Crop Profile for Grapes in Arkansas

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General Production Information

Arkansas is the oldest grape juice and wine producing state in the southern United States. Grapes were first grown commercially in Arkansas at Altus in the foothills of the Ozark Mountains in the 1870's. The Arkansas grape industry is diverse with production of grapes for the fresh market from American hybrid table grape varieties, wine made from traditional European varieties (*Vitis vinifera* L.), French-American hybrids, American hybrid varieties (*Vitis aestivalis* Michx. and *Vitis labruscana* Bailey) and muscadine varieties (*Vitis rotundifolia* Michx), and juice production based upon American hybrid varieties (*Vitis labruscana* Bailey) and muscadine varieties.

- **State Rank**: 12th
- **Percentage of U.S. Production**: <1%
- **Total acres grown**: 1400 acres
- **Cash Value**: $2,495,000

Production Regions:
Grapes are grown throughout the state. The main area for fresh market production is in White County with other plantings scattered throughout central and northern Arkansas. The Altus area (Franklin County) and Northwest Arkansas (Benton, Madison and Washington Counties) are the centers of wine grape production. Climatic differences restrict production of *V. vinifera* and *V. rotundifolia* to the area south of the Boston Mountains and disease pressure (Pierce's Disease) further limits *V. vinifera* to areas north of the Arkansas River and west of Little Rock. Juice grape production can be divided into two separate categories: production based upon Concord type grapes (*V. labruscana*) or based upon muscadine varieties. Concord type grape acreage is concentrated in Benton and Washington Counties in northwest Arkansas but this acreage is declining due to loss of market and high local land values. Muscadine juice is produced by Arkansas wineries and sales of these products are increasing. The main areas of production for muscadines grown for juice processing are in Franklin and White Counties.

Production Methods:
A successful vineyard operation in Arkansas will include appropriate site selection, cultivar selection, and cultural practices to produce sufficient yields of grapes of acceptable quality to fulfill the local and regional market demands.

Optimum criteria used for vineyard site selection are: soil with good internal drainage, acceptable chemical properties (pH) and moderate water holding capacity; available irrigation water source (precipitation, ground water, reservoir); topography, slope, aspect and vegetation management which contribute to rapid air drainage to lower elevations (frost avoidance) and maximum sunlight interception during the growing season; if previously cropped, a history of successful production; proximity to markets (PYO, winery, shipping, processing); and lastly avoidance of proximity to vineyard pests.

Selection of cultivars best adapted to Arkansas conditions is an important decision for a prospective grower and an area of continuing research by the University of Arkansas. The selection of adapted cultivars will significantly reduce the chemical, labor, and resource inputs into the vineyard operation compared to non-adapted cultivars.

Current recommendations for the table grape industry (fresh market) are 'Venus', 'Mars', 'Jupiter'

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and ‘Neptune’. These are *V. labruscana* hybrid cultivars developed by the University of Arkansas Fruit Breeding Program to fulfill a demand in eastern and Canadian markets where the unique flavors of these cultivars are often preferred. New cultivars developed by the University of Arkansas are being planted and research on IPM and cultural practices is under way to address the challenges of producing high quality fruit with reduced chemical inputs under Arkansas climatic conditions.

Wine grape cultivar selection by growers in Arkansas has become more important due to recent increases in acreage planted to wine grapes and winery demand for high quality fruit in both local and regional markets. An amazing amount of diversity in cultivars to select from is available to producers of wine grapes in Arkansas including *V. vinifera, V. labruscana, V. rotundifolia*, *V. aestivalis* and complex hybrids of some of these species allowing growers and wine makers to satisfy the diverse demands of regional consumers. Local climate and pest pressure are predominate influences in cultivar selection. For example, *V. vinifera* production is restricted to areas south of the Boston Mountains due to increased risk of low temperature injury in more northern locations and north of the Arkansas River due to the presence of Pierce’s Disease vectors in more southern locations. In addition, *V. rotundifolia* should only be planted in central and southern Arkansas to avoid increased risk of low temperature injury in more northern locations whereas *V. labruscana* cultivars are more adapted to northern locations and may not ripen appropriately if planted in areas south of the Arkansas River. Currently the leading cultivars are as follows: *V. vinifera* – Chardonnay, White Reisling, Cabernet Sauvignon, Cabernet Franc, and Merlot; American and French hybrids – Vidal Blanc, Seyval, Chardonel, Verdelet, Vignoles, Chambourcin, Cynthiana/Norton, Villard Noir; *V. labruscana* – Catawba, Niagara; *V. rotundifolia* – Carlos, Noble.

The Fruit Breeding Program at the University of Arkansas as well as breeding programs in New York, Minnesota, and other locations are currently making selections of wine grapes for release in the near future that may prove beneficial to growers in Arkansas. One objective of many of these breeding programs is increased disease resistance, which would potentially lead to reduced chemical inputs for grape production in warm, humid regions like Arkansas. Another component of cultivar selection is the choice of rootstock. Many vineyards in Arkansas are planted with own rooted grapevines but several endemic pests of grapes (phyollexra, nematodes, and grape root borer) will attack the roots leading to decreased longevity or a rapid decline of the vineyard. Little is known about which rootstocks are best adapted to the regional soils and growing conditions and much more work is needed if recommendations for specific rootstock use can be accurately made but it is likely that rootstocks will provide great utility to wine grape growers. Evaluations of currently available selections from these breeding programs and of commercially available rootstocks are under way.

Recommended cultivars for the juice production are Concord and ‘Sunbelt’ in northern Arkansas and *V. rotundifolia* – Carlos, Noble, Summit and Black Beauty in central and southern Arkansas.

Cultural practices vary with cultivar, location and intended market for the crop. Trellising is generally Single Curtain, Geneva Double Curtain, or Vertical Shoot Positioned. Irrigation is recommended as well as an appropriate fertilization regime. Vineyards in Arkansas typically have resident vegetation in the row middles that is maintained and mowed periodically or cultivated once or twice in the growing season. Most grapes are machine harvested with some hand harvest occurring with wine grapes and all table grapes. During the dormant season vines are pruned by hand or prepruned by machine with hand follow-up used to achieve final pruning level.

Commodity Destination(s):

- Fresh Market 9%
- Processing (wine) 55%
- Processing (juice) 36%

Cultural Practices

Worker Activities:
Grape vines are pruned during the dormant season. Most of the grape acres (60%) are pre-pruned with mechanical pruning. Approximately 40% of the grape acres receive follow-up hand pruning after the mechanized prepruning. Approximately 50% of the grape acres have suckers removed by hand (2 times) in April through July. Shoot thinning by hand is performed on 5% of the acres in April and May. Hand positioning of shoots during May and June is performed on approximately 10% of the grape acres. Ten percent of the acres have hand leaf removal in May and June.

Preemergent herbicide applications are applied in early spring, primarily with tractor mounted spray equipment. Postemergence herbicide applications are made in early summer and occasionally after harvest primarily with tractor mounted sprayers although backpack sprayers are occasionally used. Row middles are mowed throughout the growing season.

Insecticides and fungicides are applied from early spring up to harvest primarily with orchard blast sprayers.

Approximately 40% of the grape crop is hand-harvested in May through August with the rest mechanically harvested.

Insect Pests

Grape Berry Moth
Endopiza viteana Clemens

This is the primary insect pest of grapes in Arkansas. This native pest overwinters as a pupa. The pupa is housed within a small, folded section of grape leaf, both on wild and cultivated grapes. The adult is a small moth with a mottled brown/gray body. It is most problematic within vineyards in close proximity to woodlands with wild grapes. In the fall, pupa infested leaves are blown to the fencerows and wooded areas around the vineyard. From early April to bloom, adult Grape berry moths emerge from the woods and lay eggs in the edge row of vineyards. These eggs hatch about mid-May. These first-generation larvae will spin a web around several berries and feed on them externally. Infested berries appear shriveled within the fine webbing. The mature larva cuts a "D" shape into a grape leaf, folds the leaf over itself and uses silk to fasten the cut leaf edge to the rest of the leaf. Then the larva transforms into a pupa inside the leaf cocoon. Second-generation moths emerge typically in early-June in Arkansas, mate and lay single eggs on grape berries, cluster stems, and on vines throughout the vineyard. Larvae of this generation enter berries and feed internally on several berries before pupating. Damage at this growth stage of the berries is easily detected due to the dark tunneling under the green grape skin. Damaged berries usually rot. There may be four generations per year of grape berry moth in Arkansas. Risk of grape berry moth attack increases with increase in percent of vineyard perimeter adjacent to wooded areas.

Monitoring: Place three grape berry moth pheromone traps in edge of wooded area adjacent to the perimeter of vineyard. Check the traps twice a week and note the date when moths are first caught, usually around 10 April in Arkansas. Begin accumulating degree-days above 50°F after first moth catch using daily maximum and minimum temperatures. Move all three of the traps to vineyard center in mid-May and monitor weekly through harvest.

Control: In May, if there is a large population of moths in the perimeter traps and 450 degree

days have accumulated then a perimeter row insecticide application may be applied. For later generations, full vineyard applications can be applied at the first sign of larval damage about 1200 degree-days. This should eliminate the potential feeding damage to the edge rows. Mating disruption is available for vineyards larger than 5 acres at the rate of 400/acre. If using mating disruption, pheromone traps need to be placed in the center of the vineyard by 15 May and damage assessment of fruit conducted weekly to make sure the disruption is working properly. The following chemicals are all labeled for grape berry moth control: Danitol, Diazinon, Guthion, Imidan, Isomate GBM, Methoxychlor, and Sevin.

Climbing Cutworms

various genera in *Lepidoptera: Noctuidae*

Several generations of cutworms will occur during the season, but only the larvae exiting overwintering sites will attack grape buds during bud swell. Twelve cutworm species have been reported attacking grapes in the eastern United States. Significant damage can occur if populations are high and/or cool weather delays bud growth so that buds remain in the susceptible stage for an extended period. Feeding on the buds results in the loss of the primary and in some instances the secondary and tertiary buds as well. Damage to the buds by climbing cutworms is similar to that caused by adult grape flea beetles. Determining the true cause of bud damage can be challenging in part because climbing cutworms hide by day under loose trunk bark or under the debris beneath the trellis and walk up vines and feed at night. Climbing cutworms are often more of a problem in vineyards with light-textured soil with weeds and grasses under the vines that provide daytime cover.

Monitoring: When buds begin swelling look for feeding damaged buds. If you don't find flea beetles feeding during the day and have bud damage you can take a flashlight and monitor the buds at night looking for cutworms along the top canes and trellis wires.

Control: Eliminate groundcover under the vines to help remove sites where cutworms hide during the day. If bud damage is found, apply chemical coverage as long as feeding continues or all buds develop into first stage leaves. The following chemicals are labeled for cutworm control: Danitol and Sevin.

Grape Flea Beetle

Altica chalybea Illiger

Adult beetles emerge in early spring and attack grape buds as they are beginning to swell. The adult is a shiny blue-green black beetle approximately 1/5 inch long. Adult flea beetles feed during the day and cause similar damage to cutworm feeding. Destruction of primary buds can cause considerable yield loss. Vines can compensate for the loss of the primary bud through the production of secondary buds although shoots from these secondary buds are less fruitful than the primary buds. They lay their eggs under the edges of loose bark and the larvae will feed on the upper leaf surface. This leaf skeletonization does not affect yield. Damage is usually restricted to vineyard borders, particularly near wooded areas.

Monitoring: When buds begin swelling look for feeding damaged buds. The adults will be feeding on buds during the daytime.

Control: If bud damage is found, apply insecticide sprays to vines as long as feeding continues or all buds develop into first stage leaves. The following chemicals as labeled for flea beetle control: Danitol, Imidan, and Sevin.

Two-Spotted Spider Mite

Tetranychus urticae Koch

The two-spotted spider mite lives on broadleaf groundcover plants in the orchard floor. They are found worldwide and feed on a wide range of plants. When herbicides are applied to the groundcover or in drought conditions, these mites will move into the vines. They suck the chlorophyll from the leaves and this loss of chlorophyll can reduce fruit size and quality when mite populations build up. As a rule they have more webbing on the leaves and the leaf bronzing is grayer than that caused by the European red mites. European red mites, *Panonychus ulmi* Koch, have not been reported to feed on grapes growing in Arkansas.

Cultural controls: Maintenance of a broadleaf-free groundcover will keep the mite population low in the vines. Leaf removal will open the airflow in the canopy and may contribute to a reduction in mite populations. Predator mites are commercially available to help control the two-spotted spider mite.

Chemical Control: Examine 100 leaves for presence of mites. If groundcover touches the lower limbs, check additional leaves. Treat if you find an average of six or more mites per leaf, or >80% of leaves with mites, and less than one predator mite per leaf. The following compounds are registered for control of Two-spotted spider mites: Agri-Mek, Danitol, Diazinon, Guthion, Kelthane, Pyramite, Vendex, and Vydate.

Grape Phylloxera

Daktulosphaira vitifoliae Fitch

This tiny insect has a more complex life cycle than other grape pests and is considered the most serious grape pest worldwide because it causes vine death in the root form. The aerial form of these tiny insects begins feeding on developing leaves that respond by forming galls around individual phylloxera. There are 5-7 generations per year of this aerial form. The leaf gall opens to the upper surface of the leaf, therefore the phylloxera is protected inside the gall. The root form of phylloxera is considered an economic problem in Arkansas on own-rooted hybrids with vinifera or *V. labrusca* parentage. Grape cultivars with parentage of grape species from the SE United States are not susceptible to phylloxera.

Monitoring: On susceptible cultivars, begin examining the foliage weekly for new galls on expanding leaves after fifth leaf. By about the tenth leaf, around bloom, is when the fundatrix females begin producing young. These young walk to the expanding leaves and feed causing galls to form. When leaf galls are first found, remove the few leaves that are infested and destroy them. Plant cultivars that tolerate this insect.

Control: At tenth leaf (about bloom), apply insecticide for control. The following chemicals are labeled for foliar phylloxera control: Danitol, and Thiodan (phytotoxic to Concord cultivars). Concord tolerates foliar phylloxera. Malathion can be used for control in nursery environments.

Grape Root Borer

Vitacea polistiformis Harris

Grape root borers attack the roots of grapes in Arkansas. The larvae can severely damage the roots, causing loss of vigor, decline and eventually vine death. Infestations can build up and be several years old before vine decline is noticed. The adults are clear-wing moths that are brown and have yellow marking on the abdomen similar to wasps. Adult moths emerge from mid-June to August and lay eggs on the underside of grape leaves. They hatch, dig into the soil and tunnel into the pencil-size or larger roots. The larvae are white to cream colored with brown heads. Larvae remain in the roots of the same vine for 22 months. The larvae migrate to just below the soil

surface to pupate inside a silk cocoon. Larval root tunneling protects it from foliar and soil surface chemical applications. Adults emerge leaving the pupal case at the soil surface. This insect has a two-year life cycle in Arkansas.

Monitoring: Place pheromone traps in the vineyard by the first of June to monitor for adult flight. In July and August, inspect soil for amber colored pupal cases within 18" of 100 randomly selected trunks. By the end of the summer, you will know what percentage of vines was infested with borers.

Control: Historically the grape hoe was used to throw 4-6 inches of soil over pupae in mid-June and repeated in mid-July. This prevented adult emergence. Ohio recommends placement of nine pheromone traps in two acres, thus mass trapping the insect. Over several years this will result in a reduction of available males for mating and mated females. The newly hatched larvae are susceptible to insecticide as they enter the soil in search of roots. Lorsban is the only registered compound labeled for this insect. Good weed control is critical for getting good spray coverage of the soil under vines.

Grape Leafhoppers

Erythroneura comes Say

Heavy feeding from adults and nymphs can cause severe bronzing of the leaf surface and premature defoliation. Heavy populations may reduce fruit quality and yield. Both nymphs and adults suck sap from the underside of grape leaves. Females oviposit eggs on the underside of leaves within the leaf tissue. Eggs hatch occurs within two weeks. There are 2-3 generations per year. Depending upon cultivar susceptibility and environmental conditions, populations may reach sufficient numbers to warrant treatment. In the fall unmated adults seek protection in plant debris in woods and fencerows near the vineyard.

Monitoring: Attach yellow sticky tape (3" width) in the perimeter rows of the vineyard between posts to monitor movement of populations. Also check ten basal leaves in several locations for presence of leafhoppers.

Control: Time insecticide sprays against the nymphs, which are more susceptible to insecticide than adults. The threshold is between 5-10 nymphs per leaf.

The following chemicals are labeled for control of leafhoppers in grapes: Danitol, Diazinon, Malathion, Methoxychlor, Pyramite, Sevin, and Thiodan.

Japanese Beetle

Popillia japonica Newman

This is a new pest in Arkansas with grape leaf damage reported in 2001. The adult beetles feed on the foliage and fruits of more than 250 kinds of plants, but grape is one of the preferred hosts. The adult beetle has a shiny, metallic-green head and thorax, coppery-brown wing covers and five white tufts of hair on each side of the abdomen. Adult beetles emerge from the ground from late-June through July, and begin feeding upon foliage. Mating occurs at this time and eggs are laid in the ground under the turf. Beetles prefer foliage exposed to direct sunlight and often are seen clustered together feeding on tender vegetative parts. Vines with thin, smooth leaves, such as French hybrids, are preferred over those with thick, pubescent leaves, such as Concord. Concord vineyards rarely need special control sprays for Japanese beetles. On the other hand, French hybrids and other thin-leafed cultivars require frequent inspection to prevent damage. Damaged leaves have a laced appearance, and severely affected leaves will drop prematurely. Japanese beetles (JB) cause direct fruit injury as well as the characteristic skeletonization of leaves due to feeding. Foliage feeding greatly reduces the ability of plants to photosynthesize and hence

decreases productivity through the almost complete annihilation of leaf tissue.

Monitoring: These beetles are easily detected while walking through the vineyard. A Japanese beetle lure and trap are available for monitoring this pest. Place pheromone/floral bait traps at least 100 ft from the perimeter of vineyard. This will let you know the time period when adults may be invading the planting. Keep traps at least 100 foot from the vineyard so as not to increase numbers attacking the vineyard.

Control: If skeletonizing of leaves become evident; these cultivars may need to be protected with an application of insecticide. The usual threshold for making a spray application is about 15% of the leaves damaged. Insecticide is usually applied when feeding is apparent on most vines and skeletonized leaves are found. Spot treatment is adequate in some cases. An insecticide with long residual activity is needed when beetle populations are high. Repeated applications may be needed to control new beetles flying in from surrounding areas. Slight defoliation has not been shown to have significant effects on grape yield. Acceptance, on the part of the growers, of some defoliation on mature vines may reduce the number of chemical applications necessary for Japanese beetle control. The following chemicals are labeled for control of Japanese beetle: Danitol, Imidan, Malathion, Methoxychlor and Sevin.

Green June Beetle

Cotinis nitida l.

The green June beetle is a pest of ripe grapes in Arkansas during harvest. The adult beetle causes direct damage to the fruit. They are large bodied metallic green-brown beetles. Adults emerge from the soil after a soaking rain in late June or July. Adults are first noticed flying low to the ground over pastures and then around adjacent trees. They are maturing sexually at this time and mating. After mating the females dig into the pasture to lay eggs in the soil usually in pastures where livestock have grazed or where green manure is used as fertilizer. Larva feed on fungi and decomposed organic matter at the soil surface. The larvae spend their entire life in the soil, form soil cells the following May where they pupate and then emerge from the soil as adults. The newly emerged females emit a sex pheromone that attracts males to mate. After mating and egg laying, the adults are attracted to and feed on various types of sweet sap, ripening, and damaged fruit, such as grapes. They have an aggregation pheromone that calls other beetles to feed and congregate on the fruit in large numbers. They are messy feeders, staining and tainting the clusters and those below the feeding sites. Flying beetles are noisy and startle the harvesters.

Monitoring: Look for the beetles flying in pastures or around trees in late June through July. They will be looking for food about a week after emerging from the soil and mating.

Control: Spraying the vineyard when beetles are present will give some immediate knockdown of this insect but may also cause the beetle to spread out in the vineyard. One or more sprays may be necessary to prevent economic damage. The following chemical is labeled for control of green June beetle: Sevin.

Grape Scale

Diaspidiotus uvae Comstock

Grape scale is a pest of grapes in Arkansas. Grape is the only host of this insect with economic importance. The grape scale covering is integrated with the grape cambium (light brown with dark brown stripes). Mated scales overwinter on the grape canes and trunks and under loose bark, then resume development in the spring. The scale insect is stationary as an adult female. The females both lay eggs and give birth to live young called crawlers that are mobile for 24-48 hours. The females die after egg laying. Crawler emergence period persists for 2-3 weeks staring about mid-May and for several weeks after 16 July. Winged males emerge and mate with the stationary

female in late-June to early-July; flight is very short in duration. Wingless males emerge from mid-September to early-November when mating also occurs.

Monitoring: Look for live scale on the trunks, under loose bark and on canes during dormant pruning. Mark the sites where scale is found. In late March or early April, take a pin and lift up the scale covering to observe if the scale is alive or dead. If there is a bright-yellow blob that oozes when punctured, the scale is alive. If it is dark/amber colored and hard it is dead. Place double-sticky tape around infested canes near the scale. In early-May, begin checking twice weekly for crawlers on the tape. Replace tapes each time until no new crawlers are found.

Control: Dormant oil applications are still recommended for control of overwintered female scale but do not kill scale protected under the loose bark. It was once recommended to keep canes protected with an insecticide spray application every ten days until crawler activity ends. Currently no insecticides are labeled for protection against grape scale, although grape berry moth insecticide control often occurs at this time if the whole vineyard is sprayed.

Insecticides Labeled for Grapes

Abamectin

- Formulation: Agri-Mek 0.15% EC
- Target pests: Two-spotted spider mite
- Average rate of most common formulations:
  -- Agri-Mek 0.15%EC (8-16 fl oz/A) plus a nonionic surfactant
- Preharvest interval: 28 days
- Restricted entry interval: 12 hours

Carbaryl

- Formulations: Sevin XLR, Sevin80S, and Sevin 4F
- Target pests: Green June beetle, Grape berry moth, Leafhopper, Japanese beetle, Flea beetle, and Cutworm
- Average rate of most common formulations:
  -- Sevin XLR (1-2 qt/A)
  -- Sevin 80S (1.25-2.5 lbs./A)
  -- Sevin 4F (1-2 qt/A)
- Preharvest interval: 3 days
- Restricted entry interval: 12 hours

Chlorpyrifos

- Formulations: Lorsban 4EC
- Target pests: Grape rootborer
- Average rate of most common formulation:
  -- Lorsban 4EC (4.5 pts/100gallons for grape rootborers), apply 2 qt. of this dilute spray mix to soil surface on a 15 sq. ft area around base of each vine.
- Preharvest interval: 35 days or postharvest
- Restricted entry interval: 24 hours

Diazinon

- Formulations: Diazinon 50W, Diazinon 4EC, Diazinon AG600
- Target pests: Grape berry moth, Leafhopper, and Mites
- Average rate of most common formulation:
  -- Diazinon 50W (1-2 lb./A)
  -- Diazinon 4EC (1-2 pt./A)

-- Diazinon AG600 (12.75-25.5 fl oz/A, 100 gallon water minimum)
- Preharvest interval: 21 days
- Restricted entry interval: 24 hours

Dicofol

- Formulations: Kelthane 50WSP
- Target pests: Mites
- Average rate of most common formulations:
  -- Kelthane WSP (2.5 lbs./A)
- Preharvest interval: 7 days
- Restricted entry interval: 48 hours

Dormant Oil

- Formulations: Superior oil
- Target pests: scale
- Average rate of most common formulation:
  -- Superior oil (1-3 gallons/100 gallon for scale) or (0.5 gallon/100 gallons plus Lorsban for Grape rootborers and Scale)
- Preharvest interval: postharvest, after leaf fall only
- Restricted entry interval: 12 hours

Endosulfan

- Formulations: Thiodan 70 W, Thiodan 3EC. Phaser 70W or Phaser 3EC
- Target pests: Leafhoppers and Foliar phylloxera
- Average rate of most common formulations: prohibited on certain wine varieties and Concord varieties
  -- Thiodan 3EC (1.33 qt/A) for grape leafhoppers, foliar phylloxera
  -- Phaser 3EC (1.33 qt/A) for grape leafhoppers, foliar phylloxera
  -- Thiodan 70 WP (2 lb./A) for grape leafhoppers, foliar phylloxera
  -- Phaser 70 WP (2 lb./A) for grape leafhoppers, foliar phylloxera
- Preharvest interval: 7 days
- Restricted entry interval: 24 hours

Fenpropathrin

- Formulations: Danitol 2.4 EC
- Target pests: Flea beetle, Cutworm, Grape berry moth, Leafhopper, Foliar phylloxera, Japanese beetle.
- Average rate of most common formulation:
  -- Danitol 2.4 EC (5.3-10.7 fl oz /A), low rate for flea beetle
- Preharvest interval: 21 days
- Restricted entry interval: 24 hours

Fenbutatin-oxide

- Formulations: Vendex 50 WP, Vendex 4L
- Target pests: Mites
- Average rate of most common formulation:
  -- Vendex 50 WP (1-2.5 lbs./A)
- Preharvest interval: 28 days
- Restricted entry interval: 48 hours

Malathion

- Formulations: Malathion 8F

- Target pests: Japanese beetle, Leafhopper
- Average rate of most common formulations:
  -- Malathion 8F (2-4 pt/A) for Japanese beetle
- Preharvest interval: 3 days
- Restricted entry interval: 24 hours

Methoxychlor

- Formulations: Methoxychlor 50WP
- Target pests: Grape berry moth, Leafhopper, and Japanese beetle
- Average rate of most common formulations:
  -- Methoxychlor 50WP (6lbs/A)
- Preharvest interval: 14 day
- Restricted entry interval: 12 hours
- Comments:currently on EPA suspended status April 2002

Methomyl

- Formulations: Lannate LV
- Target pests: Grape berry moth, Leafhoppers
- Average rate of most common formulation:
  -- Lannate LV (1.5-3 pt./A)
- Preharvest interval: 1 day for fresh market grapes, 14 days for wine grapes
- Restricted entry interval: 7 days

Phosmet

- Formulations: Imidan 70W
- Target pests: Green June beetle, Grape berry moth, Japanese beetle, Flea beetle, Leafhopper
- Average rate of most common formulation:
  -- Imidan 70 W (1.3-2.1 lbs./A)
- Preharvest interval: 14 days
- Restricted entry interval: 3 days
- Comment: this chemical is being phased out over 5 years

Pyridaben

- Formulations: Pyramite 60WP
- Target pests: Mites
- Average rate of most common formulation:
  --Pyramite 60WP (6.6-13.2 oz/A)
- Preharvest interval: 7 days
- Restricted entry interval: 12 hours

Summer Oil

- Formulations: Saf-T-Side
- Target pests: Scale
- Average rate of most common formulation:
  -- Saf-T-side (1-1 ½ gallons/100 gallon)
- Preharvest interval: 14 days or postharvest
- Restricted entry interval: 4 hours

Insecticides Used on Grapes

Crop	Class	Insecticide	Trade	% Acres	%	Avgerage #

			Name	Treated as Reported by Growers in 1991	Acres Treated In 2002	Applications
Grapes	Insecticide	Carbaryl	SevinXLR or 80S or 4F	63	75	2
Grapes	Insecticide	Chlorpyrifos	Lorsban 4EC	Not reported	70	2
Grapes	Insecticide	Diazinon	Diazinon 50W or 4EC or AG600	1	2	2
Grapes	Insecticide	Endosulfan	Phaser 70W or 3EC, Thiodan 70W or 3EC	Not reported	60	2
Grapes	Insecticide	Fenbutatin-oxide	Vendex 50 WP or 4L	Not reported	2	2
Grapes	Insecticide	Malathion	Malathion 8F	15	20	2
Grapes	Insecticide	Phosmet	Imidan 70W	5	35	2
Grapes	Insecticide	Azinphos-methyl*	Guthion	5	14	3

* **The registration for the use of azinphos-methyl on grapes has been cancelled as of September 1, 2002.**

Weeds

Weed competition, especially in young vineyards with vines 1-3 years old can dramatically reduce vine vigor and may extend the time required bringing a vineyard into full production. Weeds not only compete with grapevines for nutrients and water, but also reduce airflow within the vineyard and can provide habitats for diseases and insects. On the positive side, weeds can also provide habitat for beneficial insects, those insects that prey on or parasitize pest insects. However, maintaining weed strips for this purpose requires very careful weed management such as mowing or cultivation. Generally, weeds in most vineyards are controlled using herbicide applications. The rates of preemergence herbicides are usually dependent on the weed species to be controlled, the soil texture, and the length of control desired. Soil texture and organic matter content affect most preemergence herbicides. The lower rates generally apply to sandy soils or those that are low in organic matter and the higher rates to heavy clay soils or those that are high in organic matter. An acidic soil pH in the top inch of surface soil can substantially reduce the effectiveness of simazine. Other herbicides used in vineyards are not known to be affected by soil pH. The recommended rates for postemergence herbicides are based on the species to be controlled and the weed height. The higher rate is often necessary for taller weeds. Postemergence herbicides are most effective when applied to actively growing, succulent weeds. Several of the postemergence herbicides require the use of a nonionic spreader or oil concentrate for maximum effectiveness.

Herbicides Labeled for Grapes
Preemergence Control

Clethodim

- Formulations: Select 2EC
- Target weeds: grasses
- Application: Single application of 6 to 8 fl. oz./ acre soil plus crop oil concentrate containing at least 15% emulsifier at 1% v/v
- Restricted entry interval: 12 hours
- Comments: May be applied as a spot treatment. Grasses need to be actively growing. Do not apply to vines that will be harvested within one year of treatment.

Dichlobenil

- Formulations: Casoran 4G or Norosac 4G
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 100 lb./ acre soil surface applied between November 15 and February 15 to weed free soil.
- Restricted entry interval: 12 hours
- Comments: Apply only to plants established one year or more. Do not apply during new shoot emergence, incorporate for best results.

Diuron

- Formulations: Karmex DF
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 2-3 lb. in 25-40 or more gallons of water/acre applied in spring before weeds emerge and vines leaf out.
- Restricted entry interval: 12 hours
- Comments: Apply only to plants established one year or more.

Isoxaben

- Formulations: Gallery 75DF, Gallery T & V
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 0.66 – 1.33 lb. in a minimum of 10 gallons of water/acre applied in spring before weeds emerge and vines leaf out.
- Restricted entry interval: 12 hours
- Comments: Apply only to plants established one year or more. Do not apply to newly transplanted vines until soil has settled. Rainfall/irrigation required within 21 days. For non-bearing vineyards only, do not use within one year of harvest.

Napropamide

- Formulations: Devrinol 50 DF
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 8 lb. in at least 20 gallons of water/acre. Apply to the base of plants in late fall to spring on weed free soil.
- Restricted entry interval: 12 hours
- Comments: May be applied to newly planted (non-bearing) or established (bearing) plants. Requires sufficient irrigation or rainfall to wet the soil to a depth of 4 inches within one week of application for incorporation. Do not allow spray to contact fruit or foliage. Do not apply within 35 days of harvest.

Norflurazon

- Formulations: Solicam 80 DF
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 2.5 lb. (sandy or light-colored soil) to 5 lb. (heavy or dark-colored soil) in at least 20 gallons of water/acre. Apply to clean soil surface from fall to

early spring when crop is dormant.
- Restricted entry interval: 12 hours
- Comments: Apply only to plants established two years or more. Requires rainfall or irrigation within 4 weeks of application for product activation. Application may result in temporary bleaching or chlorosis of leaves from which the plant will recover. Do not apply after bud break on sandy loam soils

Oryzalin

- Formulations: Surflan 4 AS or Oryzalin 4 AS
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 2.0 to 4.0 qt. in 20 to 40 gallons of water/acre applied to soil along the berm. Apply in the fall or early spring before weeds emerge or fruit set.
- Restricted entry interval: 12 hours
- Comments: do not apply to newly planted vineyards until soil has settled and no cracks are present. Requires rainfall or irrigation of 0.5 to 1.0 inches to activate product. Do not spray foliage.

Oxyfluorfen

- Formulations: Goal 2XL
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 2.0 to 8.0 pt. in a minimum of 40 gallons of water/acre. Do not apply if leaves or fruit are present or if buds have begun to swell.
- Restricted entry interval: 24 hours
- Comments: Do not spray foliage.

Pendimethalin

- Formulations: Prowl 4EC
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 2.0 to 4.0 qt. in a minimum of 20gallons of water/acre applied to soil along the berm. Apply to weed free soil.
- Restricted entry interval: 12 hours
- Comments: Apply only to dormant, nonbearing grapevines. Do not apply if buds have begun to swell.

Pronamide

- Formulations: Kerb 50WP
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 2.0 to 8.0 lb. in 20 to 40 gallons of water/acre applied to soil along the berm. Apply in the fall or early spring before weeds emerge or fruit set.
- Restricted entry interval: 12 hours
- Comments: Newly planted vineyards must be at least 6 months old. Restricted use pesticide.

Simazine

- Formulations: Princep 4L, Princep 90WDG
- Target weeds: annual broadleaf weeds
- Application: Single application of 2 to 5 lbs./treated acre(90WDG); 2 to 4 qt./treated acre(4L). Apply to soil under trellis in the fall or early spring before weeds emerge or fruit set.
- Restricted entry interval: 12 hours
- Comments: Do not apply to sandy, loamy sand, gravelly soils, or exposed subsoils. Use only on vineyards that are at least 3 years old.

Trifluralin

- Formulations: Treflan
- Target weeds: grasses and broadleaf weeds
- Application: Single application of 0.5 to 2.0 ai./acre applied to soil along the berm. Incorporation is required.
- Restricted entry interval: 12 hours
- Comments: Do not apply within 60 days of harvest.

Postemergence Control

Fluaziflop

- Formulations: Fusilade DX 2EC
- Target weeds: grasses
- Application: Apply as multiple applications (2-4) in established plantings as a directed spray to actively growing weeds. Apply 1.0 to 1.5 pt. with crop oil concentrate at 1 qt. in a minimum of 25 gallons of water/acre.
- Restricted entryinterval: 12 hours
- Comments: Do not apply if rainfall is expected within one hour of application. Low spray volumes (10gpa) generally improve control, repeat application needed for bermudagrass and johnsongrass, does not control nutsedge. Do not apply to vines or berries that will be harvested within one year.

Glufosinate

- Formulations: Rely 1L
- Target weeds: grasses and broadleaf weeds
- Application: Apply as multiple applications (2-4) in established plantings as a directed spray to actively growing weeds. Apply 3.0 to 6.0 qt. in a minimum of 20 gallons of water/acre.
- Restricted entry interval: 12 hours
- Comments: Do not allow spray to contact desirable vegetation, including green shoots or foliage, as severe damage will result. Do not apply more than 18 qt. in a 12-month period. Can be used for sucker control in a split application (4 weeks apart) of 4 qt. per acre.

Glyphosate

- Formulations: Roundup Ultra
- Target weeds: grasses and broadleaf weeds
- Application: Apply as a single preplant broadcast application to control perennial weeds prior to establishment or as multiple applications (2-4) in established plantings as a directed spray or wiper application (20% solution in water) to actively growing weeds. Apply 0.5 to 5 qt. in 10-40 gallons of water/acre depending on weed species.
- Restricted entry interval: 12 hours
- Comments: Do not allow spray to contact desirable vegetation, including green shoots or foliage, as severe damage will result. Do not apply within 14 days of harvest.

Paraquat

- Formulations: Gramoxone Extra
- Target weeds: grasses and broadleaf weeds
- Application: Multiple applications (2-4) of 2.0 to 3.0 pt. in 30 to 100 gallons of water/acre. Apply as a directed spray to weeds before new canes emerge. Do not allow spray to contact desirable vegetation, including green shoots or foliage, as severe damage will result.
- Restricted entry interval: 12 hours
- Comments: Use low pressure during application to produce a coarse spray. Add non-ionic surfactant at 1-2 pt. or crop oil at 1 gallon per 100 gallons of water for best results. Restricted use pesticide.

Sethoxydim

- Formulations: Poast EC
- Target weeds: grasses
- Application: Multiple applications (2-3) of 1.5 to 2.5 pt. plus 2 pt. of a crop oil concentrate in 10-20 gallons of water/acre. Apply as a directed spray when grass is actively growing.
- Restricted entry interval: 12 hours
- Comments: Do not apply more than 2.5 pt. per application or 5 pt. per season. Preharvest interval for grapes is 50 days.

Sulfosate

- Formulations: Touchdown 5
- Target weeds: grasses and broadleaf weeds
- Application: Apply as a single preplant broadcast application to control perennial weeds prior to establishment or as multiple applications (2-4) in established plantings as a directed spray or wiper application (20% solution in water) to actively growing weeds. Use an approved surfactant or wetting agent containing at least 75% active ingredient at 2 qt. per 100 gallons of water to improve coverage of weed foliage. Up to 6.4 pt. in 10-30 gallons of water/acre/year depending on weed species.
- Restricted entry interval: 12 hours
- Comments: Spray contact with any plant part other than mature, brown woody bark may cause injury. Can be used as site preparation and up to bloom during harvest years

Herbicides Used on Grapes

Crop	Class	Herbicide	Trade Name(s)	% Acres Treated as Reported by Growers in 1991	% Acres Treated in 2002	Average # Applications
Grape	Herbicide	Diuron	Karmex 80WDG	35	15	1
Grape	Herbicide	Glyphosate	Roundup Ultra	14	75	1
Grape	Herbicide	Naproamide	Devrinol 50DF	4	5	1
Grape	Herbicide	Oryzalin	Surflan 4AS, Oryzalin 4AS	7	25	1
Grape	Herbicide	Paraquat	Gramoxone Extra, BOA	40	70	1
Grape	Herbicide	Sethoxydim	Poast EC	2	20	1
Grape	Herbicide	Simazine	Princep 4L, Princep 90WDG	16	45	1

Diseases

Anthracnose

Elsinoe ampelina Shear

It has been found that certain grape cultivars, which including Cayuga White, Challenger, Glenora, Himrod, Reliance, Vidal Blanc, Vignoles, Villard Blanc and Vinered are highly susceptible to anthracnose. In vineyards where anthracnose has become a problem, a dormant spray of liquid lime-sulfur is essential for effective control. Protection of the rapidly growing, succulent, green shoots of susceptible cultivars with fungicides are also important.

Cultural control: Pruning out infected wood during dormancy and removal from the vineyard prior to bud break should reduce primary inoculum of the anthracnose fungus in the coming growing season.

Chemical control: Dormant liquid lime-sulfur applications in late winter before bud swell will help control anthracnose.

Bitter Rot

Greeneria uvicola (Berk. & M.A. Curtis) Punithalingam

Bitter rot is characterized with an unpleasant burnt bitter taste, a flavor that can be carried in to wines. The first sign of disease is a discoloration at the point of berry attachment. Bitter rot is often mistaken for black rot because the symptoms are similar. However, bitter rot infections of the fruit occur in late season, whereas black rot infections do not occur after veraison. It overwinters in infected vine tissue and on the surface of old canes and vine bark. Warm wet weather at ripening favors the development of bitter rot which, once established, spreads rapidly throughout the clusters. Catawba seems to be susceptible to bitter rot. Lack of control can result in a total crop loss.

Chemical control: Fungicides that control downy mildew will control Bitter rot.

Black Rot

Guignardia bidwelli (Ellis) Viala & Ravaz

Black rot is the most serious grape disease in Arkansas. It is the one disease that must be controlled before all other diseases. However, with early season sanitary viticultural practices and properly timed fungicides applied before bloom, black rot is easily managed. All grape cultivars are susceptible to some degree and all green tissues of the vine are susceptible to infection. Leaves are susceptible for about 1 week after unfolding. Infected leaves develop circular red spots on the upper leaf surface in late spring, which enlarge and become brown circular lesions. Black, pimple-like, fruiting bodies (pycnidia) are visible inside lesions within a few days after lesions appear. Black, elongated lesions on petioles may cause a wilting of leaves. Large, black, elliptical lesions on infected shoots may contribute to breakage by wind. The fruit infection phase may result in substantial economic loss. Berries are susceptible from bloom until sugar content reaches approximately 8%. The initial appearance of an infected berry is a light brown coloration on a portion of the berry. The entire berry soon becomes dark brown and numerous black pycnidia develop on the surface. The final stage is a shriveled, hard, black, mummified berry. The black rot fungus overwinters in mummified fruit on the vine and vineyard floor. Many spores within overwintering structures on the mummies are mature and ready for discharge by bud break. Spring rains trigger release of spores from mummies and air currents carry these spores to susceptible tissue. Infections continue throughout the growing season as long as plant tissue is susceptible and environmental conditions for the fungus are favorable. Removal of mummified

clusters during pruning and spring cultivation to bury mummies can contribute to a reduction of inoculum.

Cultural control: Removal and destruction of infected mummies, twigs or shoots is essential for black rot control. Removal of all mummies on the ground must be disked or buried. These steps will help eliminate overwintering inoculum. Cultural practices that open the canopy are also beneficial because of increased air circulation and improved spray coverage.

Chemical control: Do not apply Flint to Concord. The following are labeled for Black rot control: mancozeb, Captan, Ziram, Abound, Sovran and Flint. Early sprays are critical in controlling black rot. Sprays are recommended at bud break to boom, Shatter, and first cover to veraison.

Crown Gall

Agrobacterium tumefaciens (Smith & Townsend) Conn

This disease galls the roots, trunk and arms of grapevines. *Vitis vinifera* is more susceptible to crown gall than *Vitis labruscana*. The galls are usually found on the lower trunk near the soil line. Large galls can develop rapidly and completely girdle a young vine in one season. When there are several galls they are usually found on the major roots or in the crown area. This disease disrupts translocation of water and nutrients in the plant, which leads to poor growth, dieback and eventual death. This soil-borne bacterium can survive for long periods of time in the soil. A fresh wound on the grapevine is necessary for gall formation to start. Grafting and budding are fresh wounds that may become infected. Cold injury is another factor that contributes to crown gall. Some nursery stock may arrive already infected with crown gall.

Cultural control: Disinfect shears when working in an infected area before you travel to the next vine. Minimize the risk of cold injury to the vines by selecting cold-sensitive cultivars will help also. Hilling about the grafted union will protect buds from freezing also. Screen planting stock to remove suspicious plants with galls or swellings. Double-trunking can be successful in managing this disease. If one trunk becomes diseased, it can be cut free leaving another, which can remain disease-free for some time.

Chemical control: Dip roots and crowns before planting into a suspension of Galltrol @ to protect against infection by resident gall bacteria.

Downy Mildew

Plasmopara viticola (Berk. & M.A. Curtis) Berl & DeToni in Sacc.

Downy mildew is a fungal disease that primarily attacks the leaves, berries, and shoots (all green parts). Infected leaves will develop pale yellow-green lesions that will turn brown. Young berry clusters are highly susceptible and can be covered with white fungal spores. Reduced carbohydrate production by infected leaves results in lower yields and reduced sugar content in the fruit. The fungus causes direct yield losses by rotting inflorescences, clusters, and shoots, and indirect losses by prematurely defoliating vines, which increases their susceptibility to winter injury and delays ripening of the fruit. Downy mildew on the foliage may be responsible for the loss of vigor and even death of susceptible cultivars that have been cropped heavily. The development of downy mildew is favored by wet weather. In dry seasons, downy mildew may be almost completely absent from vineyards, even on susceptible cultivars. Downy mildew can infect young green tissue anytime during the growing season, although it usually becomes noticeable

about mid-season and increases as the season progresses in Arkansas.

Cultural control: This fungus overwinters on infected fallen leaves that remain in the vineyard area. Severe outbreaks can occur with a wet winter followed by a wet spring and a warm summer.

Good vineyard sanitation will remove overwintering inoculum. Plant vines in an area with good air drainage and use cultivars with low susceptibility.

Chemical control: The following are labeled for downy mildew control at shatter: Abound, Sovran, Flint, Nova, Rubigan, Procure, Elite, and Bayleton. Do not apply Flint to Concord. The following are recommended for control from First cover to veraison: Captan or Abound.

Eutypa Dieback

Eutypa lata (Pers.:Fr.) Tul. & C. Tul.

Eutypa dieback is a common canker disease in grapes. The pathogen needs wind-driven rains to disperse. It is a wound parasite therefore infection will usually starts around new pruning cuts. When new shoots are 6-12 inches long they will appear stunted with cupped leaves that are smaller than normal and yellow or yellow-streaked. This disease will appear in one or two shoots and spread to adjacent spurs in following seasons until it kills a cordon. One side of the vine may be healthy and the other dead. Shoots may be healthy below the infected site the first year but will be infected the next year. As this disease progresses over several years one or more arms may die. Many years ago pathologists mistakenly called this disease "dead-arm". Dead-arm is actually two diseases; Eutypa dieback and Phomopsis. There is no known varietal resistance to this disease.

Cultural control: Remove and burn diseased arms or the entire vine if necessary. Since spores are dispersed by rain, prune later when rains are not likely and the wound has time to heal.

Phomopsis Cane and Leaf Spot

Phomopsis viticola (Sacc.) Sacc.

Phomopsis cane and leaf spot is most likely to become a problem when inoculum is allowed to build up on the dead canes in the vineyard and if the weather is wet during the first few weeks of shoot growth. Shoots will develop small black spots near the base that will expand into oval-shaped lesions which will grow together to produce black, crusty spots, if not controlled. Leaves will develop small, light green spots that eventually expand and turn black with yellowish margins. The fruit will turn a light brown and have small black bumps all over the skin near harvest. The berries will shrivel after a period of time. This disease overwinters in diseased spots on previously infected canes. When spring rains arrive they help spread the spores to create new infection sites.

Cultural control: Select plantings sites with good air drainage and orient the row to maximize air movement. Diseased and dead wood should be removed and destroyed by shredding, disking or plowing into the soil, or burning. The disease can be controlled by a combination of sanitation and fungicide applications.

Chemical control: Fungicides need to be applied starting after initial vine growth and end when hot weather arrives. Under heavy disease pressure, a preventive spray of captan or mancozeb should begin as early as ½-inch shoot growth and alternated with azoxystrobin (Abound) through fruit set. The period from bloom through fruit set is a critical time to prevent fruit infection. Ziram may also be used during this period. The following are labeled for phomopsis control: mancozeb, Captan, Ziram, Abound, Sovran and Flint. Do not apply Flint to Concord.

Powdery Mildew

Uncinula necator (Schwein.) Burrill

Powdery mildew has become a more important disease with the increased planting of some of the susceptible French-American hybrids. Powdery mildew is a fungal disease that can affect all green tissues throughout the growing season. Disease tissues appear to be covered with a white to grayish-white powder. Severe leaf infection can result in cupping of leaves. Cluster infection around bloom may leaf to poor fruit set while later infections can cause berry splitting. Fruit infection may also reduce wine quality on varieties intended for that use. Berries are susceptible to infection until they reach 8% sugar content while established infections produce conidia until about 15 % sugar content. Older berries will show netlike pattern on their surface. Moisture is not necessary for this disease, so it can be a serious disease in dry years. This infection overwinters in dormant buds or as specialized structures on the surface of the vines. When conditions are favorable in the spring, spores are produced and released.

Cultural control: Select non-susceptible cultivars and plant on sites with good air drainage.

Chemical control: Sprays are recommended for bud break through harvest. The following compounds are labeled for powdery mildew control: Abound, Sovran, Flint, Nova, Rubigan, Procure, and Elite. Do not apply Flint to Concord grapes.

Pierces Disease

Xylella fastidiosa Wells et al.

This is a bacterial disease that is vectored to the grapes by sharpshooter leafhoppers. The leafhopper feed on an infected vine and becomes contaminated with the bacteria. It then is able to spread the bacteria to every cane it feeds on. The *X. fastidiosa* bacteria clog the xylem tissue of the plant and prevent water uptake. This disease will kill the vine, then that vine is a source of infection for the rest of the vineyard. In Arkansas the disease is possible in grape growing areas south of the Arkansas River, usually near the Louisiana border.

Cultural control: Do not plant a vineyard in an area considered a Pierce's Disease Zone. No European grape variety is immune to this disease. Mark and remove infected vines in early fall when symptoms are easily recognized and destroy. They are a source for infection for sharpshooter leafhopper feeding and transmitting of the disease to other vines in the vineyard.

Summer Bunch Rot Complex

(various fungi)

As fruit sugar content exceeds 8%, injured fruit are likely to be attacked by a wide variety of fungi. Entrance of the pathogens is through existing wounds (bird peck, grape berry moth feeding, previous fungal infection, or berry cracking). Severe economic losses may occur, particularly on the tight-clustered French-American hybrids and some *V. vinifera* hybrids. Cultivars differ in susceptibility to summer bunch rot complex based on the compactness of their clusters, the thickness and anatomy of the berry skin, and their chemical composition. The French-American hybrids Seyval, Vignoles, and Vidal are prone to summer bunch rot complex. When weather is dry the infected berries dry out. Disease development can be reduced by avoiding excessive vegetative growth with cultural practices such as controlled nitrogen fertilization, increased aeration and exposure of clusters to the sun with appropriate trellising systems, shoot positioning, and leaf removal. Controlling other diseases and insect pests capable of injuring the berries, particularly the grape berry moth, will also reduce summer bunch rot complex.

Cultural control: Practices that improve air circulation and thereby reduce humidity in the canopy are beneficial. These include site selection to avoid fog pockets and heavy wooded areas, canopy density management, and avoidance of excessive nitrogen usage. Any practice that reduces skin cracking or skin punctures near harvest will help control ripe fruit rot. Leaf removal near the cluster area improves cluster drying and spray penetration.

Chemical control: The following compounds are labeled for summer bunch rot complex control: Rovral, and Vangard.

Fungicides Labeled for Grapes

Azoxystrobin

- Formulations: Abound 2.08F
- Target diseases: Black rot, Phomopsis, Downy mildew, Powdery mildew, Bitter rot, Botrytis bunch rot
- Average rate of most common formulations:
  --Abound 2.08F (11-15.4-fl oz/A)
- Preharvest interval: 0 days
- Restricted entry interval: 4 hours

Captan

- Formulations: Captan 50 W
- Target diseases: Phomopsis, Powdery mildew, Black rot, Bitter rot, Botrytis bunch rot
- Average rate of most common formulations:
  --Captan 50W (3-4 lb./A)
- Preharvest interval: 0 days
- Restricted entry interval: 4 days

Cyprodinil

- Formulations: Vangard 75WDG
- Target disease: Bunch rots
- Average rate of application:
  -- Vangard 75WDG (10oz/A)
- Preharvest interval: 7 days
- Restricted entry interval: 12 hours

Copper Hydroxide

- Formulations: Kocide
- Target diseases: various fungal and bacterial diseases
- Average rate of most common formulations: Kocide 101 (2lb/A)
- Preharvest interval: 14 days
- Restricted entry interval: 24 hours

Fenarimol

- Formulations: Rubigan .6 EC
- Target disease: Powdery mildew, Black rot
- Average rate of application:
  -- Rubigan 1.6 EC (3 fl oz/A)
- Preharvest interval: 30 days
- Restricted entry interval: 12 hours

Fenhexamid

- Formulations: Elevate 50 WDG
- Target disease: Bunch rot
- Average rate of application:
  -- Elevate WDG (1 lb./A) do not apply more than 3 lb./A per season
- Preharvest interval: 0 days

- Restricted entry interval: 4 hours

Iprodione

- Formulations: Rovral 50WP
- Target disease: Bunch rot
- Average rate of most common formulation:
  -- Rovral 50WP (1.5-2 lbs./A)
- Preharvest interval: 7 days
- Restricted entry interval: 48 hours

Kresoxin-methyl

- Formulations: Sovran 50WG
- Target disease: Powdery mildew, Phomopsis, Downy mildew, Black rot, and Bunch rot
- Average rate of most common formulation:
  -- Sovran 50WG (3.2- 6.4 z/A)
- Preharvest interval: 14 days
- Restricted entry interval: 12 hours

Lime Sulfur

- Formulations: Lime Sulfur
- Target disease: Anthracnose
- Average rate of most common formulation: 6 gal/ A
- Preharvest interval: 48 hours
- Restricted entry interval: Dormant application. PHI not listed on label.

Mancozeb

- Formulations: Mancozeb 75DF
- Target disease: Black rot, Dwny mildew, Phomopsis and Bitter rot
- Average rate of application:
  -- Mancozeb 75DF (3-4 lb.), cannot be applied to juice grapes for processing past the
- initiation of bloom.
- Preharvest interval:
- Restricted entry interval

Myclobutanil

- Formulations: Nova 40WP
- Target diseases: Black rot and Powdery mildew
- Average rate of applications:
  -- Nova 40WP (3-5 oz/A)
- Preharvest interval: 14 days
- Restricted entry interval: 24 hours

Tebuconazole

- Formulations: Elite 45 DF
- Target diseases: Powdery mildew, Black rot
- Average rate of most common formulations: preharvest
  -- Elite 45 DF (4 oz/A)
- Preharvest interval: 14 days
- Restricted entry interval: 12 hours

Triadimefon

- Formulations: Bayleton 50 WDG

- Target diseases: Black rot
- Average rate of application:
  -- Bayleton 50 WDG (2-6 oz/A)
- Preharvest interval: 14 days
- Restricted entry interval: 12 hours

Triflozystrobin

- Formulations: Flint 50WG
- Target diseases: Black rot, Powdery mildew, Bitter rot, Phomopsis, Bunch rot
- Average rate of application: Do not apply to Concord
  -- Flint 50WG (1.5- 4oz/A)
- Preharvest interval: 14 days
- Restricted entry interval: 12 hours

Triflumizole

- Formulations: Procure 50WS
- Target diseases: Black rot, Powdery mildew, and Bitter rot
- Average rate of application:
  -- Procure 50 WS (4-8 oz/A)
- Preharvest interval: 7 days
- Restricted entry interval: 12 hours

Ziram

- Formulations: Ziram 76DF
- Target diseases: Black rot, Phomopsis, and Downy mildew
- Average rate of most common formulations:
  --Ziram 76 DF (3-4 lb./A)
- Preharvest interval: 21 days may not be applied after fruit set.
- Restricted entry interval: 48 hours

Fungicides Used on Grapes

Crop	Class	Fungicide	Trade Name	% Acres Treated as Reported by Growers in 1991	% Acres Treated In 2002	Avgerage # Applications
Grape	Fungicide	Azoxystrobin	Abound 2.08 F	Not reported	25	3
Grape	Fungicide	Captan	Captan 50W	15	60	2
Grape	Fungicide	Cyprodinil	Vangard 75 WDG	Not reported	5	1
Grape	Fungicide	Iprodione	Rovral 50WP	Not reported	45	1
Grape	Fungicide	Mancozeb	Mancozeb 75DF	93	60	2
Grape	Fungicide	Myclobutanil	Nova 40WP	18	40	1
Grape	Fungicide	Triadimefon	Bayleton 50WDG	68	60	3
Grape	Fungicide	Lime sulfur	Lime sulfur	35	60	2
Grape	Fungicide	Copper hydroxide	Kocide	5.6	20	2
Grape	Fungicide	Sulfur	Sulfur	11	15	2

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