

Commercial Crop Production

Small Fruit - Grape

Table 1. Symptoms, source of inoculum and management of grape diseases

Disease	
<p>Anthracnose (<i>Elsinoe ampelina</i> = <i>Sphaceloma ampelinum</i>)</p>	<p>Symptoms: Fruit infections have light gray centers and reddish-brown borders resembling a bird's eye. Stem lesions are similar in color and sunken, with slightly raised borders. Leaf spots are gray with dark borders; later, the center of the lesion drops out, giving a ragged effect. Badly infected leaves become distorted and curl down.</p> <p>Source of Inoculum: The fungus overwinters in infected fruit on the ground or in infected shoots.</p> <p>Management: Follow the fungicide spray schedule for grapes. Do not apply Pristine to Concord, Worden, Fredonia, Niagara or related grape varieties because of possible injury.</p>
<p>Black rot (<i>Guignardia bidwellii</i>)</p>	<p>Symptoms: The black rot fungus attacks all parts of the grape plant. Leaf infection appears on the upper surface in early June as tiny reddish-brown spots. The lesions enlarge to 1/4 inch or more in diameter and become brown with black borders. A ring of black fungal bodies develops near the outer edge of the brown area. Lesions on stems and tendrils are longer and darker than those on leaves. Stem lesions are narrow, sunken and often split lengthwise on the vine. Infections begin to appear on the fruit when the berries are about half grown. Initially, a small white spot forms that enlarges rapidly until the entire berry is rotten. Affected berries soon turn black, shrivel and dry up. Minute black fungal fruiting bodies develop on the surface of the dried fruit. On muscadines, lesions on berries are small, black and scabby. The fruit does not rot.</p> <p>Source of Inoculum: The fungus overwinters in mummified fruit on the vine and ground and within lesions on canes.</p> <p>Management: Pruning out mummies, cankers and dead wood is very important to reduce inoculum load. Follow the fungicide spray schedule for grapes.</p>
<p>Botrytis bunch rot (<i>Botrytis cinerea</i>)</p>	<p>Symptoms: Infected blooms rot and dry out. Infected berries develop an off-color and either dry out (during dry weather) or burst (during wet weather).</p> <p>Source of Inoculum: The fungus overwinters on canes or in buds. Spores are wind-dispersed.</p> <p>Management: Prune out diseased tissue and destroy. Rake up fallen grapes and destroy. Follow the fungicide spray schedule for grapes.</p>
<p>Downy mildew (<i>Plasmopara viticola</i>)</p>	<p>Symptoms: This is primarily a disease of bunch grapes; muscadines are relatively resistant. All green parts of the vine are susceptible. Leaf lesions are yellowish- to reddish-brown and may appear angular if they are vein delimited. Infected shoot tips tend to curl. Leaves and shoots become covered with white mycelium. Berries appear grayish and are covered with the downy felt-like growth of the pathogen.</p> <p>Source of Inoculum: The pathogen overwinters in infected leaves. Disease development is boosted by wet weather.</p> <p>Management: Shred and remove or bury by cultivation diseased leaves. Follow the fungicide spray schedule for grapes.</p>
<p>Phomopsis cane and leaf spot (<i>Phomopsis viticola</i>)</p>	<p>Symptoms: Tiny dark spots with yellow margins form on the leaf blades and veins. Heavily infected basal leaves become distorted and may not develop to full size. Infected fruit turn brown, shrivel and drop from the cluster.</p> <p>Source of Inoculum: The fungus overwinters in the bark and leaf petioles. During wet springs, fungal spores exude from infected tissues and splash on to new (young) shoot tips. Spores move within the vine, causing localized infections in the vineyard. Fruit and cluster stem infections occur from bloom until the fruit are about the size of a pea.</p> <p>Management: At pruning, remove dead and diseased wood. Destroy pruned materials and debris by burning, burying or plowing them into the soil. Sanitize pruners with a registered disinfectant after each cut or between vines. Apply a dormant spray of lime sulfur to reduce overwintering inoculum.</p>
<p>Pierce's disease (<i>Xylella fastidiosa</i>)</p>	<p>Symptoms: This is a disease of bunch grapes. Muscadines are resistant. Symptoms may vary, but generally are characterized by a scorching of the leaf margins. Grape clusters wilt and dry; bud leaves are slow to develop and show water stress during dry periods.</p> <p>Source of Inoculum: The bacterium survives in infected vines and other hosts. It is transmitted by a number of leafhoppers.</p> <p>Management: Limiting the spread of the insect vector and destruction of wild weed hosts have had limited success. Soil applications of the insecticide Admire Pro or Scorpion 35SL are recommended. Destroy infected vines.</p>
<p>Powdery mildew (<i>Uncinula necator</i>)</p>	<p>Symptoms: Produces a whitish-gray, powdery-appearing growth on affected tissues. All green tissues are susceptible. Infection of young expanding leaves causes them to become distorted. Infection of blossoms results in poor fruit set. Infection of berries results in splitting or a netlike pattern on the surface.</p> <p>Source of Inoculum: The fungus overwinters in dormant buds or on other vine surfaces. Spores are wind-dispersed.</p> <p>Management: Follow the fungicide spray schedule for grapes. Sulfur should be included in a fungicide program.</p>

Commercial Crop Production

Small Fruit - Grape

Table 2. Seasonal fungicide spray schedule for grapes

Developmental Stage	Pesticide Application Timing ¹	Diseases
Dormant	Prior to bud swell (bud is visibly swollen but no green or pink tissue is observed) and break.	Anthracoise Phomopsis cane and leaf spot
Bud break and new shoot sprays (prebloom)	Every 7-10 days from 1-inch shoot growth to prebloom.	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
Prebloom²	<10% bloom	Anthracoise Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
Bloom	10%-20% bloom	Black rot Botrytis bunch rot Phomopsis cane and leaf spot Powdery mildew
Postbloom	First cover spray at 7-10 days after the prebloom spray.	Anthracoise Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
First and second cover sprays	Every 10-14 days following postbloom spray.	Anthracoise Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
Berry touch and bunch closure		Botrytis and other fruit rots
Third and subsequent cover sprays	Matured berries ³ . Every 10-14 days until the preharvest spray.	Anthracoise Black rot (foliar) Downy mildew (foliar) Phomopsis cane and leaf spot Powdery mildew (foliar)
Veraison	Onset of ripening.	Botrytis bunch rot
Preharvest	10-14 days prior to harvest.	Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
Postharvest	Every 14-21 days until the first killing frost.	Downy mildew Powdery mildew

¹For more detailed information, see the 2016 Southeast Regional Bunch Grape Integrated Management Guide of the Southern Region Small Fruit Consortium (<http://www.smallfruits.org/SmallFruitsRegGuide/index.htm>).

²This is one of the most important sprays for downy mildew, powdery mildew, Phomopsis and black rot because it is the stage when grape berries become susceptible to infection by black rot, downy mildew and powdery mildew. All of these pathogens become active due to warmer temperatures.

³Mature berries are now resistant to black rot, downy mildew and powdery mildew. Sprays are applied to manage foliar infections caused by these diseases

Commercial Crop Production

Small Fruit - Grape

Table 3. Efficacy of selected fungicides against grape diseases. Table is reproduced from the 2014 Southern Region Small Fruit Consortium IPM/Production Guide.

Efficacy ratings: - = no significant activity; + = very limited activity, ++ = limited activity, +++ = moderate activity, ++++ = good activity, +++++ = excellent activity. No data are provided for products that are not labeled for the specific disease or if the efficacy is unknown.

Chemical name (Fungicide product name)	Ant hrac nose	Black rot	Botrytis bunch rot	Downy mildew	Phomopsis cane and leaf spot	Powdery mildew
azoxystrobin (Abound)		+++++	+++ ¹	+++++ ¹	+++	+++++ ¹
boscalid (Endura)		+++++	+++++ ¹			++++ ²
boscalid + pyraclostrobin (Pristine)	++++	+++++	+++++ ¹	+++++ ¹	+++++	+++++
captan (Captan, Captec, etc.)	+++	+++	++	++++	++++	-
Fixed coppers and Bordeaux mixture (various products)		+++	+++	+++	++	++
cyflufenamid (Torino)		-	-	-	-	++++
cyprodinil (Vanguard)		-	+++++ ¹	-	-	++
cyprodinil + fludioxonil (Switch)			++++ ¹			
cyprodinil + difenoconazole (Inspire Super)		++++	+++++ ¹			++++
famoxadone + cymoxanil (Tanos)				+++ ¹		
fenhexamid (Elevate)		-	+++++ ¹	-	-	-
ferbam (Ferbam)		++++	-	++	++	-
fenarimol (Rubigan)		++	-	-	-	+++++ ¹
fluopicolide (Presidio)	-	-	-	+++++	-	-
iprodione (Rovral, Meteor)	-	-	+++ ¹	-	-	-
kresoxim-methyl (Sovran)		+++++	++ ¹	+++ ¹	+++	+++++ ¹
lime sulfur (dormant application)	+++		-	-	+++	++
mancozeb (various: Penncozeb, Dithane, etc)		+++++	-	+++++	+++++	-
mandipropamid (Revus)	-	-	-	+++++	-	-
mandipropamid + difenoconazole (Revus Top)		++++	-	+++++	+++ ²	++++
mefenoxam + copper (Ridomil Gold Copper)		++	++	+++++	++	++
mefenoxam + mancozeb (Ridomil Gold MZ)		+++	-	+++++	+++	-
metrafenone (Vivando)		-	-	-	-	++++
myclobutanil (Rally)		++++	-	-	-	+++++ ¹
phosphonate (ProPhyt, Phostrol, etc.)				++++		
sulfur ³ (various)		-	-	-	++	+++++
tebuconazole (Elite)			-	-	-	+++++ ¹
tetraconazole (Mettle)						++++ ¹
thiophanate-methyl (Topsin M)		++	-	-	+++	+++++ ¹
trifloxystrobin (Flint)		+++++	++++	+++	++	+++++ ¹
triflumazole (Procure and Viticure)		+++ ¹	-	-	-	+++++
ziram (Ziram)		++++	++	++++	+++	-

¹Resistance (or occasional failure of control) has been observed in some southeastern states; thus, if control failure occurs, it could indicate resistance has developed. The efficacy rating could be affected by resistance development. If resistance has occurred, use of fungicides in the same class would likewise show resistance, and a substitute fungicide should be considered for pathogen management.

²Insufficient data for the pathogen-chemical combination. The rating was given based on the general knowledge on the material.

³Sulfur will cause burn on sensitive varieties, especially on hot days, >85°F.

Commercial Crop Production

Small Fruit - Grape

Table 4. Recommended pesticides, rates and pesticide use restrictions for grape

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ^{3,4}	Maximum Use	PHI ⁵	Diseases
aluminum tris (33)	Aliette	3-5 lb	7 app	15	Downy mildew
ametoctradin + dimethomorph (45, 40)	Zampro	11-14 fl oz	56 fl oz	14	Downy mildew
azoxystrobin (11)	Abound 2SC Azoxy 2SC AzoxyStar Aframe Satori 2.08 Willowood Azoxy 2SC	10.5-15.5 fl oz	92.3 fl oz	14	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew Botrytis bunch rot (suppression only)
azoxystrobin+ difenoconazole (11, 3)	Quadris Top	12-14 fl oz	56 fl oz	14	Anthracoese Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew Botrytis bunch rot (suppression only)
boscalid (7)	Endura 30WG	4.5 or 8 oz	24 oz	14	Botrytis bunch rot Powdery mildew
boscalid + pyraclostrobin (7, 11)	Pristine ⁹	8-12.5 oz	69 oz	14	Anthracoese Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew Botrytis bunch rot
	Pristine ⁹	18.5-23 oz	69 oz	14	
captan (M)	Captan 38.75% Captec 4L (various other formulations are available)	1.5-2 qt 0.75-1 qt/100 gal	12 qt 2 qt	0 0	Black rot (suppression only) Downy mildew Phomopsis cane and leaf spot
copper hydroxide (M)	Champ WG ¹⁰ ChamplON ¹⁰	2-6 lb 0.75-1.75 lb	40 lb 66.7 lb	0 0	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
copper hydroxide + mancozeb (M)	ManKocide ¹⁰	2.5 lb	66.7 lb	66	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
copper sulfate (M)	Cuprofix Ultra 40 Disperss ¹⁰ Cuproxtat ¹⁰ (various other formulations are available)	1.25-3 lb 2.5-6 pt	50 lb 98.6 pt	14 14	Black rot Downy mildew Phomopsis cane and leaf spot Powdery mildew

Commercial Crop Production

Small Fruit - Grape

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ^{3,4}	Maximum Use	PHI ⁵	Diseases
cyazofamid (21)	Ranman 400SC	2.1-2.75 fl oz	16.5 fl oz	30	Downy mildew
cyflufenamid (U6)	Torino	3.4 oz	6.8 oz	3	Powdery mildew
cyprodinil (9)	Vanguard WG	10 oz (alone) 5-10 oz (tank mixtures)	30 oz	7	Botrytis bunch rot Powdery mildew (suppression)
cyprodinil + difenoconazole (3, 9)	Inspire Super ¹¹	16-20 fl oz	80 fl oz	14	Anthracnose Black rot Botrytis bunch rot Powdery mildew
cyprodinil + fludioxonil (9, 12)	Switch 62.5WG	11-14 oz	56 oz	7	Botrytis bunch rot
difenoconazole + mandipropamid (3, 40)	Revus Top	7 fl oz	28 fl oz	14	Anthracnose Black rot Phomopsis cane and leaf spot Powdery mildew
dimethomorph (40)	Forum	6 fl oz	24 fl oz	14	Downy mildew
famoxodone+ cymoxanil (11, 27)	Tanos	8 oz	72 oz	30	Downy mildew
fenamidone (11)	Reason 500SC	2.7 fl oz	8.1 fl oz	30	Downy mildew
fenarimol (3)	Rubigan EC ¹² Vintage SC	2-6 fl oz ¹³ 3-6 fl oz ¹⁴	19 fl oz 21 fl oz	21 21	Powdery mildew
fenhexamid (17)	Elevate 50WDG	1 lb	3 lb	0	Botrytis bunch rot Powdery mildew (suppression only)
fluopicolide (43)	Presidio	3-4 fl oz	12 fl oz	21	Downy mildew
iprodione (2)	Iprodione 4L AG Meteor Nevado 4F Rovral 4F	1-2 pt 1-2 pt 1-2 pt 1-2 pt	4 app 4 app 4 app 4 app	7 7 7 7	Botrytis bunch rot
sofetamid (7)	Kenja 400SC	20-22 fl oz	66 fl oz	14	Anthracnose Botrytis bunch rot Powdery mildew
kresoxim-methyl (11)	Sovran 50WG	3.2-6.4 oz ⁸	25.6 oz	14	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
mancozeb (M)	Dithane F45 Rainshield Dithane M45 Dithane F45 Manzate Flowable Manzate Max	1.2-3.2 qt 1.5-4 lb 1.2-3.2 qt 1.2-3.2 qt 1.2-3.2 qt	19.2 qt 24 lb 19.2 qt 19.2 qt 19.2 qt	66 66 66 66 66	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot

Commercial Crop Production

Small Fruit - Grape

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ^{3,4}	Maximum Use	PHI ⁵	Diseases
	Manzate Pro-Stick Penncozeb 75DF Penncozeb 80WVP Roper DF Rainshield	1.5-4 lb 1.5-4 lb 1.5-4 lb 1.5-4 lb	7.5 lb 24 lb 24 lb 24 lb	66 66 66 66	
mancozeb + zoxamide (M, 22)	Gavel 75DF	2-2.5 lb	15 lb	66	Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot
mandipropamid (40)	Revus	8 fl oz	32 fl oz	14	Downy mildew
mefenoxam	Ridomil Gold SL, Ultra Flourish	3.6 pt	0.4 lb ai	60	Downy mildew
mefenoxam + copper hydroxide (4, M)	Ridomil Gold/Copper	2 lb	0.4 lb ai	42	Downy mildew
mefenoxam + mancozeb (4, M)	Ridomil Gold MZ WG	2.5 lb	10 lb	66	Downy mildew
metrafenone (U8)	Vivando	10.3-15.4 fl oz	46.2 fl oz	14	Powdery mildew
myclobutanil (3)	Eagle 20EW Eagle 40WP Rally 40WSP Sonoma 20EW AG	4-6 fl oz/100 gal 3-5 oz 3-5 oz 6-10 fl oz	153 fl oz 1.5 lb 1.5 lb 45.6 fl oz	14 14 14 14	Powdery mildew Anthracnose Black rot Powdery mildew
phosphite ¹⁵ (phosphorous acid salts) (33)	K-phite 7LP, Fosphite, Rampart Phostrol, Alude	1-3 qt 2.5-5 pt	NA NA	NA NA	Anthracnose Downy mildew Powdery mildew Downy mildew
polyoxin D zinc salt (19)	OSO 5% Ph-D WDG Ph-D WDG	3.75-13 fl oz 6.2 oz 6.2 oz	6 app 3 app 3 app	0 0 0	Powdery mildew Botrytis bunch rot Anthracnose
pyrimethanil (9)	Scala SC	18 fl oz (alone) 9 fl oz (tank mix)	36 fl oz	7	Botrytis bunch rot
quinoxifen (13)	Quintec	3-6.6 fl oz	33 fl oz	14	Powdery mildew
sulfur (M)	Liquid Sulfur Six Microfine Sulfur Microthiol Disperss Yellow Jacket Dusting Yellow Jacket Wettable	1-2 pt/100 gal 3.8-25 lb 3-10 lb 10-20 lb 3.8-25 lb	8 pt NA NA NA NA	NA NA NA NA NA	Phomopsis cane and leaf spot Powdery mildew

Commercial Crop Production

Small Fruit - Grape

Chemical Name (Product Mode of Action Group ¹)	Product Name ²	Rate ^{3,4}	Maximum Use	PHI ⁵	Diseases
tebuconazole (3)	Elite 45DF	4 oz	2 lb	14	Black rot Powdery mildew
	Orius 20AQ	8.6 oz	68.8 oz	14	
	Tebuzol 45DF	4 oz	2 lb	14	
	Mettle 125ME	3-5 fl oz	10 fl oz	14	
	Mettle 125ME	3-5 fl oz	10 fl oz	14	Anthracnose
tebuconazole + trifloxystrobin (3, 11)	Adament 50WG ¹⁶	3-6 oz	48 oz	14	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot
tetraconazole	Mettle 125ME	3-5 fl oz	10 fl oz	14	Black rot Powdery mildew
thiophanate-methyl (1)	Thiophanate-methyl 85WDG	0.6-1.2 lb	3.2 lb	14	Black rot Powdery mildew
	T-Methyl 70WSB	.75-1.5 lb	6 lb	7	
	Topsin M 70WP	.75-1.5 lb	6 lb	7	Black rot Botrytis bunch rot Powdery mildew
	Topsin M WSB	.75-1.5 lb	6 lb	7	
	Incognito 85WDG	0.8-1.2 lb	3.2 lb	14	Bitter rot Black rot Powdery mildew
triflumizole (3)	Procure 480SC	4-8 oz	32 oz	7	Powdery mildew
trifloxystrobin (11)	Flint 50WG ⁷	1.5-4 oz ⁸	24 oz	14	Black rot Botrytis bunch rot Downy mildew Phomopsis cane and leaf spot Powdery mildew
ziram (M)	Ziram 76DF	3-4 lb	28 lb	21	Black rot Botrytis bunch rot (suppression only) Downy mildew Phomopsis cane and leaf spot

¹Reference to commercial or trade names is made with the understanding that no discrimination is intended nor endorsement of a particular product by LSU or the LSU AgCenter is implied.

²Mode of action groups are determined by the Fungicide Resistance Action Committee (FRAC).

³Rates are the amount of formulation per acre of wine or sherry grapes unless otherwise indicated. See label for rates and restrictions for table or raisin grapes. Usually 100 gallons of water are required to give good coverage with boom sprayers.

⁴All rates refer to foliar applications unless otherwise noted. Refer to label for other application rates and directions.

⁵Postharvest interval (PHI) is the minimum number of days allowed between the last application and harvest.

⁶For resistance management purposes, only 2 applications per year is recommended.

⁷Do not use Flint on Concord.

⁸Rates vary depending on disease. Refer to label for rates and timing.

⁹Do not use on Concord or Noiret. Possible foliar injury may also occur on Worden, Fredonia, Niagara, Steuben or Rougeon. See label for additional restrictions.

¹⁰See label for variety restrictions. Add hydrated lime (1-3 lb) per pound of Champ WG to minimize foliar injury.

¹¹Do not use on Concord or Thomcord.

¹²Use a surfactant when Rubigan EC is applied alone.

¹³Prebloom apply 2-4 fl oz/A; Postbloom apply 4-6 fl oz/A; cover sprays apply 5-6 fl oz/A.

Commercial Crop Production

Small Fruit - Grape

¹⁴Prebloom apply 3-4 fl oz/A; Postbloom apply 5-6 fl oz/A; cover sprays apply 5-6 fl oz/A.

¹⁵Do not apply when temperatures exceed 90°F, shortly after a rain event, or during color break of the fruit.

¹⁶See label for variety restrictions.

Information in the grape section was updated December 2019 by Dr. R. Singh.