

2010 Southeast Regional Muscadine Grape Integrated Management Guide

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Recommendations are based on information from the manufacturer's label and performance data from research and extension field tests.

Because environmental conditions and grower application methods vary widely, suggested use does not imply that performance of the pesticide will always conform to the safety and pest control standards indicated by experimental data.

This publication is intended for use only as a guide. Specific rates and application methods are on the pesticide label, and these are subject to change at any time. Always refer to and read the pesticide label before making any application! The pesticide label supercedes any information contained in this guide, and it is the legal document referenced for application standards.

Muscadine Grape Integrated Management Guide

Dormant

Winter pruning – Proper pruning aids in disease management. Hedge or hand prune vines, leaving only 3-4” stubs (spurs) of 1-yr-old wood protruding from the main cordon or previous season’s wood. Selectively thin these spurs or spur clusters to space them approximately 4-6” along the cordon. As the vines age, remove some of the older spur clusters when crowding occurs. Young vines (1-4 yrs old) require special attention to remove grape tendrils that wrap around the new cordon. If not removed, these tendrils will girdle and kill the newly-trained arm. After the 3rd or 4th year, the cordon becomes too thick for tendrils to wrap around it, and this girdling ceases to be a threat. Late winter is the best time to prune muscadines in areas subject to winter injury.

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-iveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
Rots and foliage diseases	Sanitation and pruning		+++				Control weeds under vines with chemicals or mowing; trim vines if needed, so shoots terminate at least 18-24” from the ground. This will promote air movement and drying under vines.

Prebloom (Bud break till bloom)

Angular leafspot – (*Mycosphaerella angulata*) has great potential to limit yield. It causes leaf spotting that leads to rapid defoliation. When a muscadine vine defoliates prior to harvest, development of fruit ceases. Total crop loss may occur. Fortunately, angular leafspot is easy to control with either mancozeb or captan. In wet seasons, however, control may be expensive due to the need for repeated fungicide applications.

Dieback “dead arm” diseases – Fungal dieback diseases (caused by *Botryosphaeria*, *Phomopsis*, *Fusicoccum*, etc.) can quickly kill even mature plants. These diseases are often observed on plants as they come out of dormancy or following initial fruit swell. Symptoms are observed as a rapid death of the plant from the growing cordon tips back towards the main trunk. The disease organisms which cause these dieback diseases reside in pruning or other wounds, and they are generally present on all muscadines. Plant stress triggers the reaction which allows the disease organisms to further invade and kill a plant. Any actions to reduce plant stress throughout the year will be helpful (irrigation, proper fertilization, etc.). Cold injury may also trigger these “dead arm” diseases by causing wounds to trunks and cordons. Spraying with fungicides immediately following each day of pruning may help to reduce the ingress of pathogens in pruning wounds (recommended for bunch grapes), but there is not enough information on whether this works well for muscadines. If a dieback disease is observed, the cordon must be severed at least 6” below the area of dead and dying tissue. Severe pruning (back to the trunk; or even to the ground, a few inches above ground level) is sometimes necessary to remove dieback, in which case new growth will have to be trained to re-establish the vine on the trellis.

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

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

Flea beetles are foliage feeders that eat holes in the leaves. Less than 10% foliar injury is unlikely to be harmful. Treat if flea beetles are abundant and injury is evident. Grape flea beetles may also feed on developing buds; suggested treatment threshold is 5% damaged buds in a sample of 10 vines per acre.

Prebloom (Bud break till bloom)

Pest/Problem	Management Options	Amount of Formulation per acre	Effectiveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
Black rot Bitter rot Angular leaf spot Powdery mildew	myclobutanil (Nova 40W)	3-5 oz	++++	FRAC Code [3]	24 hrs	14 days	Do not apply more than 1.5 lb of Nova 40W per acre per year. Interval for repeat applications should not exceed 14 days.
	thiophanate-methyl (Topsin M 70WSB)	1-1.5 lb	+++	FRAC Code [1]	7 days	14 days	Apply when foliage first develops and repeat at 14 to 21 day intervals or as needed. Do not apply more than 4 lb. product (2.8 lb ai)/acre/season. Use only in combination or alternation with a labeled non-benzimidazole fungicide.
	azoxystrobin (Abound 2.08SC)	11-15.4 fl oz	+++++	FRAC Code [11]	4 hrs	14 days	Do not make more than four applications of Abound per acre per year. Do not apply more than 2 sequential sprays of Abound. Alternate applications with other fungicides having a different mode of action.
	trifloxystrobin (Flint 50WG)	2 oz	+++++	FRAC Code [11]	12 hrs	14 days	Do not apply more than 8 oz Flint per acre per season. Do not make more than 4 applications of Flint per season. Do not apply more than two applications of Flint before switching to a non-strobilurin fungicide.
	pyraclostrobin + boscalid (Pristine WG)	8-10.5 oz	+++++	FRAC Code [11+7]	24 hrs	14 days	Do not make more than five applications of Pristine or related fungicides (strobilurin or carboxamide) per season. Do not make more than two sequential applications before alternating with a fungicide with a different mode of action.
	kresoxim-methyl (Sovran 50 WG)	3.2-4.8 oz	++++	FRAC Code [11]	12 hrs	14 days	Do not make more than four applications of Sovran per acre per year. Do not apply more than 2 sequential sprays of Sovran. Alternate applications with other fungicides which have a different mode of action.
	Dithane M45	2-3 lb	+++	FRAC Code [M3]	24 hrs	66 days	Do not apply more than 24 lb of Dithane M45, Manzate 200DF, Maneb 80WP or Penncozeb 75DF per acre per season. Repeat applications at 7 to 10 day intervals.
	Manzate 75DF	1.5-4 lb	+++		24 hrs	66 days	
	Maneb 75WP	1.5-4 lb	+++		24 hrs	66 days	
	Penncozeb 75DF	1.5-4 lb	+++		24hrs	66 days	

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Prebloom (Bud break till bloom)

Pest/Problem	Management Options	Amount of Formulation per acre	Effectiveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
<i>(continued)</i> Black rot Bitter rot Angular leaf spot ONLY	Ziram 76 DF	3-4 lb	+++	FRAC Code [M3]	48 hrs	21 days	
	captan (Captan 50WP)	4 lb	+++	FRAC Code [M4]	96 hrs	0 day	Repeat Captan applications at 7 to 14 day intervals.
	captan (Captec 4L)	2 qt	+++		96 hrs	0 day	
Powdery mildew ONLY	wettable sulfur (Microthiol, various brands, 80 to 92% S)	3 to 10 lb	++++	FRAC Code [M2]	24 hrs	--	Must be applied every 7-10 days. Dilute in 100 gal of water per acre. Corrosive to sprayers and trellis wires. OMRI listed for organic growers.
Aphids	malathion 57EC	1.5 pt	++++	IRAC Code [1B]	12 hrs	3 days	Treat if aphids are abundant and terminals or foliage are becoming malformed.. Aphids rarely reach damaging levels.
	imidacloprid (Admire Pro)	7 to 14 fl oz	++++	IRAC Code [4B]		30 days	Applied via drip irrigation.
	imidacloprid (Provado)	3 to 4 fl oz	++++			0 days	
Leafhoppers	malathion 57EC	1.5 pt	++++	IRAC Code [1B]	12 hrs	3 days	Leafhopper injury is seen as colorless, cleared stippling on leaves; heavy infestations can cause defoliation. Provisional treatment thresholds suggest treating for 10 leafhopper nymphs or adults per leaf or when leafhoppers and injury are evident (weak, unthrifty growth.)
	carbaryl (Sevin 80WSP)	1.25 to 2.5 lb	+++	IRAC Code [1A]	12 hrs	7 days	
	phosmet (Imidan 70W)	1.33 to 2.12 lb	++++	IRAC Code [1B]	14 days	14 days	
	fenpropathrin (Danitol 2.4EC)	5 to 10 fl oz	+++	IRAC Code [3A]	24 hrs	21 days	
	imidacloprid (Admire Pro) or (Provado)	7 to 14 fl oz 3 to 4 fl oz	++++	IRAC Code [4B]	12 hrs	30 days 0 days	Admire Pro is applied via drip irrigation, Provado by foliar spray.
	thiamethoxam (Platinum) or (Actara)	8 to 17 oz 1.5 to 3 oz			12 hrs	60 days 5 days	Platinum is soil applied, Actara by foliar spray.

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Prebloom (Bud break till bloom)

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-Iveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
<i>(continued)</i> Leafhoppers	dinotefuran (Venom)	5 to 6 oz soil 1 to 3 oz foliar		IRAC Code [4A]	12 hrs	28 days 1 day	Only one soil application allowed per season.
Grape flea beetles	carbaryl (Sevin 80WSP)	1.25 to 2.5 lb	++++	IRAC Code [1A]	12 hrs	7 days	Flea beetles chew holes in the foliage. Less than 10% foliar injury is unlikely to be harmful. Treat if flea beetles are abundant and injury is evident. Grape flea beetle larvae also feed on buds. Treatment is recommended if 5% of vines exhibit bud damage.
	Malathion 57EC	1.5 pt	+++	IRAC Code [1B]	12 hrs	3 days	
	phosmet (Imidan 70W)	1.33 to 2.12 lb	++++	IRAC Code [1B]	14 days	14 days	

Bloom (*Do Not Apply Insecticides During Bloom*)

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-Iveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
Black rot Bitter rot Angular leaf spot Powdery mildew <i>(continued on next page)</i>	myclobutanil (Nova 40W)	3-5 oz	++++	FRAC Code [3]	24 hrs	14 days	Do not apply more than 1.5 lb. of Nova 40W per acre per year. Interval for repeat applications should not exceed 14 days.
	thiophanate-methyl (Topsin M 70WSB)	1-1.5 lb	+++	FRAC Code [1]	7 days	14 days	Apply when foliage first develops and repeat at 14 to 21 day intervals or as needed. Do not apply more than 4 lb. product (2.8 lb. ai)/acre/season. Use only in combination or in an alternating application program with a labeled non-benzimidazole fungicide.
	azoxystrobin (Abound 2.08SC)	11-15.4 fl oz	+++++	FRAC Code [11]	4 hrs	14 days	Do not make more than four applications of Abound per acre per year. Do not apply more than 2 sequential sprays of Abound. Alternate applications with other fungicides which have a different mode of action.

Bloom (Do Not Apply Insecticides During Bloom)

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-Iveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
<i>(continued)</i> Black rot Bitter rot Angular leaf spot Powdery mildew	trifloxystrobin (Flint 50WG)	2 oz	+++++	FRAC Code [11]	12 hrs	14 days	Do not apply more than 8 oz Flint per acre per season. Do not make more than 4 applications of Flint per season. Do not apply more than two applications of Flint before switching to a non-strobilurin fungicide.
	pyraclostrobin + boscalid (Pristine WG)	8-10.5 oz	+++++	FRAC Code [11+7]	24 hrs	14 days	Do not make more than five applications of Pristine or related fungicides (strobilurin or carboxamide) per season. Do not make more than two sequential applications of Pristine before alternating with a fungicide with a different mode of action (neither strobilurin or carboxamide).
	kresoxim-methyl (Sovran 50 WG)	3.2-4.8 oz	++++	FRAC Code [11]	12 hrs	14 days	Do not make more than four applications of Sovran per acre per year. Do not apply more than 2 sequential sprays of Sovran. Alternate applications with other fungicides which have a different mode of action.
Black rot Bitter rot Angular leaf spot	Dithane M45	2-3 lb	+++	FRAC Code [M3]	24 hrs	66 days	Do not apply more than 24 lb Dithane M45, Manzate 200DF, Maneb 80WP or Penncozeb 75DF per acre per season. Repeat applications at 7 to 10 day intervals.
	Manzate 75DF	1.5-4 lb	+++		24 hrs	66 days	
	Maneb 75WP	1.5-4 lb	+++		24 hrs	66 days	
	Penncozeb 75DF	1.5-4 lb	+++		24 hrs	66 days	
	Ziram 76 DF	3-4 lb	+++	FRAC Code [M3]	48 hrs	21 days	
	captan (Captan 50WP)	4 lb	+++	FRAC Code [M4]	96 hrs	0 day	Repeat Captan applications at 7 to 14 day intervals.
	captan (Captec 4L)	2 qt	+++		96 hrs	0 day	
Powdery mildew ONLY	wettable sulfur (Microthiol, various brands, 80 to 92% S)	3-10 lb	++++	FRAC Code [M2]	24 hrs	--	Must be applied every 7-10 days. Dilute sulfur in 100 gal of water per acre. Sulfur is corrosive to sprayers and trellis wires.

First Cover (post-bloom)

Pest/Problem	Management Options	Amount of Formulation per acre	Effectiveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
Aphids Leafhoppers Flea beetles	Same as sprays for Prebloom						Base treatments on scouting and scout regularly in areas with a history of injury
Black rot Bitter rot Angular leaf spot Powdery mildew	myclobutanil (Nova 40W)	3-5 oz	++++	FRAC Code [3]	24 hrs	14 days	Do not apply more than 1.5 lbs of Nova 40W per acre per year. Interval for repeat applications should not exceed 14 days.
	thiophanate-methyl (Topsin M 70WSB)	1-1.5 lb	+++	FRAC Code [1]	7 days	14 days	Apply when foliage first develops and repeat at 14 to 21 day intervals or as needed. Do not apply more than 4 lb. product (2.8 lb. ai)/acre/season. Use only in combination or in an alternating application program with a labeled non-benzimidazole fungicide.
	azoxystrobin (Abound 2.08SC)	11-15.4 fl oz	+++++	FRAC Code [11]	4 hrs	14 days	Do not make more than four applications of Abound per acre per year. Do not apply more than 2 sequential sprays of Abound. Alternate applications with other fungicides having a different mode of action.
	trifloxystrobin (Flint 50WG)	2 oz	+++++	FRAC Code [11]	12 hrs	14 days	Do not apply more than 8 oz Flint per acre per season. Do not make more than 4 applications of Flint per season. Do not apply more than two applications of Flint before switching to a non-strobilurin fungicide.
	pyraclostrobin + boscalid (Pristine WG)	8-10.5 oz	+++++	FRAC Code [11+7]	24 hrs	14 days	Do not make more than five applications of Pristine or related fungicides (strobilurin or carboxamide) per season. Do not make more than two sequential applications of Pristine before alternating with a fungicide with a different mode of action (neither strobilurin or carboxamide).
	kresoxim-methyl (Sovran 50 WG)	3.2-4.8 oz	++++	FRAC Code [11]	12 hrs	14 days	Do not make more than four applications of Sovran per acre per year. Do not apply more than 2 sequential sprays of Sovran. Alternate applications with other fungicides which have a different mode of action.
	<i>(continued on next page)</i>						

First Cover (post-bloom)

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-iveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
<i>(continued)</i> Black rot Bitter rot Angular leaf spot	Dithane M45	2-3 lb	+++	FRAC	24 hrs	66 days	Do not apply more than 24 lb Dithane M45, Manzate 200DF, Maneb 80WP or Penncozeb 75DF per acre per season. Repeat applications at 7 to 10 day intervals. **Note PHI of 66 days – cannot be used post-bloom for early-ripening cultivars
	Manzate 200DF	1.5-4 lb	+++	Code	24 hrs	66 days	
	Maneb 80WP	1.5-4 lb	+++	[M3]	24 hrs	66 days	
	Penncozeb 75DF	1.5-4 lb	+++		24 hrs	66 days	
	Ziram 76 DF	3-4 lb	+++		48 hrs	21 days	
	captan (Captan 50WP)	4 lb	+++	FRAC Code [M4]	96 hrs	0 day*	Repeat Captan applications at 7 to 14 day intervals. Label allows application up to day of harvest; however; note 4-day re-entry interval.
	captan (Captec 4L)	2 qt	+++		96 hrs	0 day*	
Powdery mildew ONLY	wettable sulfur (various brands, 80 to 92% S)	2-5 lbs	++++	FRAC Code [M2]	24 hrs	--	Must be applied every 7-10 days. Dilute sulfur in 100 gal of water per acre. Sulfur is corrosive to sprayers and trellis wires.
Sooty blotch ('Fry' variety)	captan (Captan 50WP) (Captec 4L)	2.0-4.0 lb 2.0 qt	+++	FRAC Code [M4]	72 hrs	0 days*	*Label allows application up to day of harvest; however; note 3-day re-entry interval
	azoxystrobin (Abound 2.08SC)	11.0-15.4 fl oz	+++++	FRAC Code [11]	4 hrs	14 days	Do not make more than four applications of Abound per acre per year. Do not apply more than 2 sequential sprays of Abound. Alternate applications with other fungicides which have a different mode of action.
	trifloxystrobin (Flint 50WG)	2.0 oz	+++++	FRAC Code [11]	12 hrs	14 days	Do not apply more than 8 oz Flint per acre per season. Do not make more than 4 applications of Flint per season. Do not apply more than two applications of Flint before switching to a non-strobilurin fungicide.
	pyraclostrobin + boscalid (Pristine)	8.0-10.5 oz	+++++	FRAC Code [11+7]	24 hrs	14 days	Do not make more than five applications of Pristine or related fungicides (strobilurin or carboxamide) per season. Do not make more than two sequential applications of Pristine before alternating with a fungicide with a different mode of action (neither strobilurin or carboxamide).

Summer cover (post-bloom) sprays until harvest

Fruit rots: Bitter rot and black rot – These rots are usually controlled by fungicide applications pre-bloom to first cover. Proper pruning and removal of infected berries, leaves and old fruit stems from the previous winter may reduce disease. If bitter rot is very heavy, fungicides can be applied at shoot emergence, 3-5 inches, 8-10 inches and at 7-10 day intervals until fruit set. Black rot-susceptible varieties can be sprayed with fungicide every 14 days from the start of new growth until after bloom. Black rot control is particularly needed on highly susceptible cultivars such as Carlos and Cowart. **Ripe rot** – Ripe rot can be particularly severe on susceptible cultivars such as Higgins, Magnolia, Summit, Watergate, Carlos, Fry, Dixieland, and Scuppernong. Abound and other QoI fungicides are the materials of choice in vineyards where ripe rot is a problem. **Sooty blotch** causes a dark, superficial discoloration on the surface of otherwise healthy fruit; the disease is common on the cultivar Fry. **Macrophoma rot** – control can be improved with early cover sprays of Captan, particularly on susceptible cultivars such as Chowan, Fry, Higgins, Summit and Triumph.

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

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

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

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

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

Spider mites and others – Mites are capable of explosive population growth. Treat if more than 10 mites per leaf are found or if mites are present and leaves are webbed or bronzed. Drought and heavy crop load aggravate mite injury, especially early in a growing season. Two treatments at 1 week intervals may be needed if using a material that only kills adult mites. **Brevipalpid** mites (flat mites) cause russetting around leaf veins and at the stem end of berries in NC, and this mite may occasionally warrant control.

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

Summer cover (post-bloom) sprays until harvest

Pest/Problem	Management Options	Amount of Formulation per acre	Effectiveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
Black rot Bitter rot Ripe rot Macrophoma rot Angular leaf spot Sooty blotch	Same as sprays for First Cover						Manzate products can only be used in early season applications. These products are very effective, but use is limited by the 66 day preharvest interval. Other effective cover sprays should include tank mixes of Topsin M or Nova with Captan or Captec, OR an alternation of Topsin M or Nova with Abound, Pristine or Flint.
Stink bugs	Phosmet (Imidan 70W)	1.33-2.125 lb	+++++	IRAC Code [1B]	14 days	14 days	Imidan seldom prompt outbreaks of secondary pests such as mites.
	fenpropathrin (Danitol 2.4EC)	10-21 fl oz	+++++	IRAC Code [3A]	24 hrs	21 days	Danitol is effective against a broad array of insects and is the material of choice for stink bugs. Danitol is a pyrethroid, its use may prompt rebound of mite numbers later in the season.
Japanese beetle	carbaryl (Sevin 80WSP)	1.25-2.5 lbs	++++	IRAC Code [1A]	12 hrs	7 days	Use of Sevin may encourage mites. Do not concentrate spray on clusters or visible residue may result. Do not apply more than 12 ½ lb/acre per year.
	carbaryl (Sevin XLR Plus)	1-2 qt	++++		12 hrs	7 days	Repeat applications as necessary up to a total of 5 times but not more often than once every 7 days. Do not apply more than 10 qt/acre per year.
	fenpropathrin (Danitol 2.4EC)	10-21 fl oz	+++++	IRAC Code [3A]	24 hrs	21 days	Danitol is a pyrethroid, its use may prompt rebound of mite numbers later in the season.
	acetamiprid (Assail 30SG)	2.5 oz	+++	IRAC Code [4A]	12 hrs	7 days	
	imidacloprid (Provado)	3 to 4 fl oz	++++		12 hrs	0 days	
	clothianidin (Clutch)	3 oz	+++		12 hrs	0 days	

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Summer cover (post-bloom) sprays until harvest

Pest/Problem	Management Options	Amount of Formulation per acre	Effect-iveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
<i>(continued)</i> Japanese beetle	Surround	25-50 lbs	+++	none	4 hrs	0 days	Surround coats leaves and fruit, rendering them unattractive to Japanese beetles. Surround may also decrease other pest activity. Surround is OMRI listed for use by organic growers.
Grape berry moth	carbaryl (Sevin 80WSP)	2.5 lbs	++++	IRAC Code [1A]	12 hrs	7 days	Use of Sevin may encourage mites. Do not concentrate spray on clusters or visible residue may result. Do not apply more than 12 ½ lb/acre per year.
	carbaryl (Sevin XLR Plus)	2 qt	++++		12 hrs	7 days	
	clothianidin (Clutch)	3 oz	+++	IRAC Code [4]	12 hrs	0 days	
	spinosad (Entrust)	1.25-2.5 oz	+++	IRAC Code [5]	4 hrs	7 days	Treatments should be timed to egg hatch. Entrust is OMRI listed.
	spinosad (Spintor)	4-8 fl oz	+++		4 hrs	7 days	Treatments should be timed to egg hatch.
	spinetoram (Delegate)	3-5 oz	+++		4 hrs	7 days	
		methoxyfenozide (Intrepid)	4-8 fl oz	+++	IRAC Code [18]	4 hrs	30 days
Spider mites	Fenbutatin-oxide (Vendex 50WP)	1 lb	+++	IRAC Code [12B]	48 hrs	28 days	Do not retreat with Vendex for 21 days.
	dicofol (Kelthane 50WP)	1-2 lb	+++	IRAC Code [UN]	48 hrs	7 days	
	pyridaben (Pyramite 0.6 WSB or Nexter 75WP)	4.4 oz	++++	IRAC Code [21]	12 hrs	7 days	Pyramite/Nexter is an excellent miticide for European red mite.
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<i>(continued)</i> Spider mites	bifenazate (Acaramite 50WS)	0.75-1 lb	+++++	IRAC Code [UN]	12 hrs to 5 days	14 days	Acaramite provides excellent twospotted spider mite control. Fujimite and Acaramite kill eggs, larvae and adult spider mites. After one week, scout before considering a second application.
	abamectin (Agri-Mek 0.15 EC or Abba 0.15 EC)	6 – 16 fl oz	+++++	IRAC Code [6]	12 hrs	28 days	Abamectin products are long residual miticides. They should be applied with a non-ionic surfactant. Test for possible cultivar-specific phytotoxicity prior to spraying entire blocks. A treatment 7 days after initial application may be necessary – abamectin is an adulticide and will not impact eggs or larvae.
	fenpropathrin (Danitol 2.4EC)	5 – 10 fl oz	+++	IRAC Code [3A]	24 hrs	21 days	Danitol is a pyrethroid insecticide/miticide. It is a good choice when both mites and insects need to be controlled; however, rebounds in mite abundance are often associated with using pyrethroid materials.
	fenpyroximate (FujiMite 5EC)	2 pt	++++	IRAC Code [21]	12 hrs	14 days	Fujimite and Acaramite kill eggs, larvae and adult spider mites. After one week, scout before considering a second application.

Grape root borer control

Grape root borers – Left unchecked, borers can kill grapevines. Borers tunnel inside vines at or below ground level, weakening or killing the vines. All grapes (bunch, muscadine and vinifera) are susceptible. There are two control options. Mounding provides cultural control, and Lorsban treatment provides chemical control. Neither control system is without flaw. **Mounding** uses layers of soil to make it more difficult for young larvae to reach the roots or adults to emerge. Use clean cultivation, and mound soil 1 foot high and 1½ feet out from the base of each vine to cover the entire area around the base of each vine. This practice will inhibit adult emergence from the soil when well timed; the time for this function will vary by location (early to mid-June for Georgia but 1 August for North Carolina, as examples), so check with your county agent for the appropriate time for your location. It is equally important to knock these mounds back down between early November and late December. **Alternatively, one may use plastic mulch to cover the soil.** To determine whether to use **Lorsban treatment**, examine vines on a block by block basis during September or October for damage, borers or cast pupal skins. Look at 100 vines in each vineyard block. **Treat the following year if 2% or more of the vines are infested or damaged. If possible, treat before adult borers emerge, at least 35 days before harvest.** Chlorpyrifos (Lorsban) 4E can be used at a rate of 4.5 pints per acre. Apply 2 quarts of a dilute mixture to the soil at the base of the vine. Make a single application 35 days before harvest, or a split application (reduced rate) at 35 days before harvest and again immediately after harvest. **Spray should not contact fruit or foliage.** Application can be made with flood nozzles and low pressure (40 to 60 psi).

Pest/Problem	Management Options	Amount of Formulation per acre	Effectiveness (+)	Mode of Action Code	REI	PHI	Comments and Precautions
Grape root borer	Mounding		+++				Mounding is an organically acceptable practice.
	chlorpyrifos (Lorsban 4E)	4½ pt/100 gals water, apply 2 qt of mixture/ vine	++++	IRAC Code [1B]	24 hrs	35 days	Apply 2 qt. of the dilute spray mixture to the soil surface on a 15 square foot area around the base of each vine or apply in strip as for herbicide. Do not allow spray to contact fruit or foliage. Apply Lorsban before the pest emerges, but at least 35 days prior to harvest.
	chlorpyrifos (Lorsban 4E) (split treatment)	2¼ pt/100 gals water, at least 35 days before harvest plus 2¼ pt/100 gals immediately after harvest	++++	IRAC Code [1B]	24 hrs	35 days	After a block has received a chlorpyrifos treatment check every Sept-Oct. for cast pupal skins, borers or damage. Treat the following year if damage and borer counts are over 2%.

Fire ant control

Fire ants – Fire ants may be controlled through the use of bait products. These products are often not fast-acting, but operate by sterilizing the colony (the queen lays sterile eggs). They must be applied when the ants are actively foraging -- test for foraging behavior by placing food (hot dog pieces, potato chips, sardines, etc.) and checking 30 min later for ant activity. Apply during dry weather; moisture reduces the effectiveness of bait products.

Insecticides applied for control of other insect pests will also aid in suppression of fire ants. Fire ant populations are at their highest in young vineyards, but the number of mounds drops rapidly after the vines develop a mature canopy that shades the vineyard floor

Imported Fire Ant	Pyriproxyfen (Esteem Ant Bait)	1.5-2.0 lbs	++++	IRAC Code [7C]	12 hrs	1 day	For grapes do not exceed 0.22 lbs pyriproxyfen per season
	Methoprene (Extinguish Professional Fire Ant Bait)	1.0 to 1.5 lbs	++++	IRAC Code [7A]	4 hrs	0 day	Labeled for use on “cropland”

Cultural Practices

Establishment – The most productive muscadine vineyards are on sites that have well-drained soils. Soils that stay wet during the winter months or that flood regularly are not satisfactory for muscadines. To improve drainage, bed rows 4-12” high and four feet wide. Provisions for drainage must be made prior to planting. Land preparation should begin the year before planting; have the soil tested, correct any deficiencies in P and K levels, and adjust the pH to 6.5 with dolomitic limestone. Use contact or systemic herbicides to clean up infestations of johnsongrass, bermudagrass, or nutsedge in the year *before* vines are set. Use a single-wire trellis and space rows 10 to 12 feet apart; set posts 20 ft apart within rows and plant one vine at each post (rather than between posts). This positioning will help protect the vine and minimize fruit loss during harvest, especially if mechanical harvest is planned. Plant in late April or early May (N.C and Ga./S.C. Piedmont) after danger of spring freezes has passed or during the winter in South Georgia. Commercial grow tubes (24-36” long and 3-4” in diameter) will accelerate growth and protect vines in the first growing season, but grow tubes may delay the development of vine cold hardiness in the fall, and for this reason they should be removed in late September/early October. Pull soil back over the base of any vine where roots are exposed because of soil washing away during the growing season beneath the grow tube.

Fertilization – North Carolina

Preplant: Liming, phosphate (P_2O_5) and potash (K_2O) should be adjusted based on a soil test.

Young vines: broadcast 1/4 pound of 10-10-10 in a circle, staying at least 1.5 ft away from the trunk, after new growth starts (late April to early May). Repeat in June and July.

Second year: Double the fertilizer rate for the first year and apply ½ pound of 10-10-10 per vine per application in March, May and July (but no later than mid-July as winter injury may occur). Do not put the fertilizer closer than 1.75 ft from the trunk.

Third year: In the third growing season, if the vines have grown off well, apply 0.75 pounds of premium grade 10-10-10 fertilizer or its equivalent per vine in March, in May and again in July (but no later than mid-July). Do not put the fertilizer closer than 1.75 ft from the trunk. Alternatively, for well established 3-year old vines with good yield potential, growers may wish to adapt the Georgia fertility program (below), and consider applying 1.5 pounds (not 2 pounds) of 10-10-10 fertilizer or its equivalent per vine in March, plus one pound of 10-10-10 fertilizer per vine in May. These fertilizer applications are evenly spread in a band 4-5 feet wide centered on the row.

Mature vines: In the fourth growing season, apply 1.5 pounds of premium grade 10-10-10 fertilizer or its equivalent per vine in March (near bud break), plus one pound of 10-10-10 fertilizer per vine in May. Evenly spread these applications along the row in a band 4-5 feet wide. At 218 vines per acre (10 ft x 20 ft), this program will provide a total of about 55 pounds of nitrogen per acre (with the equivalent of 0.15 pounds of nitrogen per vine being provided in March, and 0.10 pounds in May). Foliar analysis should be conducted in mid-June of each year to determine nutrient levels in the vines and make adjustments to the fertilization program (see the appropriate levels of nutrients below). The desired amount of vegetative growth per year is about 3 feet. If growth exceeds 4 feet, reducing the amount of nitrogen applied in future years may be advisable. Maintain soil pH at 6 or above with dolomitic lime. Spray annually just before bloom with 1 lb Solubor (20% B) in 100 gallons of water per acre.

Fertilization – North Carolina (continued)

Grapes have a relatively high magnesium requirement. You may want to apply Epsom salts in July at 4 lbs per 100 gallons of water (roughly 1 Tablespoon per gallon) or by sprinkling around the vines at 2 to 4 oz per vine for young vines and 4 to 6 oz per vine for mature vines to prevent or correct a magnesium deficiency.

In eastern NC, an alternative fertilizer to 10-10-10 that shows promise involves the application of 6-6-18 tobacco fertilizer because it contains several micronutrients in addition to N, P, and K. It should be applied in March and then again in late June, at ¼ lb per vine after planting and ½ lb per vine in the second year. Mature vines should receive 2 to 3 lb at each application. An application of calcium nitrate should also be applied in mid-May at 6 to 7 oz per vine. Leaf samples can be taken in mid June to determine the actual nutritional status of mature vines.

Foliar tissue analysis is recommended. Leaf tissue testing can become a valuable tool to help growers eliminate much of the guesswork associated with deciding on amounts and timing of fertilizer applications. Foliar analysis determines the actual nutritional status of the plants during critical periods of growth. In North Carolina, take leaf samples in mid-June and early July. Collect a double fist full of mature leaves, one from each shoot, choosing only the leaves located opposite a fruit cluster on fruiting shoots. Place the leaves in a paper bag and allow them to dry. Send samples to the Agronomic Division, North Carolina Department of Agriculture. To be most effective, continue the practice from year to year to help establish trends and changes in nutrient levels. Appropriate levels of nutrients based on whole-leaf nutrient concentration are shown below:

Appropriate levels of nutrients based on foliar analysis:

<u>Element (Unit)</u>	<u>Optimal Range</u>
Nitrogen (%)	1.65 to 2.15
Phosphorus (%)	0.12 to 0.18
Potassium (%)	0.80 to 1.20
Calcium (%)	0.70 to 1.10
Magnesium (%)	0.15 to 0.25
Sulfur (%)	0.15 to 0.25
Boron (ppm)	15 to 25
Copper (ppm)	5 to 10
Iron (ppm)	60 to 120
Manganese (ppm)	60 to 150
Molybdenum (ppm)	0.14 to 0.35
Zinc (ppm)	18 to 35

Fertilization -- Georgia

Fertilization should be based on a soil test. However, if a soil test is not available follow these general recommendations:

For the first growing season apply two ounces of premium grade 10-10-10 fertilizer or its equivalent per vine starting after growth begins in the spring and repeated at four to six week intervals, if at least four inches of rain or overhead irrigation have been received since the last fertilization. Apply the fertilizer fairly evenly in a circle 2.5 feet in diameter with the vine in the center. This is equivalent to about 1000 pounds per acre if the fertilizer was broadcast. Be careful to avoid placing too much fertilizer within six inches of the trunk so as to not burn the young roots. The total number of fertilizer applications for the year will probably be four to five in south Georgia and three to four in north Georgia. Do not fertilize the vines after late August in south Georgia and late July in North Georgia. Slow release nursery fertilizers also give good results with fewer fertilizer applications. Follow the manufacturer's directions on the bag.

Second year: During the second year timing and method of applications should be similar to the year before. However, the rate should be doubled to four ounces of premium grade 10-10-10 or its equivalent and the diameter of the broadcast circle should be increased to three to four feet. This is equivalent to about 1000 pounds per acre if the fertilizer was broadcast.

Third year: In the third growing season, if the vines have grown off well, apply two pounds of premium grade 10-10-10 fertilizer or its equivalent per vine in March, plus one pound of 10-10-10 fertilizer per vine in May. Evenly spread these applications along the row in a four feet wide band.

Established vines: To fertilize an established vineyard take a soil sample and follow the recommendations. Muscadines usually need about 50-60 pounds of nitrogen per acre (0.3 pounds of nitrogen per vine at 181 vines per acre) applied near bud break followed by about 30-40 pounds of nitrogen after fruit set (0.17 pounds of nitrogen per vine at 181 vines per acre). Phosphorus and potassium should be applied according to the soil test. If a soil test is not available apply 3 to 4 pounds of premium grade 10-10-10 fertilizer or its equivalent per plant near bud break. Spread the 10-10-10 fertilizer evenly in a band five to six feet wide centered on the plant row. After fruit set (June in South Georgia-July in North Georgia) apply ½ pound of ammonium nitrate fertilizer per plant or its equivalent. Spread the ammonium nitrate evenly under the canopy. On heavy or rich soils, only a single application of fertilizer in the Spring may be needed. The desired amount of vegetative growth per year is about three feet. If growth exceeds four feet, reducing the amount of nitrogen applied in future years may be advisable. Foliar analysis should be conducted in July of each year to determine nutrient levels in the vines and make adjustments to the fertilization program.

Pruning (training new vines)

Trellising young vines -- During the first two or three years, vines need regular training once a week throughout the growing season. Training establishes the optimal shape and position of the vine. Proper training is accomplished by selecting a single shoot and training it up a bamboo stake or string. Remove any side shoots that appear in the leaf axils by pinching them out as soon as possible, leaving the leaf intact. The objective is to have a single growing point rather than multiple shoots. Plastic vineyard tape is used for attaching vines to the bamboo stake and later to the trellis wire. Train the young vines up the stake or string to the wire, then pinch the tip back to approximately 4-6 inches below the wire. This will encourage a V-shaped branching. Choose two of these lateral branches and begin training them in opposite directions along the wire, as future “main arms” or cordons. Continually remove lateral suckers along the trunk in order to direct all the plant’s growth into the growing tips of the cordons. Until the cordons reach full length, cut back side shoots to approximately 4 to 6 inches during the growing season. Likewise, remove all fruit at the earliest possible stage in order to direct growth to the desired shoots.

Pruning (step-by-step for mature vines)

1. In the dormant season, prune back all new wood (called “canes” or “whips”) that grew the previous year, leaving only 2-4-inch-long “fruiting spurs”. No scientific evidence suggests that yields or fruit quality in muscadines will be improved by more time-consuming “balanced pruning” methods or more complex formulas used in bunch grape pruning. Muscadine pruning is quite simple and can be accomplished with a mechanical hedger or hand pruners, or a combination of hedging and hand pruning. However, use great caution when pruning with any mechanical hedging equipment.
2. Optional “Long spur” pruning in year two for table grape cultivars: In order to move the fruiting area of the vine slightly away from the cordon it may be desirable to make the first dormant pruning cuts on the side shoots coming off the cordons (arms) at six to ten inches on the single wire trellis. This will allow the cluster of grapes to be far enough away from the cordon for easy harvest of the grapes and improved air circulation. Shoots coming off the cordon at about a 45 degree angle are the ones preferred for forming the spur system. Shoots coming straight up or straight down should be removed if not needed. In subsequent years, the previous season's growth should be cut back to 2-4 buds to keep the canopy from becoming too wide.
3. Normal pruning recommendation for wine, juice and table grape cultivars where mechanical hedging will be used: On young vines, cut the 1-year-old “fruiting spurs,” back to about 3 inches and space them about 4-6 inches apart. As the vine grows older, it will develop clusters of spurs at each of these locations on the fruiting arm. These should be thinned to about 6 inches apart, removing downward-growing spurs first. These clusters of spurs are called “bearers” or “spur clusters”.
4. When the vines are about five or six years old, the spur cluster will have developed the appearance of a deer’s antler. Begin to thin out by removing every third or fourth spur cluster to about 8 to 12 inches apart using lopping shears. This thinning will force new spur growth to replace these older spur clusters, allowing them to be gradually renewed over a period of years.
5. Experience has shown that it is better to gradually thin out the older spur clusters starting in the third fruiting season (5- to 6- year-old vine), rather than to wait until the fourth or fifth fruiting season (7- to 8-year-old vine).

Pruning (step-by-step for mature vines, continued)

6. Each year, remove strong wood or “bull canes” that have grown at the top of the trunk. This helps to maintain vigorous growth and good yields along the lengths of the fruiting arms. If an arm becomes cold-injured, or broken, REMOVE IT ENTIRELY BACK TO THE HEAD OF THE VINE, AND TRAIN A NEW CANE TO REPLACE IT. Sometimes, a “bull cane” can be used to replace a missing arm.

7. Grapevines grow tendrils that bind to the trellis or whatever is nearby. They are especially bothersome when they encircle the trunk or fruiting arms. To prevent girdling damage, remove all tendrils attached to the trunk or fruiting arm of young vines.

Efficacy of selected fungicides against diseases of muscadine grape¹

Fungicide	PHI (Pre-Harvest Interval)	Mode-of-Action (MOA) Grouping ²	FRAC code ³	Bitter rot	Powdery mildew	Ripe rot	Macro-phoma rot	Black rot	Sooty blotch	Dead arm	Angular leaf spot
Myclobutanil (Nova)	14 days	G	3	++ ²	++++	NA	+	++++	+++	???	++++
Thiophanate-methyl (Topsin- M)	14 days	B	1	++	+++	+	+	+++	+++	++	+++
Wettable Sulfur (Microthiol and other trade names)	1 day (re-entry)	Multi-site	M 2	NA	++++	NA	NA	NA	???	NA	NA
Pyraclostrobin + boscalid (Pristine)	14 days	C	7+11	+++	++++	++++	+++++	++++	+++++	++	++++
Kresoxim-methyl (Sovran)	14 days	C	11	+++	+++	+++	++	+++	+++	++	+++
Azoxystrobin (Abound)	14 days	C	11	+++	++++	++++	++++	++++	++++	++	++++
Trifloxystrobin (Flint)	14 days	C	11	+++	++++	++++	+++++	++++	+++++	++	+++
Ziram (Ziram)	21 days	Multi-site	M 3	++	++	+++	++	+++	+++	++	+++
Captan (Captan, Captec)	0 days (72 hrs re-entry)	Multi-site	M 4	++	++	++++	+++	+++	+++	++	+++
EBDCs (includes Maneb, Manex, Penncozeb, Manzate, Dithane M-45)	66 days	Multi-site	M 3	+++	++	NA	++	+++	++	++	+++

¹ NA = no significant activity, ??? = unknown activity; + = very limited activity, ++ = limited activity, +++ = moderate activity, ++++ = good activity, +++++ = excellent activity.

² Alternation of fungicides with different modes of action helps prevent the development of pest resistance to a particular class of fungicide. There is no benefit to alternating or tank-mixing fungicides with the same mode of action. Fungicides listed as “multi-site” are the least likely to be overcome by a resistant strain of a pathogen.

³ In addition to MOA grouping, the FRAC code also indicates fungicides that can be alternated to discourage pest resistance; alternate or tank-mix only those products having different FRAC codes.

Weed Management

Grape Vineyards

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 have differing modes of action (MOA) during the growing season or tank mixing herbicides with differing MOA are strategies that can be utilized to prevent the development of herbicide resistant weeds. 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 aide 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	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 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 MOA 3 Prowl H2O	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 Rely 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	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° F.
	Norflurazon, MOA 12 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.

PREEMERGENCE 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. In new production areas application should not be made until vines have been established at least one year.
PREEMERGENCE 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 Matrix FNV 25 WG	4 oz	Vines established at least 1 year.	4	Tank mix with oryzalin, diuron, or simazine to broadenspectrum of residual control. DO NOT apply within 14 days of harvest. Matrix FNV 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).
PREEMERGENCE Broadleaf weeds and some annual grasses	Diuron, MOA 7 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.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
PREEMERGENCE Broadleaf weeds and some annual grasses (continued)	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 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, MOA 14 Chateau 51 WDG	6 to 12 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. Chateau may only be used in table grapes after completing harvest and before bud break. Chateau may be applied in vineyards producing grapes used for wine and juice 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% . Chateau has a 60 day PHI.
POSTEMERGENCE DIRECTED Non-selective control	Glyphosate, MOA 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.
	Glyphosate + Carfentrazone MOA 9 & 14 Rage	20 to 48 oz	Vines established 1 year or more	12	Apply with hooded application equipment. 14 day PHI. DO NOT allow spray to contact green stems, leaves, fruit or any other desirable vegetation. Applin combination with non-ionic surfactant at 0.25 % v/v (1 qt per 100 gal. of spray solution). The addition of ammonium sulfate at 2 to 4 lb per acre will enhance herbicide activity. Tank mix with PRE herbicides for residual control.
	Glufosinate, MOA 10 Rely 200	55 to 96 oz	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.

Weed/Timing	Material	Amount of Formulation per Acre	Crop Age Restrictions	REI (hrs)	Comments
POSTEMERGENCE DIRECTED Non-selective control (Continued)	Paraquat, MOA 22 Firestorm 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).
	Gramoxone Inteon 2 SL	2.5 to 4 pt			
POSTEMERGENCE Annual and perennial grasses	Clethodim, MOA 1 Select, Volunteer, Intensity, and others 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.
	SelectMax, Intensity One	12 to 16 oz			
	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.
	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 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 H ₂ O (vines must be dormant)	Paraquat (multiple applications as needed); Fusilade, or Poast, or Select (as needed)
Vines Established 1 to 2 years or more	Glyphosate (spot treat for perennial weeds)	Glyphosate or Rage (Mid March)	Oryzalin + Matrix FNV + 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 + 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)
	Glyphosate (spot treat for perennial weeds); Chateau + Rely (after harvest)		Chateau + Paraquat, or Rely (late May)	Rely or Paraquat or Poast (as needed)
	Glyphosate (spot treat for perennial weeds)		Chateau + Glyphosate (prior to bud break)	Rely or Paraquat or Poast (as needed)
Vines Established at least 3 years	Glyphosate (spot treat for perennial weeds)	Glyphosate or Rage (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)

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	Mornigglory, Annual	Nightshades	Pigweed	Radish, Wild	Ragweed	Sida, Prickly	Smartweed	Spotted Spurge	Bermudagrass	Dandelion	Johnsgrass	Nutsedge, Yellow	Virginia Creeper	
Preemergence																											
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	
Chateau	E	E	E	G	G	E		G	G		E	G	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	N	N	N		N	N		
Kerb	G	G	G	G	G	G		P			G		F	F	F	P	F	F		F			P		P	N	
Matrix FNV	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 ₂ O	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	
Solicam	E	E	E	E	G	E		G		F	G	G	F	F	G	P	G	G	E	G	F	P	G		P	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	
Rely 200	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

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