Southeast Regional Bunch Grape Integrated Management Guide

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Bunch Grape Integrated Management Guide (Insect and Disease Control)

Establishment

Site selection – Site selection may be the most important decision of the thousands of decisions that will be made over the life of a vineyard. Virtually every aspect of production and marketing will, in some aspect, be affected by site. 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, potentially, 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. The presence of wild grapevines near the site may increase problems with certain pests of grapes. Adjacent woodlands, brushy areas and power lines may be good nesting and roosting sites for birds, which can cause significant damage to crops.

Site development – Once a site has been selected, ample time should be devoted to preparing the site well in advance of planting. Hedgerows, overgrown fencerows or any other obstacles 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 strip 3 to 4 feet wide 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 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 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.

Bunch Grape (continued)

Dormant

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. Prunings 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 prunings. The time to prune depends on the amount of labor available, the size of the vineyards, fruitfulness of the variety 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.

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

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Black rot Bitter rot Phomopsis Ripe rot	Prune out mummies, cankers, dead wood		*****			Removal of mummies, rachises, and cankered and dead wood is very important to reduce the inoculum of rot fungi.
Downy mildew	Shred, remove or bury leaves		*****			By shredding leaves with a flail mower, burying them by cultivation, or removing them, the inoculum of the downy mildew fungus will be reduced.
Anthracnose and Phomopsis	lime sulfur	10.0 gal	+++	48 hrs	0 days	A dormant spray of lime sulfur is needed only if anthracnose is a problem. Sufficient water should be used to thoroughly wet the vines. This spray may help reduce the overwintering inoculum of the powdery mildew fungus.

Bunch Grape (continued)

Budbreak and new shoot sprays (7-10 day interval from 1-inch shoot growth until prebloom)

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. The best time to apply nitrogen to the soil in vineyards is between budbreak and 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. The ideal nutrient management plan for vineyards takes into account the following factors: (1) **Soil testing** – soil tests should be conducted every 2 to 3 years after planting. Samples should be collected from 1 to 8 inches in depth. Results from soil tests may be useful in understanding results from petiole testing. (2) **Tissue analysis** – petioles should be collected 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 variety 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. 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.

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Phomopsis Black rot Powdery mildew Downy mildew	mancozeb (various formulations) + sulfur (various formulations)	see label see label	++++	24 hrs	66 days	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. Include a fungicide for powdery mildew control in subsequent sprays (sulfur, Nova, Elite, Procure or Rubigan). Avoid sulfur on sulfur sensitive varieties. The activity of sulfur is reduced at temperatures less than 65°F. Some sulfur injury may occur if temperatures are greater than 85°F.

Bunch Grape (continued)

Budbreak and new shoot sprays (7-10 day interval from 1-inch shoot growth until prebloom; continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Phomopsis Black rot Powdery mildew Downy mildew (continued)	mancozeb (various formulations) + myclobutanil (Nova 40W)	see label 4-5 oz	+++++	24 hrs	66 days	To avoid resistance of the powdery mildew fungus to sterol inhibiting fungicides (SI fungicides, Nova, Rubigan, Elite, and Procure), limit their use to three applications a year, and use the maximum labeled rate/acre. For these applications, mancozeb is combined with the other fungicides as indicated. The REI and PHI refer to the most stringent aspect of the combined spray; mancozeb drives both the REI and the PHI for this application.
	mancozeb (various formulations) + tebuconazole (Elite 45DF)	see label 4 oz	++++	24 hrs	66 days	
	mancozeb (various formulations) + fenarimol (Rubigan 1E)	see label 3 fl oz	++++	24 hrs	66 days	
	mancozeb (various formulations) + triflumizole (Procure 50WS)	see label 4-8 oz	++++	24 hrs	66 days	

Bunch Grape (continued)

Prebloom

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 al late as veraison. The earlier that it is done, the more pronounced the effects will be. Cluster should be removed on short shoots as there may not be sufficient leaf area to ripen the fruit. Third clusters on a shoot should be removed and, if 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.

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Phomopsis Black rot Powdery mildew Downy mildew	mancozeb (various formulations) + sulfur (various formulations)	see label see label	++++	24 hrs	66 days	This is one of the most important sprays for powdery mildew, phomopsis, and black rot. If black rot is a problem, combine mancozeb with Nova or Elite. Nova and Elite are more active on black rot than Procure or Rubigan. Abound is more active on downy mildew than Flint or Sovran.
	mancozeb (various formulations) + tebuconazole (Elite 45DF)	see label 4 oz	++++	24 hrs	66 days	For these applications, mancozeb can be is combined with the other fungicides as indicated. The REI and PHI refer to the most stringent aspect of the combined spray; mancozeb drives both the REI and the PHI for this application.
	mancozeb (various formulations) + fenarimol (Rubigan 1E)	see label 3 fl oz	++++	24 hrs	66 days	
	mancozeb (various formulations) + triflumizole (Procure 50WS)	see label 4-8 oz	++++	24 hrs	66 days	
	azoxystrobin (Abound 2SC)	11-15.4 fl oz	+++++	12 hrs	14 days	

Bunch Grape (continued)

Prebloom (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Phomopsis Black rot Powdery mildew Downy mildew (continued)	kresoxim-methyl (Sovran 50WG)	3.2-4.0 oz	++++	12 hrs	14 days	
	trifloxystrobin (Flint 50WG)	1.5-2.0 oz	++++	12 hrs	14 days	Do not use Flint on Concords.
	boscalid + paraclostrobin (Pristine 38WG)	8.0-10.5 oz	+++++	24 hrs	14 days	Do not apply Pristine to Concord, Worden, Fredonia, Niagara or related grape varieties due to possible injury.
Berry moth Leafhopper Flea beetle Aphid	carbaryl (Sevin 80 WP)	1 lb	++	12 hrs	14 days	Sevin will not control aphids.
	malathion (Malathion 25 WP)	4 lb	++	12hrs	14 days	
	methomyl (Lannate 1.8 L)	1-2 2 qt	++	7 days	14 days	
	pyrellin EC	1-2 pt	+	12 hrs	14 days	May be used alone or in combination. Acts as an exciter.
	pyrellin 2L	4 pt	+	12 hrs	14 days	
	pyrellin 2S	4 pt	+	12 hrs	14 days	
	fenpropathrin (Danitol 2.4 EC)	5.33 to 10.66 fl oz	++	24 hrs	14 days	Do not apply within 21 days of harvest.
Downy mildew only	mefenoxan + copper (Ridomil gold copper)	2.0 lbs	+++++	48 hrs	66 days	Ridomil products provide excellent 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.
	Mefenoxan + manzate (Ridomil gold MZ)	2.5 lbs	+++++	48 hrs	66 days	

Bunch Grape (continued)

Bloom

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Botrytis	iprodione (Rovral 50 WP)	1-2 lb	+++	12 hrs	7 days	A spray for botrytis during bloom may be beneficial in the wet seasons and in blocks with a botrytis problem. Rovral, Vangard, Endura and Elevate should be rotated through the season when needed to avoid resistance development. See product label for complete information on resistance management and use restrictions.
	Iprodione (Rovral 4F)	1-2 pt	+++	12 hrs	7 days	
	cyrpodinil (Vangard 75WG)	10 oz	+++++	12 hrs	7 days	
	fenheximide (Elevate 50WDG)	1 lb	+++++	12 hrs	0 days	
	boscalid + pyraclostrobin (Pristine 38WG)	18.5-23 oz	+++++	24 hrs	14 days	Pristine also has activity on black rot, phomopsis, downy mildew, and powdery mildew. Do not apply to Concord, Worden, Fredonia, or Niagara.
	Boscalid (Endura 30WG)	8 oz	+++++	12 hrs	14 days	Endura will also control powdery mildew.
Postbloom (10-14 days after the prebloom spray)						
Phomopsis Black rot Powdery mildew Downy mildew Bitter rot Ripe rot	mancozeb (various formulations) + myclobutanil (Nova 40W)	see label 3-5 oz	+++++	24 hrs	66 days	Very important spray for black rot, phomopsis, and powdery mildew control. If downy mildew is a problem, substitute Ridomil Gold MZ at 2.5 lb/acre for mancozeb. Do not apply more than 4 total sprays per season of Abound, Sovran or Flint. Do not make more than 6 applications of Pristine or Pristine and Flint, Sovran and Abound. Do not make more than 2 sequential applications of QoI fungicides (Flint, Sovran, Abound or Pristine).
	Mancozeb (various formulations) + tebuconazole (Elite 45DF)	see label 4 oz	++++	24 hrs	66 days	
	azoxystrobin (Abound 2SC)	11-15.4 fl oz	+++++	12 hrs	14 days	

Bunch Grape (continued)

Postbloom (continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Phomopsis Black rot Powdery mildew Downy mildew Bitter rot Ripe rot (continued)	kresoxim-methyl (Sovran 50WG)	3.2-4.8 oz	++++	12 hrs	14 days	
	trifloxystrobin (Flint 50WG)	2.0 oz	++++	12 hrs	14 days	Do not use Flint on Concords.
	Boscalid + paraclostrobin (Pristine 38WG)	8.0-10.5 oz	+++++	24 hrs	14 days	Do not apply Pristine to Concord, Worden, Fredonia, Niagara or related grape varieties due to possible injury.
	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. Pull leaves (north and east sides), position/tuck shoots, top and hedge as needed 18 to 24 inches above the top wire.
Downy mildew only	mefenoxan + copper (Ridomil gold copper)	2.0 lbs	+++++	48 hrs	66 days	Ridomil products provide excellent 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.
	Mefenoxan + manzate (Ridomil gold MZ)	2.5 lbs	+++++	48 hrs	66 days	

Bunch Grape (continued)

Fruit set

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 varieties, especially white-fruited varieties, sunscald can be a problem. Removing leaves on the east side of a north – south oriented row, but not on the west side, may give some of the advantages of leaf removal while reducing the incidence of sunscald. 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.

First cover (10-14 days after the postbloom spray)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Phomopsis Black rot Powdery mildew Downy mildew Bitter rot Ripe rot	captan (various formulations) + myclobutanil (Nova 40W)	see label 4-5 oz	+++++	96 hrs	14 days	
	captan (various formulations) + tebuconazole (Elite 45DF)	see label 4 oz	+++++	96 hrs	14 days	
	mancozeb (various formulations) + myclobutanil (Nova 40W)	see label 3-5 oz	+++++	24 hrs	66 days	
	mancozeb (various formulations) + tebuconazole (Elite 45DF)	see label 4 oz	+++++	24 hrs	66 days	

Bunch Grape (continued)

First cover (10-14 days after the postbloom spray; continued)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Downy mildew	phosphorous acid (ProPhyt)	2.4 pt	+++++	4 hrs	0 days	These phosphorous acid-based products are not very good protectants, but they are good eradicants and have pre- and post-symptom activity.
	phosphorous acid (Phostrol)	2.5-5 pt	+++++	4 hrs	0 days	

Closing

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Botrytis	Same as **Bloom**		++++			At closing, add Rovral or Vangard or Endura or Elevate to the appropriate cover spray for botrytis control. See **Bloom Spray** for information on resistance management when using Rovral, Vangard, Endura, and Elevate.
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.
Berry moth, Leafhopper, Japanese beetle, June beetle	carbaryl (Sevin 80WP)	1.25 lb	++	12 hrs	66 days	Use high rate for Japanese beetles.
	malathion (Malathion 25WP)	4 lb	++	12 hrs	66 days	
	phosmet (Imidan 70WP)	1.33-2.125 lb	++	24 hrs	66 days	
	pyrellin EC	1-2 pt	+	12 hrs	66 days	May be used alone or in combination. Acts as an exciter.
	pyrellin 2L	4 pt	+	12 hrs	66 days	
	pyrellin 2S	4 pt	+	12 hrs	66 days	

Bunch Grape (continued)

Second and subsequent cover sprays (10-14 day intervals until the preharvest spray)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Ripe rot Bitter rot	captan (Captan 50W)	2-4 lb	+++++	96 hrs	0 days	
	Captan (Captan 4L)	1-2 qt	+++++	96 hrs	0 days	
Downy mildew	phosphorous acid (ProPhyt)	2.4 pt	+++++	4 hrs	0 days	These phosphorous acid-based products are not very good protectants, but they are good eradicants and have pre- and post-symptom activity.
	phosphorous acid (Phostrol)	2.5-5 pt	+++++	4 hrs	0 days	Additional sprays for downy mildew may be necessary if conditions are favorable for development.
Powdery mildew	sulfur (various formulations)	see label	++++	24 hrs	0 days	If additional sprays are needed for powdery mildew control, use sulfur. On sulfur –intolerant varieties, and when temperature exceeds 85^{o}F, use Quintec or a SI fungicide (Nova, Elite, Procure, or Rubigan). Rotate Quintec and SI fungicides to avoid resistance development. Do not make more than 5 applications of Quintec per year. If combined with captan, the REI for each combination is 96 hours.
	myclobutanil (Nova 40W)	4-5 oz	+++++	24 hrs	14 days	
	tebuconazole (Elite 45DF)	4 oz	++++	12 hrs	14 days	
	fenarimol (Rubigan 1E)	3 fl oz	++++	24 hrs	30 days	
	triflumizole (Procure 50WS)	4-8 oz	++++	24 hrs	7 days	
	quinoxyfen (Quintec 2SC)	3-4 oz	+++++	12 hrs	14 days	
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.

Bunch Grape (continued)

Borer control

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Grape root borer	chloropyrifos (Lorsban 4 E)	4.5 pt	++	24 hrs	35 days	Apply 2 qt dilute mixture to soil at base of vine. Make a single application 35 days before harvest. Spray should not contact fruit or foliage. Application can be made with flood nozzles and low pressure (40 to 60 psi).
	Cultivation or mounding soil		**			Use clean cultivation, mound soil (Aug 1) or use plastic mulch 3 ft from the base of vines. This practice will inhibit adult emergence from the soil when well timed.

Mite control

Mites	dicofol (Kelthane 35WP)	1.33 lb	+	12 hrs	7 days	Scout for mites throughout the season. Yellowing or speckling of leaves is an indicator, but a hand lense is necessary for positive identification.
	dicofol (Kelthane 4 MF)	1.33 oz	+	12 hrs	7 days	
	pyridiben (Pyramite 60 WP)	8.8-13.2 oz	++			The maximum amount of pyridiben allowed per acre per season is 26.4 oz.

Veraison

Botrytis	same as **Bloom**		+++++			

Bunch Grape (continued)

Preharvest (10-14 days before harvest)

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Ripe rot Bitter rot Botrytis	captan (various formulations) + iprodione (Rovral 50WP)	see label 1-2 lb	+++++	96 hrs	7 days	REIs and PHIs reflect the combination; captan alone has a 96-hour REI and 0 hour PHI. REIs and PHIs for Rovral, Vangard, Elevate and Endura, applied alone, are 48 hours and 7 days, 12 hours and 7 days, 12 hours and 0 days and 12 hours and 14 days respectfully.
	captan (various formulations) + cyprodinil (Vangard 75WDG)	see label 10 oz	+++++	96 hrs	7 days	
	captan (various formulations) + fenhexamid (Elevate 50WDG)	see label 1 lb	+++++	96 hrs	0 days	
	boscalid + paraclostrobin (Pristine 38WG)	18.5-23 oz	+++++	24 hrs	14 days	Do not apply Pristine to Concord, Worden, Fredonia, Niagara or related grape varieties due to possible injury.
	azoxystrobin (Abound 2SC)	15.4 fl oz	+++++	12 hrs	14 days	For suppression of Botrytis. When used in the preharvest spray, good control of Botrytis has been obtained in multiple field trials.
	kresoxim-methyl (Sovran 50WG)	4.8 oz	++++	12 hrs	14 days	For suppression of Botrytis. Good control of Botrytis has been obtained in multiple field trials, but the label recommends use of effective Botryticides.
	trifloxystrobin (Flint 50WG)	3.0 oz	++++	12 hrs	14 days	Do not use Flint on Concords.

Bunch Grape (continued)

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

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness (+) or Importance (*)	REI	PHI	Comments
Downy mildew	copper compounds (various formulations)	see label	++++	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 varieties for downy mildew control.
	mancozeb (various formulations)	see label	++++	4 hrs	----	
	phosphorous acid (ProPhyt)	2.4 pt	+++++	4 hrs	----	
	phosphorous acid (Phostrol)	2.5-5 pt	+++++	4 hrs	----	

Efficacy of selected fungicides against diseases of bunch grapes						
Fungicide	**Black rot**	**Bitter rot**	**Botrytis rot**	**Downy mildew**	**Phomopsis cane and leaf spot**	**Powdery mildew**
Azoxystrobin **(Abound)**	+++++[a]	+++++	+++	+++++	+++	+++++
Boscalid + Paraclostrobin **(Pristine)**	+++++	+++++	+++++	+++++	+++++	+++++
Captan **(Captan, Captec)**	+++	+++++	++	++++	+++++	**NA**
Cyprodinil **(Vangard)**	**NA**	**NA**	+++++	**NA**	**NA**	++
Fenhexamid **(Elevate)**	**NA**	**NA**	+++++	**NA**	**NA**	**NA**
Ferbam	+++++	+++	**NA**	++	++	**NA**
Finarimol **(Rubigan)**	++	**NA**	**NA**	**NA**	**NA**	+++++
Fixed Copper and Lime (Bordeaux mixture)	+++	++	+++	++++	++	+++
Iprodione **(Rovral)**	**NA**	**NA**	+++	**NA**	**NA**	**NA**
Kresoxim-methyl **(Sovran)**	+++++	+++++	++	+++	+++	+++++
Mancozeb, Maneb	+++++	+++++	**NA**	+++++	+++++	**NA**
Mefanoxam + Copper **(Ridomil Gold Copper)**	++	++	++	+++++	++	+++
Mefanoxam + Mancozeb **(Ridomil Gold MZ)**	+++++	+++++	**NA**	+++++	+++++	**NA**
Myclobutanil **(Nova)**	+++++	++	**NA**	**NA**	**NA**	+++++
Sulfur[b]	**NA**	**NA**	**NA**	**NA**	++	+++++
Tebuconazole **(Elite)**	+++++	**NA**	**NA**	**NA**	**NA**	+++++
Thiophanate-methyl **(Topsin M)**	++	+++	+++	**NA**	+++	+++++
Trifloxystrobin **(Flint)**	+++++	+++++	++++	+++	++	+++++
Triflumazole (**Procure)**	+++	**NA**	**NA**	**NA**	**NA**	+++++
Ziram	+++++	**NA**	++	++++	+++	**NA**

[a]NA = no significant activity, ??? = unknown activity; + = very limited activity, ++ = limited activity, +++ = moderate activity, ++++ = good activity, +++++ = excellent activity.
[b]Sulfur will cause burn on sensitive varieties, especially on hot days.

Fungicide classes with high risk of resistance development (generally single sites of action)	
Anilinopyrimidines	Vangard (cyprodinil)
Benzimidazoles	Topsin M (thiophanate methyl)
Carboximide	Pristine (boscalid; one component of a two-part mixture)
Demethylation Inhibitors (DMI=s) or Sterol Inhibitors	Bayleton (triadimefon) Elite (tebuconazole) Nova (myclobutanil) Procure (triflumizole) Rubigan (fenarimol)
Dicarboximides	Rovral (iprodione)
Hydroxyanelides	Elevate (fenhexamid)
Phenylamides	Ridomil Gold (mefanoxam)
Strobilurins or QoI (Quinine outside Inhibitors)	Abound (azoxystrobin) Flint (trifloxystrobin) Pristine (pyroclostrobin; one component of a two-part mixture) Sovran (kresoxim-methyl)
Fungicide classes with low risk of resistance development (generally multiple sites of action)	
Several Classes	Captan (Captan or Captec) Coppers (numerous formulations) Carbamate (ferbam) Dithane, Manzate (mancozeb) Maneb, Manex (maneb) Thiram (thiram) Ziram (ziram)

Seasonal 'at a glance' fungicidal spray schedule options for bunch grapes							
Developmental Stage	**Dormant[a]**	**Budbreak and New Shoot Sprays[b]**	**Prebloom**	**Bloom[d]**	**Postbloom**	**First Cover**	**Closing[f]**
Disease Controlled (Fungicides)	**Anthracnose and Phomopsis (Lime Sulfur)**	**Phomopsis, Black Rot, Powdery Mildew, and Downy Mildew (mancozeb [various formulations] + sulfur[c] [various formulations], or mancozeb + Nova, or mancozeb + Elite, or mancozeb + Procure)**	**Phomopsis, Black Rot, Powdery Mildew, and Downy Mildew (mancozeb [various formulations] + sulfur[c] [various formulations], or mancozeb + Elite, or mancozeb + Rubigan, or mancozeb + Procure, or Abound, or Sovran, or Flint, or Pristine)**	**Botrytis (Rovral or Vangard or Scala or Elevate or Pristine or Endura)**	**Phomopsis, Black Rot, Powdery Mildew, Downy Mildew, Bitter Rot, and Ripe Rot (mancozeb [various formulations] + Nova, or mancozeb + Elite, or Abound, or Sovran, or Flint, or Pristine);** **Downy Mildew [only] (Ridomil Gold Copper or MZ)[e]**	**Phomopsis, Black Rot, Powdery Mildew, Downy Mildew, Bitter Rot, Ripe Rot (captan [various formulations] + Nova, or captan + Elite, or mancozeb [various formulations] + Nova, or mancozeb + Elite);** **Downy Mildew [only] (ProPhyt or Phostrol)**	**Botrytis (Rovral or Vangard or Scala or Elevate or Pristine or Endura)**

(CONTINUED ON NEXT PAGE)

Seasonal 'at a glance' fungicidal spray schedule options for bunch grapes (continued)				
Developmental Stage	**Second and Subsequent Cover Sprays**	**Veraison [g]**	**Preharvest**	**Postharvest**
Disease Controlled (Fungicides)	**Ripe Rot and Bitter Rot (captan [various formulations])** **Downy Mildew (ProPhyt or Phostrol)** **Powdery Mildew (sulfur [various formulations], or Nova, or Elite, or Rubigan, or Procure, or Quintec)**	**Botrytis (Rovral or Vangard or Elevate or Pristine or Endura)**	**Ripe Rot, Bitter Rot, and Botrytis (captan [various formulations] + Rovral, or captan + Vangard, or captan + Elevate, or Pristine, or Abound, or Sovran, or Flint)**	**Downy Mildew (copper compounds [various formulations], or mancozeb [various formulations], or ProPhyt, or Phostrol)** **Powdery Mildew (sulfur [various formulations] or JMS Stylet Oil)**

[a]Lime sulfur is very effective for control of Phomopsis. Do not apply this once the leaf buds start to push; late applications will result in damage to leaves. Think about when bud break normally occurs, and back the application off by a 2-3 week period. This application may also reduce powdery mildew inoculum.

[b]In order to avoid Phomopsis in the Southeast, applications should be made very early (even less than one inch shoot growth).

[c]Sulfur has good activity for control of powdery mildew, but it can be damaging on certain grape varieties, such as Concord, Norton and Chambourcin. It should not be applied when temperatures are above 85° F.

[d]Unless using Pristine, if the bloom interval exceeds 10-14 days from the prebloom spray, consider using either Mancozeb or Captan as well as the more efficacious Botrytis-control materials listed for the bloom spray. These will provide disease control for diseases other than Botrytis.

[e]Ridomil Gold Copper or MZ provide excellent activity against downy mildew. However, only one or two applications are recommended per year, due to potential resistance issues. In general, other products should be utilized till downy mildew symptoms are first observed or environmental conditions are very conducive; if observed, use Ridomil immediately.

[f]Unless using Pristine, add appropriate cover spray materials for control of diseases other than Botrytis if more than 10-14 days from the last cover spray application.

[g]Unless using Pristine, add appropriate cover spray materials for control of diseases other than Botrytis if more than 10-14 days from the last cover spray application.

Weed Management

Grape Vineyards

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
PREPLANT/ SITE PREPARATION	**Glyphosate** Roundup WeatherMax 5.5 SL or Various Generic Formulations 4 SL	1.4 to 2.8 pt 1 to 2 qt	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** Surflan 4 AS or FarmSaver Oryzalin	2 to 4 qt	Newly Planted (once soil has settled after transplanting) and Established Vineyards.	12	Surflan or FarmSaver 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.
	Pendimethalin Prowl 3.3 EC or Prowl H2O	2.4 to 4.8 qt 2 to 4 qt	Newly Planted (once soil has settled after transplanting). DO NOT apply to bearing grapes.	12	Prowl should be tank mixed with paraquat, glyphosate, or Rely for postemergence weed control.
	Pronamide Kerb 50 WP	2 to 8 lb	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 55^{o} F.
PREEMERGENCE Annual grasses and small seeded broadleaf weeds (Continued)	**Norflurazon** Solicam 80 DF	1.25 to 5 lb	Grapes established 2 years.	12	Apply in fall or winter to vineyards having sandy loam or coarser textured soils. Tank mix with glyphosate, paraquat or Rely for control of emerged weeds. Residual control is expanded when Solicam is tank mixed with simazine or Karmex.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
PREEMERGENCE Annual weeds and some perennial weeds	**Dichlobenil** Casoron 4G	100 to 150 lb	Newly planted (4 wks after transplanting) and established vineyards.	12	Apply in January or February for best results. Warm temperatures increase volatilization therefore overhead irrigation may be use for activation when applied in early spring.
PREEMERGENCE Broadleaf weeds	**Isoxaben** Gallery	0.66 to 1.33 lb	Newly planted (once soil has settled after transplanting) or non-bearing vineyards only.	12	Apply in at least 10 gallons of spray solution per acre. Tank mix with Surflan for broad spectrum residual control. In newly planted vineyards apply once soil settles after transplanting.
	Oxyfluorfen 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.
PREEMERGENCE Broadleaf weeds and some annual grasses	**Diuron** Karmex 80 DF Or Direx 80 DF	2 to 3 lb	Vines established at least 3 years.	12	Rainfall soon after application to soils low in clay and <2% organic matter may result in injury. Apply with glyphosate, paraquat or Rely for postemgence weed control.
	Simazine 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 Rely for postemergence weed control. The addition of oryzalin (Surflan) or norflurazon (Solicam) with simazine will extend residual grass control several weeks.
PREEMERGENCE Annual broadleaf and grass weeds	**Flumioxazin** Chateau 51 WDG	6 to 12 oz	Newly planted and established vineyards	12	Do not apply to grapes established less than 2 years unless they are trellised at least 3 ft. from the soil surface. Newly planted vines must be protected from contact with grow tubes or some other shield. Applications after flowering in bearing vineyards must be made with hooded or shielded application equipment. Do not apply within 60 days of harvest. Tank mix with glyphosate, paraquat, or Rely for broadspectrum post-emergence weed control. Chateau performs best when an initial application is made in the spring (6 to 8 oz/A) followed by a second application (6 to 8 oz/A) when control from initial application fails. Do not apply sequential within 30 days of initial application. Do not apply more than 6 oz/A per application on soil that has a sand plus gravel content over 80% if trees or vines are less than 3 years of age.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
POSTEMERGENCE Non-selective control	**Glyphosate** Roundup WeatherMax 5.5 SL or Various Generic Formulations 4 SL	1.4 to 2.8 pt 1 to 2 qt	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.
POSTEMERGENCE Non-selective control (Continued)	**Glufosinate** Rely 1L	3 to 5 qt	Newly planted (shielded) and established vineyards	12	Do not allow herbicide to contact desirable foliage or immature, uncallused bark. Rely may be used for grape sucker control. Refer to label for details. Apply in a minimum spray volume of 20 gal./A. **Do not apply within 14 days of harvest.**
	Paraquat Gramoxone Max 3 SL	1.7 to 2.7 pt	Newly planted (shielded) to established vineyards	12	Do not allow herbicide to contact desirable foliage or immature, uncallused bark. Young vines must be shielded. Apply in a minimum spray volume of 20 gal./A with non-ionic surfactant at 0.25 % v/v (1qt per 100 gal. of spray solution).
POSTEMERGENCE Broadleaf weeds and yellow nutsedge	**Bentazon** Basagran	1.5 to 2 pt	Newly planted or non-bearing vineyards	48	Apply in a minimum spray volume of 20 gal./A. Add 2 pt of crop oil concentrate per acre for optimum results. Timely, sequential applications will control yellow nutsedge. Refer to label for details.
POSTEMERGENCE Annual and perennial grasses	**Clethodim** Select 2EC or Arrow 2EC	6 to 8 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.
	Fluazifop 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.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
POSTEMERGENCE Annual and perennial grasses (Continued)	**Sethoxydim** 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 can not exceed 5 pt/A per year.

Suggested Herbicide Programs

Grape Vineyards

Crop Age	Fall	Winter	Spring	Summer
Newly Planted			Oryzalin (Once soil settles after transplanting)	Oryzalin + Paraquat (May or June); Fusilade, or Poast, or Select (as needed).
			Chateau (Once soil settles after transplanting)	Chateau + Paraquat (June or July); Fusilade, or Poast, or Select (as needed).
			Prowl 3.3 or H2O (vines must be dormant)	Paraquat (multiple applications as needed); Fusilade, or Poast, or Select (as needed)
Vines Established 1 to 2 years	Glyphosate (spot treat for perennial weeds)	Glyphosate (Mid March)	Oryzalin + Paraquat, glyphosate, or Rely (Early May)	Paraquat or Rely (multiple applications as needed)
	Glyphosate (spot treat for perennial weeds)	Chateau + glyphosate, paraquat or Rely (mid to late March)	Chateau + glyphosate, paraquat or Rely (early June)	Poast (as needed for POST grass control)
	Glyphosate (spot treat for perennial weeds)	Solicam (vines est. 2 yrs) + glyphosate, paraquat, or Rely		Glyphosate, paraquat, Rely, or Poast (as needed)
Vines Established 3 years or more	Glyphosate (spot treat for perennial weeds)	Glyphosate (mid March)	Simazine + oryzalin + glyphosate, or Karmex + glyphosate	Paraquat, Rely, or Poast (as needed)
	Glyphosate (spot treat for perennial weeds)	Chateau + glyphosate (mid to late March)	Chateau + glyphosate (early June)	Poast (as needed for POST grass control)
	Glyphosate (spot treat for perennial weeds); Simazine + paraquat or Rely (after harvest)		Chateau + glyphosate (mid to late May)	Paraquat, Rely, or Poast (as needed)