Crop Profile for Grapes in Ohio

Prepared: September, 1999

General Production Information

(*Vitaceae, Vitis* spp)

Introduction

Grape production in Ohio can be divided into two main groups. The majority of grapes produced (1280 acres) are used for processing into grape juice. These grapes are primarily of the variety Concord and are marketed almost exclusively to Welch's, Inc. Concord is an "American variety", *Vitis labrusea*, and is much more resistant to certain diseases such as Powdery mildew and Botrytis bunch rot than the French hybrid or vinifera varieties that are used for the production of wine. In addition, grapes processors have placed restrictions on the use of certain pest control chemicals used on processing grapes. For example, Captan fungicide can not be used on processing grapes, but is legal for use on wine grapes. Mancozeb fungicide can not be applied to processing grapes past first bloom, but may be applied on wine grapes up to within 66 days of harvest. Reduced susceptibility of the American varieties (Concord) combined with pesticide restrictions imposed by processors and the relatively low value of juice grapes, results in much less use of fungicides for disease control than for wine grapes. Insecticide and herbicide use patterns generally remain the same for all grapes. For this reason, data on percent acres treated, average rate and frequency of applications, and pre-harvest interval (PHI) for fungicides are provided separately for both American (processing) and French hybrid and vinifera (wine) grapes. The same information provided for insecticides and herbicides do not differ greatly between the two types of production, and are presented for all grapes combined. The preharvest interval (PHI) presented in the text refers to the actual number of days before harvest that the chemical is applied by growers, and does not necessarily reflect the PHI on the pesticide label. In most cases, the PHI for the last application made by growers exceeds the legal PHI on the label. The information presented in this profile is based on the results of a grower survey in which respondents represent 40% (26 growers) of the acreage for American Varieties (Juice grapes) and 81% (21 growers) of the acreage for French hybrid and vinifera varieties (wine grapes).

General Information on Ohio Grape Production:

Grapes (American Varieties)
(*Vitis labrusca)*

Production Facts:

- Acres of American varieties in Ohio: 1280
- Percent of US Production/Rank: 1.4%, 5th in U.S.
- Number of Growers: 89
- Per Ton Value: $300.00
- Per Acre Value: $1230.00
- Value of Production in Ohio: $1,574,400.00

Location of Production:
Juice grapes are grown commercially in 16 Ohio counties. The majority of juice grape acres are in the counties of Ashtabula (909), Lorain (133), Ottawa (116), Lake (107), Erie (45), and Warren (11). The average size of an Ohio juice grape vineyard is approximately 15 acres, and the largest vineyard site is over 102 acres. Concord is the most commonly grown American variety planted in Ohio with over 1060 acres. Catawba is second, being grown on approximately 114 acres, and Niagara is third with 80 acres in production.

Production Methods:
Many of the juice grape vineyards in Ohio were established over 50 years ago on the higher elevations along Lake Erie. Production sites were chosen along the lake due to the reduce potential of spring frost. Vines were established in rows 9-10 feet apart and 6 to 8 feet apart within row. Most juice grapes are trained to either bilateral cordons that are spur pruned, or long canes tied to an umbrella kniffen system. Harvesting of juice grapes is predominantly done by machine. Soil drainage has been conducted in 30% of the fields. Most of the tile laid prior to the 1970s was the traditional 4-6" clay tile. In recent years, 4" black corrugated plastic tile has been used to in vineyards that are difficult to drain, however, juice grape vineyards do not have a high profit margin and therefore, will probably not be tiled as intensively as French hybrid or vinifera vineyards.

Soil testing and analysis is encourage to determine what elemental nutrients levels are, which can help provide more accurate fertility recommendations. An annual petiole test by variety is recommended to determine if there are nutrient deficiencies in the vines. As with soil testing, most grape growers only test when there is a problem. Manufactured fertilizers (e.g., 33.5-0-0, 0-0-62,19-19-19) are commonly used to amend vineyard soils.

Average yields are 4.5 tons per acre. Grapes begin veraison (fruit coloring) in late August-September and harvest generally begins in late-September and concludes by mid to late-October. Growers must monitor the ºBrix (% soluble solids) of their grapes to determine the optimum time for harvest. The ºBrix (e.g., 16) is measured as each load of grapes arrives at the processing facility, and the fieldman schedules with the grower when the fruit is to be harvested.

Grapes (French hybrid and Vinifera Varieties)
(*Vitis vinifera, V. vinifera* x *V. labrusca)*

Production Facts:

- Wine Grape Acres in Ohio: 275
- Percent of US Production/Rank: 0.23%, 8th in U.S.
- Number of Commercial Growers: 41
- Per Ton Value
    - French hybrids: $750.00
    - Vinifera: $1250.00
- Per Acre Value
    - French hybrids: $3000.00
    - Vinifera: $5000.00
- Value of Production in Ohio
    - French hybrids: $422,226.00
    - Vinifera: $179,075.00

Location of Production:
French hybrids and vinifera are grown commercially in 18 Ohio counties. The majority of wine grape acres are in the counties of Ashtabula (89), Ottawa (79), Lake (44), Warren (21), and Lorain (9). The average size of an Ohio wine grape vineyard is approximately 5-10 acres, and the largest vineyard site is over 80 acres. Vidal is the most commonly grown French hybrid variety planted in Ohio with 39 acres. Riesling is planted on 46 acres making it the most widely grown vinifera.

Production Methods:
Several wine grape vineyards were established over 20 years ago along Lake Erie and on North Bass Island taking into consideration the moderating temperature effects of the lake. All vinifera varieties are grown on rootstocks (e.g., 3309C, SO4) to enhance adaptability, and grafting of French hybrid varieties is starting to become more popular. Vines are commonly established in rows 9-10 feet apart and 5-6 feet apart within row. Grapevines are generally trellised using high bilateral cordon, umbrella kniffen, low to mid-wire bilateral cordon vertically shoot positioned, and fan systems. Soil drainage is a very important issue in heavy clay soils throughout Ohio. Several Ohio grape growers are starting to increase the amount of tiling used to vineyards where winter injury is found to be prevalent in vinifera varieties. In contrast to juice grapes, wine grape varieties have a considerably higher profit margin and thus, increased yield of French hybrid or vinifera varieties can pay for the added tiling costs.

Soil testing and analysis is conducted to determine the elemental nutrient levels. Annual petiole tests are conducted by variety to determine if there are nutrient deficiencies in the vines. Fertility recommendations are based on soil and plant analysis, and manufactured fertilizers (e.g., 33.5-0-0, 0-0-

62,19-19-19) are commonly used to amend vineyard soils.

Average yields range form 3.5 to 6 tons per acre. Grapes begin veraison (fruit coloring) in late August-September and harvest generally begins in late-September and concludes by mid- to late-October. Harvesting of wine grapes is primarily done by hand, but due to labor and shipping concerns there is a growing trend toward machine harvest. Fruit composition and quality is very important in making high quality wines.

Insect Pests

The 7 major insect pests which inflict economic damage to cultivated grapes in Ohio are: Grape berry moth, *Endopiza vitenna*; Grape root borer, *Vitacea polistiformis*; Japanese beetle, *Popillia japonica*; Grape flea beetle, *Altica chalybea*; Grape phylloxera, *Daktulosphaira vitifolia*; Grape leafhopper, (*Erythroneura comes*); and Rose chaffer, *Macrodactylus subspinosus*.

Ohio vineyards should be monitored and scouted for all of these pests that, may occur independent of, each other, during the season. All require the use of pesticides to achieve effective control. Cultural practices can provide some benefit.

Grape berry moth:
This is the major insect pest of grape berries in the eastern United States and Canada. When vineyards are left unmanaged, up to 90% of the fruit often is destroyed by the larvae and the diseases facilitated by the damage afflicted upon the fruit. Pheromone traps should be used in vineyards to monitor for this pest and can be useful in timing pesticide applications. However, one should not depend entirely on pheromone traps for detecting this pest. Scouting should be implemented on a weekly basis after bloom. If cluster damage reaches 6% in grapes used for processing or 3% in those grown for fresh market, a protective cover spray should be applied. The following list of chemicals are registered for controlling grape berry moth: Guthion, Sevin, Imidan, and Penncap-M and Isomate GBM2 pheromone ties. Studies indicate that Penncap-M provides the best control of grape berry moth. Isomate pheromone ties have proven to be marginally effective in controlling this pest and are best suited for areas with minimal berry moth pressure. Pesticide may be applied from 2 to 4 times during the season for control of this pest.

Grape root borer:
Larvae of the grape root borer (GRB) attack the larger roots and crown of grapevines. They tunnel into these parts of the plant and feed internally. The feeding and boring of the larvae will weaken and may eventually kill the vine. Larvae also provide entry points for disease organisms. Vines that are severely infested may wilt under stress; sometimes only part of the vine will show stress. Pheromone traps are

available for monitoring this pest and are very effective in attracting the adult male moths. Chemical control of this pest is difficult due to its cryptic nature below the soil line. Chlorpyrifos (Lorsban) is the only chemical currently labeled for control of grape root borer. This treatment should be applied to the ground immediately under the grape trellis when the first adults are captured in the pheromone traps. This application provides a toxic barrier that newly hatched larvae must penetrate to gain access to the grape vine's root system. GRB pheromone ties that are used for pheromone confusion technique are marginally effective and are better suited for vineyards having little external pressure from this pest.

Japanese beetle:
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, and coppery-brown wing covers. Adult beetles emerge from the ground in June and July, and begin feeding upon foliage. Mating occurs at this time and eggs are laid in the ground. 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-leaved cultivars require frequent inspection to prevent damage. Damaged leaves have a laced appearance, and severely affected leaves will drop prematurely. A Japanese beetle lure and trap are available for monitoring this pest. However, these beetles are easily detected while walking through the vineyard. If skeletonizing of leaves becomes evident, thin leaved 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. The following list of chemicals are registered for control of Japanese beetle. Guthion, Sevin, and Penncap-M. All of these do a good job of controlling this pest. However Sevin is the most widely used.

Grape flea beetle:
The grape flea beetle occasionally is a serious pest of grapes in Ohio. It is dark metallic greenish-blue or steel-blue and about 3/16 inch long. The most serious damage occurs in the spring. The flea beetles overwinter as adults and emerge during April. Upon emergence adult beetles begin to feed upon newly swollen grape buds, chewing holes in the ends and sides. Such damage destroys the capacity of a bud to develop a primary or secondary shoot. Once the buds have grown to a length of 1/2 inch or more, the beetles cannot cause significant injury. Brush and woodlots located near a vineyard can be a continual source of flea beetles and these areas should be cleaned-up. Cultivation of open areas between rows and around the vineyard can reduce the number of newly emerging adults. However, one can not depend on this practice to control flea beetles. If beetles are present at bud swell, a broad-spectrum insecticide should be applied to prevent bud damage. This should be effective against adults migrating to vines from their hibernation sites; timing is critical. Another application of spray in June, when larvae are feeding on the grape foliage, may help to control an outbreak the following year. Guthion and Sevin are the primary chemicals registered for control of this pest.

Grape Phylloxera:
Phylloxera is one of the most destructive grape pests worldwide. This small aphid-like insect has a complex life cycle that involves survival on the roots throughout the year, and on the leaves during the growing season. The insect forms galls on the leaves and roots of grapevines. The vine will die if its roots become heavily infested with phylloxera. If leaves become heavily infested, premature defoliation and retarded shoot growth may result. In many areas of the world, susceptible cultivars are grafted onto resistant rootstocks to prevent damage by the root form. However, the foliar form still may occur in such cases. Currently only one insecticide endosulfan (Thiodan) is labeled for the foliar form of grape phylloxera. In Ohio the foliar form of this pest is spotty. This is primarily due to the Ohio grape industry, in its early years, being centered on the juice industry and the cultivation of labrusca grapes. Some native American cultivars have natural resistant to the foliar form of phylloxera. However, this resistance is changing and a new biotype that can establish on the foliage of labrusca grapes has become established in southern Ohio and evidence of phylloxera existing on the roots of labrusca grapes in northern Ohio has been documented. This new trend, along with the shift of Ohio's grape industry to the establishment of susceptible wine producing cultivars is of major concern and warrants close monitoring of this pest. Most of Ohio vineyards currently have little more than patchy outbreaks of foliar phylloxera. However, given the current industry trends and the development of a new more susceptible cultivars, this pest may become a major concern in the future of the grape industry in Ohio.

Grape Leafhoppers:
This pest is of concern primarily in the Lake Erie growing belt of the state. Heavy feeding from adults and nymphs can cause severe scaring of the leaf surface and premature defoliation. Important plant diseases may also be vectored by this pest. Depending upon environmental conditions' populations may reach sufficient numbers to warrant treatment. Current pesticides registered for controlling this pest are Sevin, Provado, Guthion and Penncap-M. Provado is a newly labeled pesticide which has little activity toward other grape pests but is extremely good against leafhoppers.

Rose chaffer:
Rose chaffer adults attack grapes at bloom as they emerge from the soil. Not only do they destroy the fruit blossom, in addition, they frequently skeletonize the leaves, leaving only the large veins intact. This insect is especially abundant in areas of light, sandy soil like northeastern Ohio, and western Pennsylvania and Michigan. Adult chaffers begin emerging in late May and early June at the time of grape bloom. A spray application is recommended if more than two beetles per vine are present. If only a few beetles are present, they may be handpicked from the vine and destroyed. The pupal stage is extremely sensitive to disturbance, therefore cultivating between rows may be effective in destroying a good number of chaffers. However, it is our experience that growers with numbers of beetles sufficient to inflict economic damage will not be able to control this pest by this method of cultural control. An alternative method to chemical control has been developed for this pest by the department of Entomology at Ohio State University. This method uses a very powerful feeding attractant and a Japanese beetle trap. Intensive trapping over a four year period reduced the population to below the threshold level of two beetles per vine. An application of insecticide may be required in combination with the trapping effort if the population is extremely high. It is our experience that it takes a couple of years of intensive trapping to reduce the population within a heavily infested vineyard to the point that

chemicals are no longer needed to control this pest. Current chemicals registered for control of this pest are, Sevin, Penncap-M, Guthion, and the rose chaffer feeding attractant.

Chemical Pesticides used for insect control:

Azinphos-methyl (Guthion)

Class: organophosphate
Action: insecticide
Percent acres treated: 9%
Average rate and frequency of application: 1.5 lb product, 1 application per year
PHI: 64 days
Efficacy rating: moderate to high
Common formulations: 35 WP, 50 WP and 2 S

Carbaryl (Sevin)

Class: carbamate
Action: insecticide
Percent acres treated: 91%
Average rate and frequency of application: 2 lbs A.I per acre, 3 applications per year
PHI: 56 days
Efficacy rating: moderate to high
Common formulations: 50 WP, 4EC(XLR), 80 WP, and 4F

Methyl parathion encapsulated (Penncap-M)

Class: organophosphate
Action: insecticide
Percent acres treated: 6%
Average rate and frequency of application: 2 qt (1lb A.I) per acre, 2 applications per year
PHI: 52 days
Efficacy rating: high
Common formulations: 2 EC

Endosulfan (Thiodan)

Class: organochlorine
Action: insecticide/acaricide
Percent acres treated: 2%

Average rate and frequency of applications: 1 lb A.I per acre, 2 applications per year
PHI: 68 days
Efficacy rating: moderate
Common formulation: 50 WP, 3 EC

Diazinon (Diazinon)

Class: organophosphate
Action: insecticide/nematicide
Percent acres treated: less than 1% (6 acres)
Average rate and frequency of applications: 1 lb A.I per acre, 3 applications per year
PHI: 60 days
Efficacy rating: moderate
Common formulations: 50 WP, 4 EC

Malathion

Class: organophosphate
Action: insecticide
Percent acres treated: less than 1% (4 acres)
Average rate and frequency of applications: 2.5 lb product/A, 2 applications per year
PHI: 7 days
Efficacy rating: low to high (dependent upon target species)
Common formulations: 8 EC, SEC and 8 F

Dicofol (Kelthane)

Class: organochlorine
Action: acaricide
Percent acres treated: 2%
Average rate and frequency of applications: 1 lb A.I per acre, 1 application per year
PHI: 51 days
Efficacy rating: high

Diseases

There are five major diseases caused by fungi that attack grape vines in Ohio. These are: Black rot, caused by *Guidnaridia bidwellii*; Downy mildew, caused by *Uncinula necator*; Phomopsis cane and leaf

spot, caused by *Phomopsis viticola*; and Botrytis bunch rot or gray mold, caused by *Botrytis cinerea*. All of these diseases require preventative (protectant) applications of fungicide used in conjunction with certain cultural practices to achieve effective control. Fungicide applications are required on an annual basis to control these diseases.

Eutypa dieback, caused by the fungus *Eutypa armeniacea* is also an important disease of grape in Ohio; however, fungicide use for control of this diseases in minimal. Benlate is registered for use as a slurry (paint) or spray to protect fresh wounds from infection immediately after pruning. The number of acres treated in this manner is very small.

During most growing seasons in Ohio, all five of the above mentioned diseases may occur simultaneously within the vineyard. With the exception of Powdery mildew (which does not require free water to infect), all diseases require free water to infect and are more severe during wet growing seasons. Because of the number of major diseases involved and similarities in their environmental requirements for infection, most fungicide applications to grape vines in Ohio are directed toward controlling all the major diseases simultaneously. Due to differences in the efficacy of specific fungicides to control specific diseases, mixtures on tank-mixes of fungicides are often required to provide simultaneous control of all diseases.

Crown gall of grape, caused by the bacterium *Agrobacterium tumefaciens*, is the only disease caused by a bacterium and is a serious problem (especially on wine grapes) in Ohio. At present, there are no chemical controls available for control of crown gall.

In general, the V. labrusca variety Concord, which makes up the largest acreage of grapes in Ohio is much less susceptible to most diseases than French hybrid or V. viniferia varieties. For this reason, usage information will be supplied for American and French hybrid and viniferia grapes separately.

Black Rot
Most of the acreage in Ohio is treated to control this disease annually. The disease attacks leaves and fruit and results in fruit rot that can destroy 50 to 90% of the crop. Fungicides are essential for effective control and are generally applied in a protectant (calendar-based) program from pre-bloom through veraison (beginning of berry ripening). Fungicide spray intervals vary from 7 to 14 days depending upon weather conditions. Most effective fungicides include Abound, Bayleton, Ferbam, Mancozeb, Nova and Ziram.

Downy Mildew
Most of the acreage in Ohio is treated to control this disease annually. The disease attacks all parts of the grape wine and can result in a 100% crop loss. In addition, late season infection can result in defoliation that reduces winter hardiness and results in severe winter injury or death of the vine during cold winters. Fungicides are essential for effective control, and are generally applied on a preventative (calendar-based) schedule from pre-bloom through harvest. Applications intervals vary from 7-14 days and the number of applications depends upon weather conditions (rainy-wet weather favors disease

development). Most effective fungicides include: Abound, Captan, fixed copper & lime, Mancozeb and Ridomil.

Powdery Mildew
Most of the acreage in Ohio is treated to control this disease annually. The disease attacks all parts of the grape vine and can result in 100% crop loss. In addition, high levels of infection can reduce winter hardiness and result in severe winter injury or death of the vine during cold winters. Fungicides are essential for effective control, and are generally applied on a preventative (calendar-based) schedule from pre-bloom through harvest. Application intervals range from 10 to 14 days. On wine grapes, fungicide applications are generally required all season because the fungus does not require free water (rain) to infect vines. Thus, the disease is a problem during all years regardless of rainy weather. Concord (juice grapes) are less susceptible to powdery mildew and generally require less fungicide sprays during the summer (late season) than wine grapes. Most effective fungicides include: Sterol-inhibiting fungicides (Nova, Bayleton, Rubigan), sulfur, Abound, fixed copper & lime, and JMS Stylet-oil.

Phomopsis cane and leaf spot
Most of the acreage in Ohio is treated annually for Phomopsis. The disease attacks canes, leaves and fruit, and during seasons with excessively wet springs can result in serious damage to canes and significant levels of fruit infection. Early season fungicide sprays are essential for controlling this disease. Generally, early season fungicide applications to control black rot and downy mildew also control Phomopsis. The most critical time for control is from bud break or 1 inch shoots through 2 to 4 weeks after bloom. Most effective fungicides include Captan, Mancozeb, Abound and Ziram. Captan and Mancozeb are the standard fungicides for control of Phomopsis and or more efficacious than Abound or ziram.

Botrytis bunch rot or gray mold
This disease is a serious problem on wine grape varieties that have tight clusters. Approximately 10 to 15% of Ohio's acreage is treated for control of this disease. On tight-clustered wine grapes the disease can result in 100% crop loss and lesser levels of infection can result in serious quality losses in wine. Juice grapes are rarely treated specifically for control of Botrytis bunch rot. Wine grape growers generally apply one to three application from bloom through veraison depending upon varietal susceptibility, weather conditions, and harvest date. Most effective fungicides include Rovral, Vangard and Benlate. Benlate is generally not recommended due to the development of fungicide resistance in Botrytis.

Chemical Disease Controls (average rate of application is given in amount of formulated product).

Azoxystrobin (Abound 2.08F)

Target diseases: black rot, powdery mildew, and downy mildew

Percent acres treated: (American 54%, French hybrid and vinifera 66%)
Average rate of application: (American 11 oz, French hybrid and vinifera 12 oz)
Average number of applications: (American 2, French hybrid and vinifera 3)
PHI: (American 73 days, French hybrid and vinifera 34 days)
Efficacy rating: Very good
Special uses: Resistance Management

Benomyl (Benlate 50WP)

Target disease: Botrytis bunch rot
Percent acres treated: (American 0, French hybrid and vinifera 7%)
Average rate of application: (American 0, French hybrid and vinifera 1 lb)
Average number of applications: (American 0, French hybrid and vinifera 2)
PHI: (American NA, French hybrid and vinifera 55 days)
Efficacy rating: good, if fungicide resistance is not present. Due to resistance, Benlate is generally not used to control Botrytis in Ohio.
Special uses: Resistance Management

Ergosterol Biosynthesis Inhibiting Fungicides (sterol inhibitors) (Bayleton, Nova, Rubigan)

Triadimefon (Bayleton 50 WDG)

Target diseases: Black rot and Powdery mildew
Percent acres treated: (American 19%, French hybrid and vinifera 24%)
Average rate of application: (American 2 oz, French hybrid and vinifera 4 oz)
Average number of applications: (American 3, French hybrid and vinifera 4)
PHI: (American 46 days, French hybrid and vinifera 32 days)
Efficacy rating: very good for black rot (fungicide resistance in powdery mildew is a problem).
Special uses: Resistance management.

Myclobutanil (Nova 40WP)

Target diseases: Black rot and Powdery mildew
Percent acres treated: (American 31%, French hybrid and vinifera 24%)
Average rate of applications: (American 3 oz, French hybrid and vinifera 4 oz.)
Average number of applications: (American 2.5, French hybrid and vinifera 3)
PHI: (American 55 days, French hybrid and vinifera 44 days)
Efficacy rating: very good
Special uses: Resistance management.

Fenarimol (Rubigan 1.6 EC)

Target disease: Powdery mildew (effective, but weaker than other sterol-inhibitors against black rot).
Percent acres treated: (American 2%, French hybrid and vinifera 84%)
Average rate of application: (American 3 oz, French hybrid and vinifera 4 oz)
Average number of applications: (American 2, French hybrid and vinifera 4)
PHI: (American 62 days, French hybrid and vinifera 47 days)
Efficacy rating: very good for powdery mildew.
Special uses: Resistance management

Captan (Captan 50 WP)

Target diseases: Downy mildew and Phomopsis cane and leaf spot.
Percent acres treated: (American 0, French hybrid and vinifera 90%)
Average rate of applications: (American 0, French hybrid and vinifera 3 lb)
Average number of applications: (American 0, French hybrid and vinifera 4)
PHI: (may not be applied to juice grapes for processing), (American NA, French hybrid and vinifera 33 days)
Efficacy rating: very good.
Special Uses: Resistance Management

Ferbam (Carbamate 76 WDG)

Target disease: Black rot
Percent acres treated: (American 7 %, French hybrid and vinifera 0)
Average rate of application:(American 4 lb, French hybrid and vinifera 0)
Average number of applications: (American 2, French hybrid and vinifera 0)
PHI: (American 50 days, French hybrid and vinifera NA)
Efficacy rating: very good

Fixed Copper and lime (many formulations and products available)

Target disease: Downy mildew and powdery mildew, weak on black rot
Percent acres treated: (American 25%, French hybrid and vinifera 10%)
Average rate of application: (American 2.5 lb, French hybrid and vinifera 3 lb)
Average number of applications: (American 1, French hybrid and vinifera 4)
PHI: (may vary depending on product), (American 50 days, French hybrid and vinifera 55 days)
Efficacy rating: very good for downy and powdery mildew (problem with phytotoxicity on copper sensitive varieties or during cool-wet weather).

JMS - Stylet Oil

Target disease: Powdery mildew

Percent acres treated: (American 0, French hybrid and vinifera 0)Not used in Ohio

Mancozeb (Dithane DF, Penncozeb, Manzate) - most are 75% dry flowable formulations

Target disease: Black rot, downy mildew and Phomopsis cane and leaf spot.
Percent acres treated: (American 77%, French hybrid and vinifera 93%)
Average rate of application: (American 4 lb, French hybrid and vinifera 3 lb)
Average number of applications: (American 2, French hybrid and vinifera 5)
PHI: (American 91 days, French hybrid and vinifera 68 days)
Efficacy rating: very good
Special Uses: Resistance Management
Restriction: Mancozeb cannot be applied to American (juice grapes for processing) past the initiation of bloom.

Mefenoxam (Ridomil Gold MZ, Ridomil MZ-72, Ridomil Gold Copper)

Target disease: Downy mildew
Percent acres treated: (American 1%, French hybrid and vinifera 8%)
Average rate of application: (American 1 lb, French hybrid and vinifera 1.5 lb)
Average number of applications: (American 2, French hybrid and vinifera 3)
PHI: (American 120 days, French hybrid and vinifera 70 days)
Efficacy rating: very good

Iprodione (Rovral 50 WP)

Target disease: Botrytis bunch rot
Percent acres treated: (American 0, French hybrid and vinifera 26%)
Average rate of application: (American 0, French hybrid and vinifera 1.5 lb)
Average number of applications: (American 0, French hybrid and vinifera 2)
PHI: (American NA, French hybrid and vinifera 21 days)
Efficacy rating: very good (fungicide resistance a problem)
Special Uses: Resistance Management

Sulfur (many formulations and products available)

Target disease: Powdery mildew
Percent acres treated: (American 0, French hybrid and vinifera 60%)
Average rate of application: (American 0, French hybrid and vinifera 5 lb)
Average number of applications: (American 0, French hybrid and vinifera 7)
PHI: (American NA, French hybrid and vinifera 35 days)
Efficacy rating: good (can cause severe damage on sulfur sensitive varieties. Concord is highly sensitive).

Cyprodinil (Vangard 75 WDG)

Target disease: Botrytis bunch rot
Percent acres treated: (American 0, French hybrid and vinifera 1%)
Average rate of application: (American 0, French hybrid and vinifera 10 oz)
Average number of applications: (American 0, French hybrid and vinifera 1)
PHI: (American 0, French hybrid and vinifera 50 days)
Efficacy rating: very good.
Special Uses: Resistance Management
NOTE: This is a newly registered material and use patterns are not yet established.

Ziram (Ziram 76 WP)

Target disease: Black rot, phomopois cane and leaf spot, downy mildew
Percent acres treated: (American 45%, French hybrid and vinifera 1%)
Average rate of application: (American 3 lb, French hybrid and vinifera 3 lb)
Average number of applications: (American 2, French hybrid and vinifera 2)
PHI: Under federal label may not be applied after fruit set. Under 24-C registration for Ohio, there is a 21 day PHI (American 64 days, French hybrid and vinifera 30 days)
Efficacy rating: good for black rot. Fair for Phomopsis and downy mildew

Cultural Controls for Disease Management

Ohio grape growers use several important cultural practices in conjunction with the use of fungicides in order to achieve an effective level of disease control. Several practices that reduce or eliminate pathogen populations or help to create an environment within the planting that is less conducive to disease development are used by the majority of Ohio growers. The following cultural practices are used whenever possible as an integral portion of the grape disease management program.

Sanitation (Removal of Overwintering Inoculum)

Vineyard sanitation is an extremely important part of the disease management program. Most disease causing pathogens overwinter (survive from one season to the next) in old diseased plant material such as mummies, leaves and infected canes within the vineyard. Removal of old, infected wood, tendrils, and clusters with mummified berries from the vines and wires greatly reduces overwintering inoculum of several diseases. Wild grapes in nearby woods and fence rows also are sources of disease inoculum and insects. Removal of these wild hosts is beneficial to the disease management program. This especially applies to abandoned grape vineyards adjacent to managed sites with respect to contamination from powdery downy mildew.

Use of a balanced fertility program

Fertility is based on soil and foliar analysis. The use of excessive fertilizer, especially nitrogen is avoided. Sufficient fertility is used to produce a crop, but excess nitrogen is avoided in order to reduce dense foliage that increases drying time in the plant canopy (stays wet longer).

Controlling Weeds In and Around the Vineyard
Good weed control within and between the rows is a common practice. >From a disease control standpoint, weeds in the planting prevent air circulation and results in fruit and foliage staying wet for longer periods. For this reason, most diseases caused by fungi are generally more serious in plantings with poor weed control than in those with good weed control. Ohio growers recognize this relationship and realize the importance of good weed control to disease management.

Avoiding winter injury
Wounding by freeze injury appears important in the development of crown gall. If winter injury is controlled, crown gall may not become an important problem. Practices such a hilling or burying vines of cold-sensitive cultivars are commonly used by Ohio growers. Proper pruning practices to maintain proper crop loads for maximum vine vigor result in stronger vines that are less susceptible to winter injury. The importance for controlling diseases such as downy and powdery mildew during the growing season in order to prevent winter injury is also recognized by most growers.

Canopy Management
Any cultural practice that alters vegetative growth and canopy density has an effect on vine microclimate, and vine microclimate has a direct effect on disease development. Cultural practices such as shoot thinning, pruning, and shoot positioning have a direct impact on vine microclimate and are commonly used in most Ohio vineyards. Shoot thinning, leaf removal and summer pruning are frequently done specifically to reduce canopy density, so as to increase fruit exposure to light, improve ventilation, and aid in spray coverage. Leaf removal in the fruiting zone of the canopy is important for optimal control of Botrytis bunch rot on wine grapes, and is becoming a common practice. Shoot positioning is usually done to ensure canopy separation of divided canopies or to enhance light exposure of the renewal zone of the vine; it also decreases vegetative growth and canopy density, increases light exposure of fruit, and air circulation in the canopy. Avoid winter injury.

Weeds

Controlling weeds can be a major challenge in vineyards. Growers can minimize the detrimental impacts of weeds and the cost of control by using an integrated approach. An integrated pest management approach to weeds means the grower would utilize several tactics such as measures to prevent introduction of new weeds, tillage and herbicides while understanding and appreciating the interaction between these practices and the biology of the pest.

Understanding weed biology is especially important. The ability to identify weeds correctly is essential to any weed control program. Several, excellent books are available to assist the grower in weed identification. *Weeds of the Northeast* is particularly appropriate for Ohio , it includes most weeds common to the area and has excellent descriptions and illustrations.

All weeds fall into one of three categories:

Annuals, which germinate from seed, grow vegetatively for a period, flower, set seed and die in less than 12 months. Many annuals which germinate in tall, overwinter and complete their growth the following spring and summer.

Biennials, which germinate from seed, grow vegetatively during the first growing season, overwinter and commence growing again the following spring with flowering, seed production and death of the plant usually occurring during the second growing season.

Perennials, may germinate from seed or arise from vegetative structures such as rhizome, stolon or root pieces. Perennials plants persist for two or more growing seasons. Two types of perennials are recognized:

Simple perennials are those that spread mainly be seed such as dandelions and docks. They do not spread extensively by the root system unless the root is cut and spread around.

Creeping perennials are those that spread mainly through underground structures or creeping stems such as johnsongrass and Canada thistle. Creeping perennials are difficult to control unless eradicated before planting.

Different weed management strategies are required for annuals, biennials and perennials:

Perennials
should be considered first. A full year prior to planting the site should be intensively managed to eliminate rhizomes and other vegetative propagules of creeping perennial weeds. Growers can accomplish this by using herbicides, tillage and smother crops. Failure to eradicate established perennials before planting will result in a never-ending battle to keep them under control.

During site preparation, annuals should be identified and recorded. Rank the species from most to least common. This information will be used to select the appropriate herbicide to use after grape vines have been planted. Remember that tillage and hand weeding are also important tactics for controlling weeds during establishment and producing years of a vineyard. Perennial weeds arising from seed can be controlled by the same practices that control germinating annuals.

Consideration should also be given to the value of planting a permanent ground cover or sod. The ground cover can be planted in strips with bare ground for planting between the strips of sod. Alternatively, planting strips can be sprayed out with a herbicide in late fall or in early spring before planting occurs. A grass ground cover will reduce soil erosion, improve trafficability and minimize the growth of annual weeds between the trellis. Grass ground covers can be managed by mowing, tillage and/ or by the use of herbicides.

Biennial
weeds are less likely to be a problem in the vineyard than are annuals and perennials. Biennials such as wild carrot and yellow rocket are best controlled as seedlings and are sensitive to the same control practices as are seedlings of annuals and perennials, namely tillage, hand weeding and herbicides.

Major Weeds Problems

Quackgrass and johnsongrass
along with many broadleaf perennial weeds are best controlled with fall applications of herbicide. Grasses should be at least 8 inches tall when treated. Fall frosts before spraying will generally not affect control of quackgrass provided at least 60% of the foliage is still green when you spray. Johnsongrass should be sprayed before frost occurs. An extended period of drought just before spraying may adversely affect control.

For long-term control of quackgrass in sod ground use Roundup Ultra at 1 - 2 quarts per acre or Touchdown at 3.33 pints per acre. Use the 1 quart per acre rate of Roundup Ultra in 5 to 10 gallons of water per acre on land that has been in row crops. The 2 quart per acre rate will provide longer lasting control when spraying sod. After spraying, wait at least four days before plowing but generally don't delay plowing more than seven days. Quackgrass may recover somewhat from the treatment if tillage is delayed until the foliage has turned brown. When planning spring applications of glyphosate don't fall plow, simply wait until grasses reach the right growth stage (four to five new on quackgrass and in the boot to heading stage of johnsongrass) and spray. Spring applications will generally not provide good control of broadleaf perennials.

Dandelions and some other broadleaf weeds are killed more rapidly with tank-mixes of either Roundup Ultra or Touchdown with 2,4-D amine (add 2,4-D at a rate of 1 pint per acre). Remember that the risk of damaging nearby sensitive fruit and vegetable crops with 2,4-D drift or spray-tank residue is high!

Canada thistle
can be treated in the flower bud to flowering stage in late spring or during the rosette to flower bud stage during late summer or fall. In summer fallow systems tillage should stop in late July and thistles allowed

to re-grow for at least 5 weeks. Apply Roundup Ultra or Touchdown before a killing frost and when Canada thistle re-growth reaches the flower bud stage or is at least 10 to 12 inches high. Apply Roundup Ultra at 2 -3 quarts per acre in 5 to 10 gallons of water or Touchdown at 2 quarts per acre. Spot sprays of a 2 % solution (0.5 pints in 6 gallons of water) of either herbicide will also be effective.

Field bindweed
must be treated when it is actively growing and at or beyond bloom. Fall treatment is best but apply herbicides before a killing frost. Apply Roundup Ultra at 3 to 4 quarts per acre or Touchdown at 5.33 pints per acre. Alternatively, spot spray with a 2 % solution of either product.

Chemical Controls:
The following herbicides are those recorded by 47 Ohio grape growers in a survey conducted in 1999. Other herbicides can be used on grapes in Ohio including Casoron/Norosac, Gallery, Devrinol, Solicam, Prowl, Kerb and Treflan.

Diuron (Karmex)

Target Weeds: Annual grasses and broadleafs
Percent acres heated: 55%
Average rate and frequency of applications: 2 lb product, 1 application early spring.
PHI: 127 days
Efficacy rating: good

Paraguat (Gramoxane Extra)

Target weeds: most annual weeds and top kill of perennials
Percent acres treated: 33%
Average rate and frequency of applications: 1 pint per acre, 1.3 applications
PHI: 68 days
Efficacy rating: very good

Glyphosate (Roundup)

Target weeds: most annual and perennial grasses and broadleaf weeds
Percent acres treated: 43%
Average rate and frequency of application: 1 qt per acre, 2 applications per year
PHI: 72

Simazine (Princep)

Target weeds: fair control of grass, good control of many broadleaf weeds
Percent acres treated: 25%
Average rate and frequency of applications: 2.5 lb to 5 lb per acre, 1 applications per year
PHI: 126 days
Efficacy rating: good

Oryzalin (Surflan)

Target Weeds: Annual grass and some broadleafs
Percent acres treated: less than 1%
Average rate and frequency of application: 3 qt per acre, 1 application per year
PHI 125 days
Efficacy rating: moderate to good

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