* 2% solution	G	4 hrs	0 days	OMRI approved. **(IRAC=UN)**
	malathion (Malathion 8F or Malathion 5EC)	1.88 pt (8F) 3 pt (5EC)	F F	24 hrs 24 hrs	3 days 3 days	REI = 72 hrs for girdling and tying. As is common with most EC formulations, adverse effects, such as spotting or discoloration of the fruit or foliage may occur with high temperatures, poor drying conditions, excessive spray runoff, or certain tank mixes with other chemicals or pesticides. **(IRAC=1B)**
	acetamiprid (Assail 70 WP)	1.1-2.3 oz	G	12 hrs	7 days	**(IRAC=4A)**
	indoxacarb (Avaunt 30 DG)	3.5-6.0 oz	G	12 hrs	7 days	Very effective against lepidopteran pests such as grape berry moth. **(IRAC=22A)**
Grape berry moth	See pre-bloom recommendations					

Bunch Grape (continued)						
Early cover (7-10 days after the post-bloom spray) and Second cover (7-10 days after first cover)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Sharpshooter leafhoppers (Pierce's disease suppression)	See pre-bloom recommendations					
Mealybugs	See bud break recommendations					
Grape rootworm	carbaryl (Sevin XLR Plus)	2 qt	G	48 hrs	7 days	This is a sporadic pest. Apply when beetles appear, usually mid-June or July. A second application may be needed 10 days later.
European red mite Twospotted spider mite	See post-bloom recommendations					
Berry touch and bunch closure						
Diseases						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Botrytis Ripe rot Bitter rot	Leaf pulling		*****			Complete leaf pulling if not completed earlier. Removing leaves at will help expose the fruit clusters which will reduce drying time and increase pesticide deposition on and within the clusters.
Phomopsis Powdery mildew Downy mildew	See early cover recommendation for the backbone chemical management options. If you are concerned about black rot (its critical period should be over, or very end of it), see pre-bloom DMI recommendations or pre-bloom QoI recommendations.					
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Ripe rot Bitter rot	See bloom recommendations for chemical management options					

Bunch Grape (continued)						
Early cover (7-10 days after the post-bloom spray) and Second cover (7-10 days after first cover)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Downy mildew (specific)	See pre-bloom recommendations.					
Powdery mildew (specific)	See pre-bloom recommendations.					
Botrytis	See bloom recommendations for chemical management options					
Anthracnose (specific)	See pre-bloom recommendations.					
Insect pests						
Sharpshooter leafhoppers (Pierce's disease suppression)	See pre-bloom recommendations					
Mealybugs	See bud break recommendations					
European red mite Twospotted spider mite	See post-bloom recommendations					
Japanese beetle	See first cover recommendations					
Spotted wing drosophila	While too early for conventional control of SWD, an application of **Surround** just before clusters close may aid subsequent control of this pest. Oviposition sites often occur in the interior of clusters, out of reach of insecticide sprays closer to harvest. Use block history as a guide in decision making.					

Bunch Grapes (continued)

Post berry touch to veraison (10-14 day intervals)

Diseases

At this moment, berries are matured and become resistant against black rot, downy mildew, and powdery mildew.
The second cover was applied 20-28 days after post-bloom with 10-14 days of protection, thus, 34-42 days post-bloom protection was achieved. However, rachis is still susceptible to powdery mildew infection, and Phomopsis can cause fruit rot late in the season. In addition, Botrytis and other late season rots can become active. Also, some of *V. vinifera* cultivars are susceptible to black rot up to 7-8 weeks after bloom. Please check susceptibility to black rot with nursery or other sources.

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

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

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments (FRAC/IRAC)
Botrytis Bitter rot Ripe rot Downy mildew	canopy management		*****			Shoot training, removal, and pruning/hedging through the summer will enhance drying and improve disease control and pesticide penetration within the canopy.
Phomopsis Powdery mildew Downy mildew	See early cover recommendation for the backbone chemical management options.					
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Downy mildew (specific)	See pre-bloom recommendations.					
Powdery mildew (specific)	See pre-bloom recommendations.					
Botrytis	See bloom recommendations for chemical management options					
Sour rot	In a recent study done in Cornell University, a mixture of zeta-cypermethrin (Mustang Maxx) and hydrogen dioxide (Oxidate) sprayed twice after around 15-Brix provided an excellent control of sour rot. It is important to control the fruit fly, which is the vector of sour rot pathogens.					

Bunch Grapes (continued)	
Post berry touch to veraison (10-14 day intervals)	
Insect pests	
Grape berry moth	See pre-bloom recommendations
Sharpshooter leafhoppers (Pierce's disease suppression)	See prebloom recommendations
Mealybugs	See budbreak recommendations
European red mite Twospotted spider mite	See postbloom recommendations
Japanese beetle	See first cover recommendations

Borer control						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Grape root borer	Isomate-GRB	100 dispensers	VG			Pheromone-based mating disruption has provided 90% reduction of pupal counts in Virginia. Apply at the beginning of flight.
	chloropyrifos (Lorsban Advanced)	----	F	24 hrs	35 days	Note: This product will be discontinued soon. Be aware that this material has been linked with neonatal neurodevelopment effects with subsequent attention and motor symptoms in children. Apply 2 qt dilute mixture to soil at base of vine, for 4.5 pt per 100 gal. Make a single application 35 days before harvest or post-harvest, depending upon moth flight timing. Moths can be monitored using pheromone baited traps. Spray should not contact fruit or foliage. Application can be made with flood nozzles and low pressure (40 to 60 psi). **(1B).**
	Cultivation or mounding soil		Labor intensive and challenging to implement. Can be effective if implemented well. May be useful in blocks not amenable to other approaches.			Use clean cultivation, mound soil (July 1 or at first moth emergence when using pheromone traps) or using tightly-sealed plastic mulch 3 ft from the base of vines. This practice will inhibit adult emergence from the soil when well timed. Mounded soil needs to be removed by September 1st.

Bunch Grape (continued)

Veraison

General comments

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

In terms of disease management, it is recommended to manage crop yield by crop thinning at or before veraison. Once berries start to accumulate sugar, dropped berries may attract birds and insects, which could find hanging berries and puncture them. Wounding is a major entry point for late season rots such as Botrytis and sour rot, thus proper insect and bird management can significantly reduce the risk of later season rot development.

Diseases

Phomopsis Powdery mildew Downy mildew	See early cover recommendation for the backbone chemical management options. If you are concerned about black rot (its critical period should be over, or very end of it), see pre-bloom DMI recommendations or pre-bloom QoI recommendations.
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.	
Botrytis	See bloom recommendations for chemical management options (Critical period for Botrytis management)
Sour rot	
Ripe rot Bitter rot	See bloom recommendations for chemical management options (Critical period for ripe rot management)
Downy mildew (specific)	See pre-bloom recommendations.
Powdery mildew (specific)	See pre-bloom recommendations.
Anthracnose (specific)	See pre-bloom recommendations.

Insect pests

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

Spotted-wing drosophila	Closely examine berries for oviposition beginning when berries reach 15 degrees Brix. Risk appears to be related to skin thickness and penetration pressure; this is an active area of investigation. Control decisions should be influenced by history, since vineyard blocks are not uniform in infestation. Infestation by SWD may increase incidence of sour rot. A research from Cornell suggests the management of fruit fly can decrease the risk of sour rot.

Bunch Grape (continued)

Post veraison to Preharvest (10-14 day's before harvest)

General comments

Diseases

Preharvest

What can you do when diseases get out of hand at this time of season?

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

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

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

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

Use of sulfur, captan, or copper within 30 days of harvest is often not preferred due to their potential negative effects on fermentation process (Eric to expand on it?). Consult with your winemaker.

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

Insect pests

Spotted-wing drosophila (SWD) is a recently introduced invasive insect pest of soft skinned fruits. It is unclear how significant SWD will be as a grape pest. Growers should carefully monitor adult presence in vineyards (using a 60:40 blend of red wine and apple cider vinegar, **other commercial lures (Scentry, Trece, etc., check weekly**) and larval presence in fruit. Wine grapes may experience greater injury than fresh market table grapes; results are mixed on differential varietal susceptibility, and this is a current research area. If adult SWD are present soft fruit may be a risk. Larvae begin to infest fruit as they ripen, so insecticide treatments should be applied on a weekly basis and reapplied in the event of rain. While risk begins at véraison, risk increases significantly when fruit reach 15 degrees Brix. When berries reach a vulnerable stage, applications may be needed every 5-7 days. If SWD will be a target, effective SWD materials should not be used against other pest early in the season, if other alternatives exist. Do not exceed maximum allowed applications per season.

Bunch Grape (continued)						
Preharvest (10-14 days before harvest)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Diseases						
Phomopsis Powdery mildew Downy mildew	See early cover recommendation for the backbone chemical management options.					
Section below shows materials for specific diseases. These materials should be mixed with other materials to provide protection against other major diseases.						
Botrytis	See bloom recommendations for chemical management options					
Ripe rot Bitter rot	See bloom recommendations for chemical management options					
Downy mildew (specific)	See pre-bloom recommendations.					
Powdery mildew (specific)	See pre-bloom recommendations.					
Insect pests						
Spotted-wing drosophila	beta-cyfluthrin (Baythroid XL)	1.6-3.2 fl oz	VG	12 hr	3 days	**(IRAC=3)**
	fenpropathrin (Danitol 2.4 EC)	10.6-21.3 oz	VG	24 hr	21 days	**(IRAC=3)**
	imidacloprid & cyfluthrin (Leverage 2.4)	3-8 fl oz	G	12 hrs	3 days	**(IRAC=4A & 3)**
	spinetoram (Delegate)	3-5 fl oz	G	4 hrs	7 days	**(IRAC=5)**
	phosmet (Imidan 70WSB)	1.33-2.12 lb	P G	14 days	14 days	Application rates of 1.33 lb or less, mechanical harvesting is permitted at 7 days after application **(IRAC=1B)**

Bunch Grape (continued)						
Preharvest (10-14 days before harvest)						
Pest/Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness or Importance**	**REI**	**PHI**	**Comments (FRAC/IRAC)**
Spotted-wing drosophila (continued)	malathion (Malathion 8F or Malathion 5EC)	1.88 pt (8F) 3 pt (5EC)	VG	12 hrs	3 days	Rates based on 200 gal per acre spray volumes. As is common with most EC formulations, adverse effects, such as spotting or discoloration of the fruit or foliage may occur with high temperatures, poor drying conditions, excessive spray runoff, or certain tank mixes with other chemicals or pesticides. **(IRAC=1B)**
	zeta-cypermethrin (Mustang Maxx)	4 fl oz	VG	12 hrs	1 day	**(IRAC=3)**
	spinosad (Entrust 80W, Entrust SC)	1.25-2.5 oz 4-8 fl oz	G	4 hrs	7 days	Entrust is OMRI listed. **(IRAC=5)**
	Cyclaniliprole (Verdepryn 100SL)	8.2-11 fl oz				
Sharpshooter leafhoppers (Pierce's disease suppression)	See pre-bloom recommendations					
European red mite Twospotted spider mite	See post-bloom recommendations					
Japanese beetle Green June beetle	See first cover recommendations					

Bunch Grape (continued)

Post-harvest (14-21 day intervals from harvest until the first killing frost)

General comments

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

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

Efficacy of selected fungicides against diseases of bunch grapes							
Chemical name (Fungicide product name)	**Anthracnose**	**Black rot**	**Bitter rot**	**Botrytis rot**	**Downy mildew**	**Phomopsis cane and leaf spot**	**Powdery mildew**
Azoxystrobin **(Abound)**		**E**[a]	**E**	**G**[b]	**E**[b]	**G**	**E**[b]
Benzovindiflupyr **(Aprovia)**, Isofedamid **(Kenja)**	**G**[c]	**VG**		**E**[b]			**VG**[c]
Boscalid **(Endura)**				**E**[b]			**VG**[c]
Boscalid *plus* Pyraclostrobin **(Pristine)**	**VG**	**E**	**E**	**E**[b]	**E**[b]	**E**	**E**
Captan **(Captan, Captec, etc.)**	**G**	**G**	**E**	**F**	**VG**	**VG**	**NA**
Fixed coppers and Bordeaux mixture (various)		**G**	**F**	**G**	**G**	**F**	**F**
Cyazofamid **(Ranman)**					**VG**		
Cyflufenamid (**Torino**)		**NA**	**NA**	**NA**	**NA**	**NA**	**VG**
Cyprodinil **(Vangard)**		**NA**	**NA**	**E**[b]	**NA**	**NA**	**F**
Cyprodinil *plus* Fludioxonil **(Switch)**				**VG**[b]			
Cyprodinil *plus* Difenoconazole **(Inspire Super)**		**VG**		**VG**[b]			**VG**
Famoxadone *plus* cymoxanil **(Tanos)**					**G**[b]		
Fenhexamid **(Elevate)**		**NA**	**NA**	**E**[b]	**NA**	**NA**	**NA**
Ferbam (**Ferbam**)		**VG**	**G**	**NA**	**F**	**F**	**NA**
Fenarimol **(Rubigan)**		**F**	**NA**	**NA**	**NA**	**NA**	**E**[b]
Fluopyram *plus* tebuconazole (**Luna Experience**)	**NA**	**E**	**NA**	**E**[b]	**NA**	**NA**	**E**
Iprodione **(Rovral, Meteor)**	**NA**	**NA**	**NA**	**G**[b]	**NA**	**NA**	**NA**
Kresoxim-methyl **(Sovran)**		**E**	**E**	**F**[b]	**G**[b]	**G**	**E**[b]
Lime Sulfur (dormant application)	**G**			**NA**	**NA**	**G**	**F**
Mancozeb (various: Penncozeb, Dithane, etc)		**E**	**E**	**NA**	**E**	**E**	**NA**
Mandipropamid **(Revus),** Dimethomorph **(Forum),** Dimethomorph *plus* Ametoctradin **(Zampro)**	**NA**	**NA**	**NA**	**NA**	**E**	**NA**	**NA**
Mandipropamid *plus* Difenoconazole **(Revus Top)**		**VG**	**VG**[c]	**NA**	**E**	**G**[c]	**VG**
Mefenoxam *plus* Copper **(Ridomil Gold Copper)**		**F**	**F**	**F**	**E**	**F**	**F**
Mefenoxam *plus* Mancozeb **(Ridomil Gold MZ)**		**G**	**G**	**NA**	**E**	**G**	**NA**
Metrafenone **(Vivando)**		**NA**	**NA**	**NA**	**NA**	**NA**	**VG**
Myclobutanil **(Rally)**		**E**	**F**	**NA**	**NA**	**NA**	**E**[b]
Phosphonate **(ProPhyt, Phostrol, etc.)**					**VG**		
Sulfur[d] (various)		**NA**	**NA**	**NA**	**NA**	**F**	**E**
Tebuconazole **(Elite)**		**E**	**NA**	**NA**	**NA**	**NA**	**E**[b]
Tetraconazole **(Mettle)**							**VG**[b]
Thiophanate-methyl **(Topsin M)**		**F**	**G**	**NA**	**NA**	**G**	**E**[b]
Trifloxystrobin **(Flint)**		**E**	**E**	**VG**	**G**	**F**	**E**[b]
Triflumazole (**Procure and Viticure)**		**G**[b]	**NA**	**NA**	**NA**	**NA**	**E**
Ziram (**Ziram**)		**VG**	**NA**	**F**	**VG**	**G**	**NA**
Cevya		**VG**					**VG**
Miravis Prime		**VG**		**VG**			**VG**

[a] The efficacy rating: NA = no significant activity; P = very limited activity, F = limited activity, G = moderate activity, VG = good activity, E = excellent activity

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

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

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

Fungicide classes with high risk of resistance development (generally single sites of action)	
Anilinopyrimidines (FRAC group 9)	Vangard (cyprodinil) Switch (cyprodinil *plus* fludioxonil) Inspire Super (cyprodinil *plus* difenoconazole) Scala (pyrimethanil)
Benzimidazoles (FRAC group 1)	Topsin M (thiophanate methyl)
Carboxylic acid amides (Group 40)	Forum (dimethomorph) Revus (mandipropamid) Revus Top (mandipropamid *plus* difenoconazole) Zampro (dimethomorph *plus* ametocradin)
Demethylation Inhibitors (DMIs) or Sterol Inhibitors (FRAC group 3)	Bayleton (triadimefon) Cevya (mefentrifluconazole) Elite and generics (tebuconazole) Inspire Super (cyprodinil *plus* difenoconazole) Luna Experience (tebuconazole *plus* Fluopyram) Mettle (tetraconazole) Procure/Viticure (triflumizole) Quadris Top (difenoconazole *plus* azoxystrobin) Rubigan/Vintage (fenarimol) Revus Top (mandipropamid *plus* difenoconazole) Rhyme (flutriafol) Rally/Nova (myclobutanil) Topguard EQ (flutriafol *plus* azoxystrobin)
Dicarboximides (FRAC group 2)	Rovral (iprodione)
Hydroxyanelides (FRAC group 17)	Elevate (fenhexamid)
Phenylamides (FRAC group 4)	Ridomil Gold (mefenoxam)
Phenylpyrroles (FRAC group 12)	Miravis Prime (Pydiflumetofen *plus* fludioxonil) Switch (fludioxonil *plus* cyprodinil)
QiI: Quinone outside Inhibitors (FRAC group 21)	Ranman (cyazofamid)

Fungicide classes with high risk of resistance development (generally single sites of action)	
QoI: Quinine outside Inhibitors (FRAC group 11)	Abound (azoxystrobin) Flint (trifloxystrobin) Intuity (mandestrobin) Pristine (pyraclostrobin *plus* boscalid) Quadris Top (azoxystrobin *plus* difenoconazole) Reason (famoxadone) Sovran (kresoxim-methyl) Tanos (famoxadone *plus* cymoxanil) Topguard EQ (azoxystrobin *plus* flutriafol)
Quinone X Inhibitor (FRAC group 45)	Zampro (dimethomorph *plus* ametocradin)
SDHI: Succinate dehydrogenase inhibitors (FRAC group 7)	Aprovia (benzovindiflupyr) Aprovia Top (benzovindiflupyr *plus* difenoconazole) Endura (boscalid) Luna Experience (Fluopyram; one component of a two-part mixture) Miravis Prime (Pydiflumetofen *plus* fludioxonil) Kenja (isofedamid) Pristine (boscalid *plus* pyraclostrobin)

Fungicide classes with low risk of resistance development (generally multiple sites of action)	
Several FRAC groups and classes	Captan (Captan or Captec) (M4) Coppers (numerous formulations) (M1) Carbamate (ferbam) (M3) Dithane, Manzate, Penncozeb (mancozeb) (M3) Maneb, Manex (maneb) (M3) Phosphonates (ProPhyt, etc.) (P07) Thiram (thiram) (M3) Sulfur (M2) Ziram (ziram) (M3)

Seasonal 'at a glance' fungicidal spray schedule options for bunch grapes

	Diseases to be considered (use highlight to indicated the timing)							Fungicide(s) to be used		
Developmental Stage	**Anthracnose**	**Bitter Rot, Ripe Rot**	**Black Rot**	**Botrytis**	**Downy Mildew**	**Phomopsis**	**Powdery Mildew**	**Basic**	**Options**	**Note**
Dormant (7-10 days prior to bud break)	Main trunk and cordons					Main trunk and cordons			Lime sulfur (10 g/A)	Dormant application is recommended if either Phomopsis or anthracnose has been a major issue in the previous years (It may reduce powdery mildew population.)
Bud Break and New Shoot (Very important sprays for Phomopsis management)	Leaf and cane					Leaf and cane	Initial leaf infection	mancozeb *plus* sulfur	Captan *plus* sulfur	
Prebloom (Critical period)			Leaf		Leaf	Leaf and cane	Leaf and rachis	mancozeb *plus* sulfur	Add PM or DM material based on your needs PM: Vivando, etc DM: Revus, etc	This is the start of critical period for berry infection by various diseases
Bloom (Critical period)		Flower	Leaf and berry	Flower				mancozeb *plus* sulfur *plus* Botrytis specific material: Elevate, Vangard, etc.	If ripe rot has been an issue, consider a QoI	It will reduce the risk of Botrytis outbreak.
1st and 2nd cover (Critical period)		Berry	Leaf and berry		Leaf and berry	Leaf, cane, and berry	Leaf and berry	mancozeb *plus* sulfur *plus* a PM or DM specific material	Downy mildew specific material (Revus - protectant, Ridomil products - curative), Black rot (Rally - curative)	Under wet conditions, add Ridomil or Phosphite product for DM and Rally for Black rot

Seasonal 'at a glance' fungicidal spray schedule options for bunch grapes

	Diseases to be considered (use highlight to indicated the timing)							Fungicide(s) to be used		
Developmental Stage	**Anthracnose**	**Bitter Rot, Ripe Rot**	**Black Rot**	**Botrytis**	**Downy Mildew**	**Phomopsis**	**Powdery Mildew**	**Basic**	**Options**	**Note**
Match the guide's heading 3rd cover (Critical period is almost over)		Berry	Berry		Leaf	Berry	Leaf and rachis	captan *plus* sulfur (*plus* a PM or DM specific material, if needed)	Downy mildew specific material, *plus* Rally, if Black rot is a concern	Mancozeb may not be available due to its 66-day PHI
Bunch closure		Berry		Berry				captan *plus* sulfur *plus* Botrytis specific material: Elevate, or Vangard, or Scala, or Endura, or Pristine, etc	Canopy management, and bird and bee control are very important for Botrytis (*plus* sour rot) management.	This is the last opportunity to deliver the material into the cluster
4th cover		Berry			Leaf	Berry	Leaf and rachis	captan *plus* sulfur (*plus* a PM or DM specific material, if needed)	Downy mildew specific material (Phosphite)	Scout young leaves for DM and PM. If the early season protection was successful, you may be able to relax the schedule a bit.
Veraison		Berry		Berry				captan *plus* sulfur *plus* Botrytis specific material: Elevate, or Vangard, or Scala, or Endura, or Pristine, etc	Bird and bee management	We only have protective materials against Botrytis.

Seasonal 'at a glance' fungicidal spray schedule options for bunch grapes

	Diseases to be considered (use highlight to indicated the timing)							Fungicide(s) to be used		
Developmental Stage	**Anthracnose**	**Bitter Rot, Ripe Rot**	**Black Rot**	**Botrytis**	**Downy Mildew**	**Phomopsis**	**Powdery Mildew**	**Basic**	**Options**	**Note**
Preharvest		Berry		Berry	Leaf	Berry	Leaf	captan *plus* sulfur *plus* a Botrytis material (Captan has some efficacy against sour rot and other general rots)	Downy mildew specific material (Phosphite)	Need to adjust the spray program based on field condition
Postharvest					Leaf		Leaf	Phosphite *plus* sulfur Or mancozeb *plus* sulfur	Fixed copper material	Clean-up for the next season. Vines still need leaves for accumulation of carbohydrates for the winter.

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

	Common and key insect pests and monitoring suggestions							
Developmental Stage	**Grape flea beetle**	**Mealybugs**	**Sharpshooters/ Leafhoppers**	**Grape berry moth**	**Mites**	**Japanese beetles**	**Grape root borer**	**Spotted wing drosophila**
Dormant		Scout for mealybugs by looking under the bark.			Examine twigs using a hand lens for European red mite eggs (round reddish-orange eggs)			
Bud swell (bud is visibly swollen but no green or pink tissue is observed)	Check for feeding on unfolding leaves and buds from small, metallic blue-green beetles	Scout for mealybugs by looking under the bark and near base of vine.						
Bud Break and New Shoot		Peel back loose bark on canes and look for the presence of grape mealybug crawlers	Place several double-sided yellow sticky traps per block. Check traps weekly and replace when they become dirty or discolored.					
Prebloom	Check for feeding on leaves and buds from small, metallic blue-green beetles and larvae that are brown with black dots		Continue monitoring with double-sided yellow sticky traps.	Flight periods can be monitored using commercially available pheromone-baited traps. For the first three flights, expect 50% emergence at 187, 869, and				

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

	Common and key insect pests and monitoring suggestions							
Developmental Stage	**Grape flea beetle**	**Mealybugs**	**Sharpshooters/ Leafhoppers**	**Grape berry moth**	**Mites**	**Japanese beetles**	**Grape root borer**	**Spotted wing drosophila**
				1094 Degree Days above a base of 47°F after first male catch.				
Postbloom		Check leaves for sticky honeydew and black sooty mold. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor using commercially available pheromone-baited traps.	Check leaves for chlorotic spots and "bronzing". Using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf			
Fruit set		Check leaves for sticky honeydew and black sooty mold. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor with pheromone-baited traps. Look for webbing in the clusters when berries are small. Larvae will web together multiple berries.	Check leaves for "bronzing" and using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf	Shiny green and copper-colored adults. Feeding "skeletonizes" leaves and is concentrated in the upper part of the vine canopy.		
Berry touch and bunch closure		Check clusters for waxy, white residue between berries and on rachis. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor with pheromone-baited traps. Check berries for holes, webbing, and dark tunneling underneath skin. Check berries	Check leaves for "bronzing" and using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more	Check for beetle aggregations and skeletonized leaves in the upper part of the vine canopy.		

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

	Common and key insect pests and monitoring suggestions							
Developmental Stage	**Grape flea beetle**	**Mealybugs**	**Sharpshooters/ Leafhoppers**	**Grape berry moth**	**Mites**	**Japanese beetles**	**Grape root borer**	**Spotted wing drosophila**
				showing symptoms for larvae.	than 10 mites per leaf			
Pre-veraison		Check clusters for waxy, white residue between berries and on rachis. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor with pheromone-baited traps. Check berries for holes, webbing, and dark tunneling underneath skin. Check berries showing symptoms for larvae.	Check leaves for "bronzing" and using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf	Check for beetle aggregations and skeletonized leaves in the upper part of the vine canopy.	Monitor flight activity using commercially available pheromone-baited traps. Examine soil near base of vine for empty pupal skins.	
Veraison		Check clusters for waxy, white residue between berries and on rachis. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor with pheromone-baited traps. Check berries for holes, webbing, and dark tunneling underneath skin. Check berries showing symptoms for larvae.	Check leaves for "bronzing" and using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf	Check for beetle aggregations and skeletonized leaves in the upper part of the vine canopy. Severe feeding after veraison can have significant impact on fruit quality.		Berries become attractive at 15°Brix. Presence in vineyards can be monitored with homemade traps, commercial lures, and larvae in fruit. Control decisions should be influenced by history

Seasonal ‘at a glance’ insect activity and monitoring options for bunch grapes

	Common and key insect pests and monitoring suggestions							
Developmental Stage	**Grape flea beetle**	**Mealybugs**	**Sharpshooters/ Leafhoppers**	**Grape berry moth**	**Mites**	**Japanese beetles**	**Grape root borer**	**Spotted wing drosophila**
Preharvest		Check clusters for waxy, white residue between berries and on rachis. Often associated with the presence of ants.	Continue monitoring with double-sided yellow sticky traps.	Monitor with pheromone-baited traps. Check berries for holes, webbing, and dark tunneling underneath skin. Check berries showing symptoms for larvae.	Check leaves for “bronzing” and using a hand lens, check the underside of the leaf, along the leaf veins. Manage if more than 10 mites per leaf	Check for beetle aggregations and skeletonized leaves in the upper part of the vine canopy. Severe feeding after veraison can have significant impact on fruit quality.		Presence in vineyards can be monitored with homemade traps, commercial lures, and larvae in fruit. Control decisions should be influenced by history

Weed Management
Grape Vineyards

The primary goal of any weed management program is to minimize competition in order to direct as much 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 has 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.

Vineyard Herbicide Options

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	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	**Oryzalin, MOA 3** Surflan 4 AS or Oryzalin	2 to 6 qt	Newly Planted (once soil has settled after transplanting) and Established Vineyards.	12	Oryzalin may be tank mixed with paraquat, glyphosate, or Rely for postemergence weed control. In established vineyards tank mix with simazine for expanded residual control of annual weeds.
(Continued on next page)	**Pendimethalin MOA 3** Prowl H_2O	2 to 6 qt	Newly Planted (once soil has settled after transplanting) and established vineyards.	12	In newly planted vineyards Prowl may only be applied once soil has settled after transplanting but prior to bud swell. In established vineyards Prowl may be used any time after harvest, through winter, and in the spring. Use rate cannot exceed 6 qt per acre per year. Prowl has a 90 day PHI. Prowl should be tank mixed with paraquat, glyphosate, or glufosinate for postemergence weed control.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
PREEMERGENCE Annual grasses and small seeded broadleaf weeds *(Continued)*	**Pronamide, MOA 3** Kerb 50 WP or Kerb SC	2 to 8 lb 2.5 to 9.5 pt	Fall or winter transplanted grapes established at least 1 year or spring transplanted grapes established at least 6 months.	12	Apply in fall after harvest for cool season perennial grass and small seeded broadleaf weed control. Apply when temperatures do not exceed 55º F. The need for activation is tied directly to air temperature. Under warmer conditions, more degradation and herbicide loss occurs until activated by rainfall or overhead irrigation.
Annual weeds and some perennial weeds	**Dichlobenil, MOA 20** Casoron 4G Or Casoron 1.4 CS	100 to 150 lb 1.4 to 2.8 gal	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. The Casoron CS formulation should only be used under well-established vines (1 year or older). The Casoron 4G formulation may be used as early as 4 weeks after transplanting young vines.
Broadleaf weeds	**Oxyfluorfen, MOA 14** Goal or Galigan or OxiFlo 2 EC	2 to 8 pt	Newly planted (once soil has settled after transplanting) and established vineyards.	24	**DO NOT apply after bud swell.** Use in newly planted vineyards that are trellised and once soil has settled after transplanting.
	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 oryzalin, diuron, or simazine to broaden spectrum of residual control. **DO NOT** apply within 14 days of harvest. Rimsulfuron will provide POST weed control of certain species like horseweed, wild radish, pigweed, chickweed, and henbit. Tank mix with glufosinate, glyphosate, or paraquat for non-selective POST weed control. Tank mixes with glyphosate will provide partial control of yellow nutsedge (2 to 3" tall).

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
PREEMERGENCE 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.
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 oryzalin (Surflan) or norflurazon (Solicam) or pendimethalin (Prowl H_2O) with simazine will extend residual grass control several weeks.
Annual broadleaf and grass weeds *(Continued on next page)*	**Flumioxazin, MOA 14** Chateau 51 SW Tuscany 51 WDG Tuscany SC	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.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
PREEMERGENCE 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.
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 oryzaline for broadspectrum 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.
POSTEMERGENCE DIRECTED					
POSTEMERGENCE DIRECTED Non-selective control	**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 (hrs)	Comments
	Glufosinate, MOA 10 Cheetah Lifeline, Reckon 280 Rely 280 Surmise	48 to 82 oz	Newly planted (shielded) and established vineyards	12	Do not allow herbicide to contact desirable foliage or immature, uncallused bark. Apply in a minimum spray volume of 20 gal./A. **Do not apply within 14 days of harvest.**
	Paraquat, MOA 22 Firestorm, Parazone, or Paraquat Concentrate 3SL Gramoxone SL	1.7 to 2.7 pt 2.5 to 4 pt	Newly planted (shielded) to established vineyards	12	Do not allow herbicide to contact desirable foliage or immature, uncallused bark. Young vines must be shielded. Apply in a minimum spray volume of 20 gal./A with non-ionic surfactant at 0.25 % v/v (1qt per 100 gal. of spray solution).
POSTEMERGENCE DIRECTED Certain broadleaf weeds	**Carfentrazone MOA 14** Aim	1 to 2 fl. oz	Vines established 1 year or longer.	12	Do not allow herbicide to contact desirable fruit or foliage. The addition of a non-ionic surfactant at 0.25 % v/v (1 qt per 100 gal of solution) or crop oil concentrate at 1% v/v (1gal per 100 gal. of solution) is necessary for optimum herbicide performance. Ammonium sulfate may be used in addition to a non-ionic surfactant, refer to label for details. Aim may be tank mixed with glyphosate or Rely or various preemergence herbicides. For chemical removal of suckers use the maximum rate and refer to label for details. Aim has a 3-day PHI.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
POSTEMERGENCE Annual and perennial grasses	**Clethodim, MOA 1** Select, Volunteer, Intensity, and others 2EC SelectMax, Intensity One	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/A per year.

Suggested Herbicide Programs for Grape Vineyards

Crop Age	Fall	Winter	Spring	Summer
Newly Planted	Glyphosate (Pre-Plant to kill weeds in herbicide strip)		Oryzalin	Oryzalin + Paraquat (May or June); Fusilade, or Poast, or Clethodim (as needed).
			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)	Oryzalin + Rimsulfuron + Paraquat, Glyphosate, or Glufosinate (Early May)	Paraquat or Glufosinate (multiple applications as needed)
	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 + Oryzalin (**vines est. 2 yrs**) + glyphosate, paraquat, or Glufosinate	Zeus Prime + Oryzalin + 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 + Oryzalin + Glyphosate, or Karmex + Glyphosate	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
Kerb	G	G	G	G	G	G		P			G		F	F	F	P	F	F		F			P		P	N
Rimsulfuron	F	F	P	P	P	G				G	G	E	G	G	F	E	G	F			G		F		F	
Oryzalin	E	E	E	G	G	G	N	N		F	F		E	F	P	E	P	P	P	P	F	N	P		N	N
Prowl H_2O	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 table below. Additional factors influencing the performance of these herbicides on perennial grasses include spray volume and soil moisture. Graminicides are systemic herbicides, they enter the plant and move through the vascular system to their targeted site of action. Systemic herbicides need to be applied in spray volumes that do not exceed 25 gal. of spray solution per acre. Higher volumes dilute the herbicide and may reduce their effectiveness. Weeds free of stress (drought, etc.) also respond best to systemic herbicides because the herbicide moves into plant and through its vascular system more readily. All of these herbicides require a second application for them to be effective. It is important that the second application be timed appropriately and when the weed has regrown from the initial herbicide application. The time between the first and second application can vary depending upon environmental conditions so this requires monitoring in order to get the second application applied timely.

Appropriate Application Time for Perennial Grass Control

	Bermudagrass		**Johnsongrass**	
Herbicide	**1st Application**	**2nd Application**	**1st Application**	**2nd Application**
Poast	6 inches	4 inches	25 inches	12 inches
Clethodim	3-6 inches	3-6 inches	12-24 inches	6-18 inches
Fusilade	4-8 inches	4-8 inches	8-16 inches	6-12 inches

Refer to product label for spray additive recommendations.

Wildlife Damage Prevention

Pest/Problem	Management Options
Efforts to control birds and other wildlife that damage fruit crops should be focused on the perimeter of the planting first, especially on the side(s) facing favorable wildlife habitat. This is where the first damage will be observed and, in some cases, it may be sufficient to head off the problem. However, don't discontinue monitoring for wildlife damage throughout the planting.	
Birds	Crop losses to birds appear to be increasing in small fruit crops. Not only do birds consume fruit, but the damage they cause can result in increased problems with fruit rots and other pests such as bees and yellow jackets. Several different types of birds can cause problems. Robins, starlings and mockingbirds are among the more common ones, but orioles, cedar waxwings and 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. Birds are federally protected and lethal control methods are not generally available to growers. Non-lethal methods such as exclusion (netting) are often sufficient when properly installed. Visual deterrents are usually ineffective as birds quickly learn to ignore these stimuli. Auditory distress calls and chemical repellents can be more effective. Chemical repellents can impart an off-flavor to the fruit crop.

Wildlife Damage Prevention

Pest/Problem	Management Options
Birds *(Continued)*	**Auditory repellants** Auditory scare devices such as propane cannons, noise makers or distress calls may offer temporary relief for some types of birds. Regardless of which one or ones is/are used, the following points should be considered to attain the best results: - Assess the potential for objections to the noise from your neighbors. - Start before birds establish a feeding pattern. - Operate control devices beginning shortly before sunrise and continuing until just after sunset, as early and late in the day may be the most intense feeding times. - Vary the frequency, the direction and the timing in which auditory devices are operated. Propane cannons should not be fired at intervals closer than 3 minutes. - Consider using more than one type of auditory device and possibly combine them with visual repellents. - If using distress calls, it is essential to identify the type(s) of birds you want to discourage and get distress calls specific to them. - Reinforce the sense of danger by shooting (if allowed). **Visual repellants** Visual repellents include such things as scare eyes suspended above the crop, mylar tape on the canopy of the crop, aluminum pie pans, plastic owls and plastic snakes. These range from ineffective to moderately effective for a short period of time. Birds will get used to them quickly if they are not moved around or if another type of repellent is not used along with it. Yellow scare 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 repellants Methyl anthranilate is registered as a bird repellent. While it is sometimes advertised as a taste repellent, this is not exactly correct. When sprayed on a crop, it causes an unpleasant sensation in the bird's mouth. Methyl anthranilate is a naturally occurring material used in the food service industry. Early reports have been inconsistent in regards to its effectiveness. It has also been reported to impart an undesirable foxy flavor to certain grape cultivars. Methyl anthranilate has a short residual, so frequent reapplication will be necessary to achieve lasting results. Results may vary depending on the type of birds. Combining with another type of deterrent may result in greater effect than when used alone. As with other types of deterrents, applications need to start before birds establish feeding patterns. **Exclusion** Exclusion (netting) is the only consistently effective method of reducing bird damage. Netting is more expensive than other types of deterrents and can require fair amounts of labor, so it may not be an economically viable alternative in all situations. Nets are either laid on the canopy of the crop or suspended from a framework over the crop. The fruiting area of the plant needs to be completely protected. Birds will enter the canopy of the plant from below the net if it is open under the plant. If used with care, nets can be maintained for use over several years. For crops requiring multiple harvests such as blueberry, suspending the netting over the crop and around the sides of the field will allow easier access to the crop. If nets are placed directly on the crop canopy, birds can perch on it and feed on berries below them. Wild turkeys are becoming more of a problem in many areas of the country. While there is no doubt that they do consume some fruit, some research has shown that the turkeys are often after insects instead of the fruit. They do not appear to like loud and/or distressing sounds. While netting will work, turkeys can tear holes in it for access to the fruit.

Wildlife Damage Prevention

Pest/Problem	Management Options
Deer	Deer can damage small fruit plantings by foraging on succulent new growth during the growing season or by eating fruit. In fall, bucks can damage plants by rubbing their antlers on stems and stalks. This is more of a problem in tree fruits than small fruits. Deer can also puncture plastic mulch and possibly the irrigation tape underneath, resulting in loss of weed control. Deer numbers are increasing and incidents of deer damaging crops are also increasing. Deer populations are increasing across most of their range. Hunting on neighboring properties can reduce local damage but neighboring hunting clubs may be actively working to increase deer populations. Locating the planting away from favorable habitat for deer will help to lessen losses. However, this is not generally possible; deer travel 1 to 1.5 miles and it is highly unlikely that anyone can locate plantings sufficiently far from suitable habitat. Several control options do exist. Determining which one or ones to use depends on the deer population, availability of other food sources, location of favorable habitat, the duration for which protection is needed, and the value of the crop to be protected.
	Repellants Both taste and smell repellents exist. Smell repellents include commercially available products or materials such as tankage, blood, putrified egg solids, and certain soaps. Repellants will not provide long-term control and will not provide control when populations are high or alternate food sources are scarce. **Exclusion** Exclusion (fencing) is the only truly effective long-term control for deer damage prevention. Fences can be electrified or not. Deer will try to go under a fence, through a fence, or over it. For non-electrified fences, the lowest wire needs to be within 10 inches or less of the lowest point in the ground around the fruit crop planting and tight enough to prevent deer from pushing under it. Do not neglect ditches or other low spots in the ground around the field, because the deer will find them. While some deer can easily clear an 8 foot fence, generally 6 feet will be sufficient to deter most deer. Wire mesh fences are more desirable than multiple strands of barbed wire. Wire mesh fence up to 5-feet high with the addition of 3 single strand wires for a total of 8 feet will reduce costs.

Wildlife Damage Prevention

Pest/Problem	Management Options
Deer (cont.)	For electric fences, several different designs have been used and, under certain conditions, each can be effective. The simplest and least expensive electric fence uses a single high-tensile wire at about 30 inches 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 inches 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 feet 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.

USER NOTES

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