

Crop Profile: Labrusca Grapes in New York

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II. Basic Commodity Information

State Rank: 2

% U.S. Production: 28%

Acres Planted: 26,000

Acres Harvested: 25,500

Cash Value: \$33,300,000

Yearly Production Costs: Average cost is \$1,350 per acre

Production Regions: Labrusca grape production is concentrated in the Lake Erie and Finger Lakes Region of New York State. Production of grape varieties fitting this classification are also grown in other areas of New York State but are more scattered with smaller acreage represented.

Cultural Practices:

Commodity Destination(s):

Juice, Jams and Concentrate. 70%

Wine.....30%

Introduction

Grapes are ranked second in value of production among fruit crops in New York. Approximately 26,000 acres of V. Labrusca varieties such as 'Concord' and 'Niagara' are grown in New York State with the majority of the acreage found in the Lake Erie region. 'Concord' and 'Niagara' grapes are used primarily for juice and jam production with the remainder going into fresh and fermented grape products. The combined annual value of Labrusca grapes is over \$33 million with yields averaging 5 tons per acre.

The use of pesticides in the production of Labrusca grapes is minimized due to: 1) a smaller insect pest complex than other fruit crops, 2) being lower in susceptibility to many of the diseases affecting grapes when compared to V. vinifera and French Hybrid varieties, and 3) the fact that the majority of these grapes are used in processed products and not as fresh fruit. A pesticide use database has been under development since 1989 and shows the changes in pesticide use patterns due to resistance development, weather patterns, and restrictions or removal of various pesticides. In 1997 (this year was chosen as it comes closest to representing a "normal" year) Labrusca growers in New York State applied an average of 2.6 pre-emergence and post emergence herbicides (tank mixing led to an average of 1.8 applications), 5.0 Fungicides (an average of 3.4 applications) and 1.1 insecticides (average of 1.1 applications). Prior to the implementation of the Grape Berry Moth Risk Assessment protocol in 1989 (developed by Hoffman and Dennehy, NYSAES, Geneva, NY) the conventional pest control strategy called for 3 insecticide applications, with fungicide applications driven by the timing of these applications. Fungicide applications are no longer timed by the need for insecticides. In 1997, 27% of the growers applied no insecticide, 44% applied only one insecticide, 23% had two insecticide applications and only 5% used 3 applications of insecticide. Of those growers applying insecticides, 12% of the insecticides were applied to only a portion of the acreage which was infested with grape berry moth or grape leafhopper.

However, public concern over food and environmental safety, whether justified or not, is intensifying and changing the way Labrusca grape growers manage their vineyard pests. Grape processors in the Lake Erie region process grapes from across New York State and have taken a proactive approach to consumer concerns over pesticides. Because Labrusca grapes are used

primarily in products (grape juices and jams) which have children as a major part of their consumer base, consumer concern over pesticides have lead to a voluntary ban of Captan use by growers who deliver to these processors. The use of EBDC fungicides (Dithane, Penncozeb, Maneb, and Mancozeb) has been restricted, by processors, to the period prior to the first sign of bloom to eliminate the chance of residues being present at harvest. The grape industry in New York State has long supported the use of Integrated Pest Management in vineyards by making available research and implementation funding through the Lake Erie Processors group and the New York Wine and Grape Foundation. While pesticides remain an important component of the vineyard pest management tool box, the focus of the industry is to expand the number of options available to improve the integrated approach to pest management growers are currently using.

III. Pest Information

1. Black Rot

Type of Pest: Disease

Frequency of Occurrence: 3- to 5-inch shoot growth through approximately August 1

Damage Caused: Black rot is one of the most serious diseases of grapes in the eastern United States. This disease can cause substantial crop loss under the appropriate environmental conditions. All green tissues of the vine are susceptible to infection.

% Acres Affected: 30%

Pest Life Cycles: The black rot fungus overwinters primarily in mummified fruit on the vineyard floor or fruit retained within the vine. It can also overwinter within cane lesions. Spores within cane lesions are available for infection starting at bud break; however, the vast majority of spores (those within mummified fruit) first become available about 2-3 weeks after bud break, then reach peak levels from about 1-2 weeks before bloom until about 1-2 weeks after, depending on the year. Rain triggers the release of infective spores from mummies, and infection occurs if susceptible tissues remain wet for a sufficient length of time, which depends on temperature. Pycnidia develop within lesions caused by current season infections and release a new crop of spores during the summer. It is this secondary round of spore release and infection that is responsible for the majority of fruit rot damage. Thus, if very few current season infections are present, protective sprays can usually be stopped once most of the overwintering inoculum has been depleted (about the time berries become pea-sized). However, if more than a few current infections (and new spores) are present, protection must be maintained until fruit are no longer susceptible to infection, about August 1 in the Finger Lakes region of New York.

Timing of Control: Disease severity the previous year and varietal susceptibility to black rot are the major factor in determining how early protection is required. Under heavy disease pressure protectant application could begin as early as 3-inch shoot growth on susceptible varieties. However, the two most important sprays are the immediate prebloom and 10 to 14-days later at the immediate postbloom.

Yield Losses: 50% in years of frequent early rainfall which favors development of primary infections.

Regional Differences:

Cultural Control Practices: Removal of mummified clusters during pruning significantly reduces disease pressure for the coming season; spring cultivation to bury mummies also can contribute to a reduction of inoculum. Cultural practices that open the canopy are beneficial because they increase air circulation and improve spray coverage.

Biological Control Practices: None available at this time

Post-Harvest Control Practices: Removal of mummified berries during pruning

Other Issues: Many of the fungicides currently available for use in New York vineyards provide control of more than one disease. One application of azoxystrobin (Abound) provides protection against black rot, powdery mildew, downy mildew and some protection against Phomopsis Cane and Leaf Spot. Mancozeb and maneb + zinc salt materials provide protection against black rot, downy mildew and Phomopsis Cane and Leaf Spot while *myclobutanil* (Nova), provides protection against both black rot and powdery mildew. While any one chemical may be sprayed up to 3 times during the growing season for black rot, it is more common to see a single application of a variety of materials depending on the primary disease targeted for that particular application. In general no more than 3 applications of pesticide are used for black rot protection in a normal year and a majority, if not all, of the applications are applied for protection of other diseases as well. The use of mancozeb and maneb + zinc salt materials are banned by Lake Erie Processors once bloom begins in an attempt to eliminate residues of these materials at harvest.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>azoxystrobin</i> (Abound)	26	foliar, ground	11-12 oz/Acre	3 to 5-inches of shoot growth (on highly susceptible varieties in years which frequent, early rainfall) to 3-4 weeks post bloom.	1.1	14	12

<i>triadimefon</i> (<i>Bayleton</i>)	5	foliar, ground	3-4 oz/Acre	10 to 12-inch shoot growth to 3-4 weeks post bloom	1.25	14	12
<i>ferbam</i> (<i>Carbamate WDG</i>)	20	foliar, ground	2 lbs/100 gallons	10 to 12-inch shoot growth to 3-4 weeks post bloom	1.1	7	24
Efficacy Issues:	Ferbam is chemically related to Ziram and has the same general range of activity and effectiveness: good against black rot and Phomopsis, but only fair against downy mildew. Ferbam is most useful as a postbloom substitute for EBDC's (Mancozeb, Dithane, Penncozeb, Manzate) where processor restrictions prohibit their use after bloom.						
<i>mancozeb</i> (<i>Manzate, Dithane, Penncozeb</i>)	54	foliar, ground	3-4 lb depending on formulation	3 to 5-inch shoot growth to 3-4 weeks post bloom	1.4	66	24
<i>maneb + zinc salt</i> (<i>Maneb Plus Zinc, Manex II</i>)	8	foliar, ground	2.4-3.2 qt	3 to 5-inches of shoot growth to 3-4 weeks post bloom	1.5	66	24
<i>myclobutanil</i> (<i>Nova</i>)	58	foliar, ground	4-5 oz/Acre	3 to 5-inches shoot growth to 3-4 weeks post bloom	1.3	14	24
Use in IPM Programs:	Nova can be used in black rot management either on a protectant or post-infection basis. Using a post-infection program growers must be able to accurately monitor weather conditions as sprays are applied after an infection has occurred. Nova is highly effective against black rot when applied within 72 hours after the start of an infection period. However, post-infection activity is strongly rate-dependent, thus high labeled rates must be used, particularly if extended kickback activity is required. Good early season management often allows black rot management programs to end once fruit reach 1/4-inch in diameter.						
Efficacy Issues:	Nova is used for both powdery mildew and black rot management. A slip in efficacy for powdery mildew has been observed in the field which may make this a less desirable choice of the sterol-inhibiting class of fungicides. No problems with resistance have been seen with Nova and black rot						
<i>ziram</i> (<i>Ziram</i>)	43	foliar, ground	3-4 lb per acre	6-inches shoot growth to 3-4 weeks after bloom.	1.2	21	48
Efficacy Issues:	Ziram is chemically related to ferbam and has the same general range of activity and effectiveness: good against black rot and Phomopsis, but only fair against downy mildew. Ziram is most useful as a postbloom substitute for EBDC's (Mancozeb, Dithane, Penncozeb, Manzate) where processor restrictions prohibit their use after bloom.						

2. Downy Mildew

Type of Pest: Disease

Frequency of Occurrence: 10-inch shoot growth to harvest

Damage Caused: Berries, leaves and young shoots can be infected. This can result in a loss of growth with early season shoot infection, premature defoliation with leaf infections and direct crop loss through berry infections.

% Acres Affected: 20%

Pest Life Cycles: The downy mildew fungus overwinters as dormant spores within infected leaves on the vineyard floor and first becomes active in the spring about 2-3 weeks before bloom (at approximately 10-inch shoot growth). Infective spores are then produced during rainy periods if temperatures are above 50 F, and are splashed onto susceptible tissues to cause the season's first (primary) infections. (Note that inoculum for such early-season infections comes from within the vineyard.) Epidemic disease development can then result from repeated cycles of secondary spread, which is caused by new spores produced within the white fungal growth on infected tissues. These spores are produced only at night when the relative humidity is extremely high (>95%). They can be blown relatively long distances and cause infection when they land on susceptible tissues that remain wet. (Note that later-season disease spread can be regional.) Thus, disease spread is most severe during periods when humid nights with moderate to warm temperatures (which allow the secondary spores to form) are followed the next day by rains or thundershowers (which allow them to germinate and cause new infection).

Timing of Control: 10-inch shoot growth through harvest, depending on frequency of early season rainfall, varietal susceptibility and overwintering inoculum.

Yield Losses: Can be 90% if early season infections to shoots, leaves and /or clusters are not controlled.

Regional Differences: No regional differences are readily apparent.

Cultural Control Practices: Any practice that improves air circulation and speeds drying within vine canopies will help to control downy mildew. Spring cultivation to bury fallen, infected leaves from the previous year will also help to reduce early season disease pressure. However, properly timed fungicides are still necessary for reliable disease management.

Biological Control Practices: None available at this time

Post-Harvest Control Practices: None available at this time

Other Issues: Many of the fungicides currently available for use in New York vineyards provide control of more than one

disease. One application of azoxystrobin (Abound) provides protection against black rot, powdery mildew, downy mildew and some protection against Phomopsis Cane and Leaf Spot. Mancozeb and maneb + zinc salt materials provide protection against black rot, downy mildew and Phomopsis Cane and Leaf. While any one chemical may be sprayed up to 3 times during the growing season for downy mildew it is more common to see a single application of a variety of materials depending on the primary disease targeted for that particular application. In general no more than 2 applications of pesticide are used for downy mildew protection in a normal year and a majority, if not all, of the applications are applied for protection of other diseases as well. The use of Captan has been banned by Lake Erie region grape processors while the use of mancozeb and maneb + zinc salt materials are limited by Lake Erie Processors the prebloom period only in an attempt to eliminate residues of these materials at harvest.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>azoxystrobin</i> (<i>Abound</i>)	26	foliar, ground	11-12 oz/Acre	Immediate prebloom, Immediate postbloom	1.4	14	12
<i>Captan</i> (<i>Captan</i>)	<1	foliar, Air blast sprayer	2-4 lb depending on formulation	10 to 12-inch shoot growth through mid-summer	1	14	96
<i>Copper</i> (<i>Copper</i>)	47	foliar, air blast sprayer	Varies by formulation	As needed. Typically a late summer application.	1.1	0	24-48
<i>mancozeb</i> (<i>Manzate, Dithane, Penncozeb</i>)	54	foliar, ground	varies by formulation	10 to 12-inch shoot growth to post bloom	1.4	66	24
<i>maneb + zinc salt</i> (<i>Maneb + Zinc, Manex II</i>)	8	foliar, ground	variable by formulation	10 to 12-inch shoot growth to post bloom	1.5	66	24
<i>metalaxyl</i> (<i>Ridomil Gold MZ, Ridomil/Copper/Gold</i>)	1	foliar, ground	11-12 fl oz	Immediate prebloom to post bloom	1	66	48
Use in Resistance Management:	Resistance to Ridomil by the downy mildew fungus has been reported in several other countries. To reduce the risk of developing resistance, use no more than three total applications of Ridomil per season, and do not use to eradicate sporulating lesions on leaves or fruit.						

3. Eutypa Die Back

Type of Pest: Disease

Frequency of Occurrence: Spores are available during winter during rainfall or snow melt events.

Damage Caused: Eutypa dieback produces cankers in the cordons, or trunks, of a vine which slowly caused portions of the vine above the canker to die. The entire vine, or portions of the vine can be affected.

% Acres Affected: 30%

Pest Life Cycles: In winter, during rainfall or snow melt, fungal spores are released from fruiting structures on dead infected wood. Spores are dispersed by the wind and infection occurs when they enter fresh pruning wounds. Cankers and foliage symptoms are not evident until two to four years after infection; then vine deterioration continues until the trunk or arm is finally killed. New shoots above cankers often appear stunted, with shortened internodes and small, cupped, greenish-yellow leaves in the spring. Healthy growth usually overgrows and obscures affected shoots by midsummer. Shoot and leaf symptoms become progressively worse each season until, eventually, no growth is produced.

Timing of Control: Chemical control is during dormant pruning. Cultural practices at 10 to 12-inch shoot growth.

Yield Losses: Loss of vines due to infection can cause significant loss of crop if disease is not caught early and controlled.

Regional Differences: No regional differences are apparent.

Cultural Control Practices: Infected arms and trunks should be removed in late spring when foliar symptoms are noticeable and wounds are less susceptible to reinfection. Pruning should be far enough below the canker that healthy wood is evident. Any infected wood or stumps should be removed from the vineyard and burned.

Biological Control Practices: None available at this time

Post-Harvest Control Practices: None

Other Issues: Success in using Benlate for Eutypa has been limited at best. Most growers have found that the benefit is not significant enough to justify the extra time and effort it takes to make the application during pruning with the labor force that they are currently using.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>benomyl</i> (Benlate)	<1	pruning wounds on trunks, painted on or sprayed	3.2 oz/gallon	During the dormant season while pruning	1	70	24

4. Phomopsis Cane and Leaf Spot and Fruit Rot

Type of Pest: Disease

Frequency of Occurrence: 1-inch shoot growth through immediate post bloom Shoot lesions can produce inoculum for a period of 5 to 7-years.

Damage Caused: All green tissues of the vine are susceptible to infection. Severely infected leaves are misshapen, yellow, and fall from the vine prematurely. Infected rachises are brittle so that portions of the cluster may fall off before harvest. Infected fruit are discolored and can drop to the ground before maturity.

% Acres Affected: 75%

Pest Life Cycles: Rainy weather during the early growing season favors disease development. Spores (pycnidiospores) are produced within the black fruiting bodies (pycnidia) and ooze out during wet weather. These spores are then splashed by the rain onto newly developing shoots. Shoot tips may become infected at any time during the year, but infection is more common between bud break and bloom. Shoot and leaf lesions typically appear 3 to 4 weeks after infection. Infection of the rachis can occur from the time clusters are first visible, when shoot growth measures 2- to 3-inches, through fruit set. Fruit becomes infected at or shortly after bloom, but the fungus remains latent until the fruits ripen. Symptoms of fruit rot and most rachis lesions begin to appear 1 to 3 weeks before harvest. Infected leaves may not develop symptoms until they become senescent. Some infections of the shoot may never develop symptoms but will produce pycnidia during the dormant season. The fungus overwinters on the vine in infected canes and rachises and may survive and sporulate in dead infected canes for more than one season. Spores from pycnidia are produced in the spring to renew the disease cycle.

Timing of Control: The critical period for development of the cane and leaf spot phase of the disease is during the first few weeks of growth (starting at 1-inch shoot growth). Rachises are susceptible from the time clusters first become visible until after pea-sized berries are formed. Fruit are most susceptible from bloom until after pea-sized berries are formed.

Yield Losses: When incidence of the disease is high, crop losses of 10 to 30 percent can occur.

Regional Differences: Varietal differences and differences in training systems are more apparent than regional differences.

Cultural Control Practices: None available

Biological Control Practices: None available at this time

Post-Harvest Control Practices: Removal of infected wood during dormant pruning. In cases of severe infection this method of control is not practical as the integrity of the training system would be compromised due to removal of canes used in the structure of the vine.

Other Issues: Phomopsis diseases are most likely to become a problem when the fungus is allowed to build up on dead canes in the vines (e.g. pruning stubs), especially if weather is wet during critical stages of disease development. Therefore, mechanically pruned vineyards are at particular risk of incurring economic losses from Phomopsis although damage can occur in all pruning and training systems if weather is very wet. Many of the fungicides currently available for use in New York vineyards provide control of more than one disease. One application of azoxystrobin (Abound) provides protection against black

rot, powdery mildew, downy mildew and some protection against Phomopsis Cane and Leaf Spot. Mancozeb and maneb + zinc salt materials provide protection against black rot, downy mildew and Phomopsis Cane and Leaf. While any one chemical may be sprayed up to 3 times during the growing season for Phomopsis, it is more common to see a single application of a variety of materials depending on the primary disease targeted for that particular application. In general no more than 2 applications of pesticide are used for Phomopsis protection in a normal year and a majority, if not all, of the applications are applied for protection of other diseases as well. The use of Captan has been banned by Lake Erie region grape processors, while the use of mancozeb and maneb + zinc salt materials are limited by Lake Erie Processors to the prebloom period only in an attempt to eliminate residues of these materials at harvest.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg. # of Appl.	PHI	REI
<i>azoxystrobin</i> (<i>Abound</i>)	26	foliar, ground	11-12 oz/Acre	Immediate prebloom and/or immediate postbloom	1.1	14	12
<i>captan</i> (<i>Captan, Captec</i>)	<1	foliar, ground	1.25-4 lb or 1.5-2 qt depending on formulation	1-inch shoot growth to 3-4 weeks post bloom	1	14	12
<i>ferbam</i> (<i>Carbamate WDG</i>)	20	foliar, ground	2 lbs/100 gallons	1-inch shoot growth to 3-4 weeks post bloom	1.1	7	24
Efficacy Issues:	Ferbam is chemically related to Ziram and has the same general range of activity and effectiveness: good against black rot and Phomopsis, but only fair against downy mildew. Ferbam is most useful as a postbloom substitute for EBDC's (Mancozeb, Dithane, Penncozeb, Manzate) where processor restrictions prohibit their use after bloom.						
<i>mancozeb</i> (<i>Manzate, Dithane, Penncozeb</i>)	54	foliar, ground	3-4 lb depending on formulation	1-inch shoot growth to 3-4 weeks post bloom	1.4	66	24
<i>maneb + zinc salt</i> (<i>Maneb Plus Zinc, Manex II</i>)	8	foliar, ground	2.4-3.2 qt	1-inches of shoot growth to 3-4 weeks post bloom	1.5	66	24
<i>ziram</i> (<i>Ziram</i>)	43	foliar, ground	3-4 lb per acre	6-inches shoot growth to 3-4 weeks after bloom.	1.2	21	48
Efficacy Issues:	Ziram is chemically related to ferbam and has the same general range of activity and effectiveness: good against black rot and Phomopsis, but only fair against downy mildew. Ziram is most useful as a postbloom substitute for EBDC's (Mancozeb, Dithane, Penncozeb, Manzate) where processor restrictions prohibit their use after bloom.						

5. Powdery Mildew

Type of Pest: Disease

Frequency of Occurrence: 1-inch shoot growth through approximately August 1

Damage Caused: The powdery mildew fungus can infect all green tissues of the grapevine. It appears as a white or grayish-white powdery covering on the upper and lower surfaces of leaves and fruit. Expanding leaves that are infected become distorted and stunted. When green shoots are infected, the fungus appears dark brown to black and remains as brown patches on the surface of dormant canes. Cluster infection before or shortly after bloom may result in poor set and considerable crop loss. If berries are infected when they are pea-size or larger, the epidermis stops growing but the pulp continues to expand and the berry splits. When berries of purple or red cultivars are infected as they begin to ripen, they fail to color properly and have a blotchy appearance at harvest. Such fruit will produce wines with off flavors.

% Acres Affected: 100%

Pest Life Cycles: The powdery mildew fungus overwinters as cleistothecia on dead leaves and bark. Shortly after bud break, cleistothecia swell under moist conditions and break open, releasing the ascospores contained within. The ascospores may then cause infections on all green tissue. Lesions resulting from ascospore infections produce conidia, which spread the disease. Wind-borne spores (conidia) are produced abundantly on the infected tissue and spread the disease to neighboring vines. As adjacent leaves and flower clusters become infected, new conidia are produced on them and the disease can spread rapidly throughout the vineyard. In late summer the powdery mildew fungus produces black spherical bodies (cleistothecia) on the surface of the infected leaves, shoots, and berries.

Timing of Control: 1-inch shoot growth through late summer. One-inch spray is for highly susceptible varieties or problem

areas if the weather forecasts call for rain and temperatures above 50°F.

Yield Losses: Severe, early season infections can result in 20% crop loss as the cells in the skin of the berry are killed and lose the ability to expand. This results in cracked berries which can lead to secondary infections by molds and other mildews.

Regional Differences: No regional differences are present.

Cultural Control Practices: Any practice that improves air circulation and thereby reduces humidity within the canopy is of significant benefit.

Biological Control Practices: None available at this time

Post-Harvest Control Practices: None available at this time

Other Issues: Many of the fungicides currently available for use in New York vineyards provide control of more than one disease. One application of azoxystrobin (Abound) provides protection against black rot, powdery mildew, downy mildew and some protection against Phomopsis Cane and Leaf Spot while *myclobutanil* (Nova) provides protection against both powdery mildew and black rot. While any one chemical may be sprayed up to 3 times during the growing season for powdery mildew it is more common to see a single application of a variety of materials depending on the primary disease targeted for that particular application. In general no more than 3 applications of pesticide are used for powdery mildew protection in a normal year and a majority, if not all, of the applications are applied for protection of other diseases as well.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>azoxystrobin</i> (Abound)	26	foliar, ground	11-12 oz	Immediate prebloom and/or immediate postbloom.	1.1	14	12
<i>fenarimol</i> (Rubigan)	76	foliar, ground	2-6 oz depending on time of year.	1-inch shoot growth to late summer.	1.6	30	12
<i>paraffinic oil</i> (JMS Stylet Oil)	<1	foliar, ground	1-2% Conc.	1-inch shoot growth to late summer. Typically applied as a late summer application.	1	0	4
Use in Resistance Management:	JMS Stylet Oil can be used as a resistance management tool as it has a unique mode of action compared to the other pesticides used for powdery mildew.						
Efficacy Issues:	Thorough spray coverage is critical for the successful use of this product due to its mode of action. Some phytotoxicity has been seen with repeated applications in some varieties. Use of multiple applications of JMS Stylet Oil has been shown to reduce the rate of sugar accumulation which can be a detriment in seasons where sugar accumulation is slowed by weather conditions. JMS Stylet Oil is incompatible with many of the pesticides currently used in vineyard disease management in New York. Care needs to be taken when using this product to limit use of other products prior to, during, and after the use of JMS Stylet Oil.						
<i>triflumizole</i> (Procure)	<1	foliar, ground	4-6 oz/Acre	3 to 5-inches of shoot growth to 3-4 weeks post bloom	1	7	24
<i>myclobutanil</i> (Nova)	58	foliar, ground	4-5 oz/Acre	3 to 5-inches shoot growth to 3-4 weeks post bloom	1.3	14	24
Use in IPM Programs:	Nova can be used in powdery mildew management either on a protectant or post-infection basis. Using a post-infection program growers must be able to accurately monitor weather conditions as sprays are applied after an infection has occurred. Nova is effective against powdery mildew when applied within 72 hours after the start of an infection period. However, post-infection activity is strongly rate-dependent, thus high labeled rates must be used, particularly if extended kickback activity is required.						
Efficacy Issues:	Nova is used for both powdery mildew and black rot management. A slip in efficacy for powdery mildew has been observed in the field which may make this a less desirable choice of the sterol-inhibiting class of fungicides.						
<i>copper</i> (various formulations)	47	foliar, ground	2 lb + 4 lb of hydrated lime	Second post bloom through late summer.	1.1	0	24

Efficacy Issues:	Copper can be phytotoxic to some varieties. Fixed coppers will not control powdery mildew on highly susceptible varieties. Tank mixes of fixed copper and Nova should be sprayed out as soon as possible; periods of several hours or more in a solution with copper can reduce the effectiveness of Nova. Fixed copper plus lime should not be mixed with Bayleton, Carbamate, Guthion, Sevin, Imidan, or Thiodan.						
<i>sulfur</i> (Wettable sulfur, COCS, Super Six Liquid Sulfur)	<1	foliar, ground	varies due to formulation	1-inch shoot growth through late summer.	1	0	24
Efficacy Issues:	Sulfur can be phytotoxic to some varieties. Sulfur will provide no more than 7-10 days protection following each spray. Sulfur is much less active at temperatures below 65°F, and may therefore provide mediocre control under heavy disease pressure.						

6. Banded Grape Bug

Type of Pest: Insect

Frequency of Occurrence: Sporadic pest of grapes. When present damage occurs between mid-May and early June

Damage Caused: Feeding injury results in floret drop, reduced berry set, and reduced cluster number

% Acres Affected: 10%

Pest Life Cycles: Nymphs of this insect emerge in the spring and feed, using their sucking and piercing mouth parts, on flowers and young berries. Injury by small nymphs, occurring between 3- to 5-inch shoot growth (around May 15) and early June, results in floret drop, reduced berry set, and reduced cluster number. Subsequent feeding by larger nymphs and adults does not affect cluster development. This injury only occurs in the early prebloom stages (between 5- and 10-inch shoot growth). Subsequent feeding by nymphs does not reduce berry set. Adults appear to be predaceous and do not cause injury to berries.

This pest is sporadic and does not require treatment in most years.

Timing of Control: 3- to 10-inch shoot growth

Yield Losses: Up to 100% reduction in area infested by this pest through loss of florets. Reduction of crop size of 50% is typical when banded grape bug exceeds the economic threshold of 1 nymph per 10 shoots.

Regional Differences: This pest appears to be more widespread in the Lake Erie region as opposed to the Finger Lakes Region, Hudson Valley or Long Island.

Cultural Control Practices: None available

Biological Control Practices: None available

Post-Harvest Control Practices: Not applicable

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>Carbaryl</i> (Sevin)	10	Foliar, Ground	0.75 - 4 lb depending on formulation	3- to 5-inch shoot growth and 10- to 12-inches of shoot growth	1.4	7	12
Use in IPM Programs:	Used in conjunction with scouting protocol of examining clusters and shoot tips for presence of nymphs. Research has shown that due to the destructive nature of this pest ,an economic threshold of 1 nymph per 10 shoots is required to prevent crop loss.						
Use in Resistance Management:	Sevin is the only pesticide labeled in New York State for banded grape bug under a FIFRA 2(ee) recommendation.						

7. Climbing Cutworm

Type of Pest: Insect

Frequency of Occurrence: Sporadic pest of grapes. Cool springs which delay buds moving from bud swell to shoot growth favor injury by this pest.

Damage Caused: Feeding results in the loss of primary and in some instances loss of secondary and tertiary buds. Grapevines do compensate, at least to some extent, for primary bud loss through production of secondary buds. However, shoots from such buds are less fruitful than those from primary buds. When both primary and secondary buds are damaged the tertiary buds produce only a shoot but no fruit.

% Acres Affected: <1%

Pest Life Cycles: Larvae feed on the buds from full bud swell through bud break and until shoots are 10 to 15 cm long. Larvae

hide during the day under the bark and in the soil litter beneath a vine and come out at night to feed.

Timing of Control: Bud swell

Yield Losses: In areas with high levels of feeding activity 30% crop reduction can occur. This pest can severely impact newly planted vineyards by destroying buds and delaying, or eliminating, shoot development needed to produce the necessary training systems.

Regional Differences: This pest is more prolific in the Lake Erie Region due to its preference of sandy, light textured soils.

Cultural Control Practices: Maintaining a vegetation-free band under the row can reduce habitat needed by the climbing cutworm to hide during the day.

Biological Control Practices: No alternatives have been shown to be viable at this time.

Post-Harvest Control Practices: Not applicable

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>Carbaryl (Sevin)</i>	<1	foliar, ground	2.5-4 lb, 2 qt depending on formulation	Bud swell	1	7	12
Use in IPM Programs:	Scouting for damaged buds is used prior to application of insecticide for this pest.						

8. European Corn Borer

Type of Pest: Insect

Frequency of Occurrence: 10- to 12-inches of shoot growth. Corn borer problems are rare, but under some circumstances may require management. They are usually found in vinifera varieties, especially vines with excessive foliage or where vineyards are weedy or surrounded by corn, sorghum, sudan grass, or related crops. Young vineyards or nursery stock may be more seriously affected by borer injury than mature vines.

Damage Caused: After initially feeding on young leaves, larvae bore into canes. This weakens or kills shoots, especially when the larvae enter the middle or lower sections.

% Acres Affected: <1%

Pest Life Cycles: Egg laying can occur in late May, late June to early July, or early August, depending on the genetic race of corn borer present. Damage by larvae is typically confined to early in the season

Timing of Control: Mid-May and Mid July. Two applications of insecticide 7 days apart at each timing are necessary for management of this pest.

Yield Losses: Yield losses from destruction of shoots can result in some crop loss. However, this pest is most destructive in newly planted vineyards and nurseries where the structure of the vine can be destroyed by destruction of shoots.

Regional Differences: None

Cultural Control Practices: Good weed management and management of canopy to eliminate excessive foliage will help reduce incidence of this pest. Also, not planting near fields which could be planted to corn, sorghum, sudan grass, or related crops will reduce pressure from this pest.

Biological Control Practices: None available at this time which have been proven to be effective for this sporadic pest.

Post-Harvest Control Practices: Not applicable

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>Carbaryl (Sevin)</i>	<1	foliar, ground	1.25 - 2 lb depending on formulation	Two applications 7 days apart, mid-May and again in mid-July	1	7	12

9. European Red Mite

Type of Pest: Insect

Frequency of Occurrence: Sporadic to yearly pest of grapes depending on location.

Damage Caused: Given a head start, the vine can tolerate a fair amount of feeding damage on lower leaves. If mites get out on the shoot tips early in the season, however, they can stunt shoot development. Heavy mite infestations (20 to 30 mites per leaf) early in the season can cause stunted, chlorotic shoots with small leaves and pinpoint necrotic areas on leaves. Later in the season, as shoot growth rate declines and the vine allocates more resources to fruit, mites may also have an increased capacity to cause damage.

% Acres Affected: 5%

Pest Life Cycles: Mites overwinter as eggs on the bud scales. Nymphs appear very early in the growing season and pierce the leaf cells to extract plant juices. Both nymphs and adults feed on grape leaves. European red mite can have four to nine generations per year depending on weather conditions.

Timing of Control: Particular attention should be paid to the 1- to 4-inch shoot growth stage and immediate to 20 days postbloom. Vines should be monitored for the presence of this pest and acaricides applied if populations are over the economic threshold for that scouting period.

Yield Losses:

Regional Differences: Serious infestations in the Finger lakes region have occurred more frequently in recent years. Problems with spider mites in the Lake Erie region are uncommon.

Cultural Control Practices:

Biological Control Practices: Predatory mites, when present in the vineyard at sufficient densities, can provide excellent biological control of spider mites. Recent research indicates that frequent use of mancozeb fungicides (a common fungicide in NY vineyard disease management programs) reduce predatory mite populations.

Post-Harvest Control Practices: Not applicable

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>Osdicofol</i> (<i>Kelthane</i>)	<1	foliar, ground	1.5-3.5 lb depending on formulation	When scouting indicates mite populations are above threshold	1.5	7	12
Use in IPM Programs:	Scouting for European red mite can be accomplished at any time after bud break. Particular attention should be paid to the 1- to 4-inch stage and immediate to 20 days postbloom period.						
<i>hexakis fenbutatin-oxide</i> (<i>Vendex</i>)	<1	foliar, ground	1.25-2.5 lb	When scouting indicates mite populations are above threshold	1	28	48
Use in IPM Programs:	Scouting for European red mite can be accomplished at any time after bud break. Particular attention should be paid to the 1- to 4-inch stage and immediate to 20 days postbloom period.						

10. Grape Berry Moth

Type of Pest: Insect

Frequency of Occurrence: There are two to three generations of this pest every year. Grape Berry Moth is one of the most serious insect pests affecting grapes in New York.

Damage Caused: Direct feeding on clusters by larvae during the bloom period. After berries have developed, larvae enter berries and feed within. Late season feeding results in damage to multiple berries per clusters as berry enlargement causes berries to touch each other facilitating movement of a single larvae from berry to berry within a cluster.

% Acres Affected: 50%

Pest Life Cycles: Overwintered pupae emerge as adult moths in late May and lay eggs among the grape clusters. The larvae are small (up to 0.38 inch long) and feed internally in grape berries. The larvae cut flaps in grape leaves and pupate inside, emerging as adult moths (wingspan is 0.5 inch). Two to three generations of this pest can occur each season depending on length, and heat accumulation, of growing season.

Timing of Control: Timing of sprays is determined using the Grape Berry Moth Risk Assessment protocol and scouting. Timings could include; immediate post bloom, first week in August and first week in September. Applications are made using the Grape Berry Moth Risk Assessment Protocol developed by Hoffman and Dennehy. The Risk Assessment Protocol is detailed in Bulletin No. 138. Risk Assessment for Grape Berry Moth and Guidelines for Management of the Eastern Grape Leafhopper. This bulletin can be found on line at: <http://www.nysaes.cornell.edu/ipmnet/ny/fruits/grapes/grmanfs/risk.pdf>

Yield Losses: Load rejection due to grape berry moth found in excess of Federal inspection standards is minimal. Percent crop loss has not been determined but research has shown 50-80% cluster infestation at harvest is not uncommon. Crop loss is estimated at 40% of tonnage on the first 6 rows, or 3 post lengths, nearest the edge of vineyards classified as being at high risk of damage from grape berry moth.

Regional Differences: No regional differences are apparent. Vineyards located next to wooded areas, those having prolonged snow cover, and/or vineyards in areas where winter temperatures are mild (i.e. lake plains) are more susceptible to infestation by grape berry moth. High risk vineyard sites are found across New York State.

Cultural Control Practices: No feasible cultural control practices are available

Biological Control Practices: While research is being conducted on biological alternatives for grape berry moth no economically feasible alternatives are currently available.

Post-Harvest Control Practices: Not applicable

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>Carbaryl (Sevin)</i>	58	foliar, ground	2.5-4 lb, 2.5 qt depending on formulation	Timing is determined by used the Grape Berry Moth Risk Assessment protocol.	1.4	7	12
Use in IPM Programs:	Prior to use of insecticide, vineyards are rated using the grape berry moth risk assessment protocol to determine timing of scouting and the need for insecticide applications.						
<i>azinphosmethyl (Guthion)</i>	1	foliar, ground	1.5 lb	Timing is determined by used the Grape Berry Moth Risk Assessment protocol.	1	0-10	48
Use in IPM Programs:	Prior to use of insecticide, vineyards are rated using the grape berry moth risk assessment protocol to determine timing of scouting and the need for insecticide applications.						
<i>phosmet (Imidan)</i>	1	foliar, ground		Timing is determined by used the Grape Berry Moth Risk Assessment protocol.	1	14	24
Use in IPM Programs:	Prior to use of insecticide, vineyards are rated using the grape berry moth risk assessment protocol to determine timing of scouting and the need for insecticide applications.						
<i>bacillus thuringiensis (Dipel 2X)</i>	<1	foliar, ground	0.5-1 lb	Timing is determined by used the Grape Berry Moth Risk Assessment protocol.	4	0	4
Use in IPM Programs:	Prior to use of insecticide, vineyards are rated using the grape berry moth risk assessment protocol to determine timing of scouting and the need for insecticide applications.						
Efficacy Issues:	Research has shown that to be effective in the management of grape berry moth two applications of Dipel 2X are required as a replacement for each conventional insecticide application. Applications are timed just prior to the conventional timing and one week later. The double application of this material makes it difficult to justify economically.						
<i>bacillus thuringiensis (Biobit)</i>	<1	foliar, ground	1.5-3 pints	Timing is determined by used the Grape Berry Moth Risk Assessment protocol.	4	0	4
Use in IPM Programs:	Prior to use of insecticide, vineyards are rated using the grape berry moth risk assessment protocol to determine timing of scouting and the need for insecticide applications.						
Efficacy Issues:	Research has shown that to be effective in the management of grape berry moth two applications of Dipel 2X are required as a replacement for each conventional insecticide application. Applications are timed just prior to the conventional timing and one week later. The double application of this material makes it difficult to justify economically.						

<i>methomyl</i> (Lannate)	1	foliar, ground	0.5-1 lb	Timing is determined by used the Grape Berry Moth Risk Assessment protocol.	1	14	168
Use in IPM Programs:	Prior to use of insecticide, vineyards are rated using the grape berry moth risk assessment protocol to determine timing of scouting and the need for insecticide applications.						

11. Grape Cane Gallmaker

Type of Pest: Insect

Frequency of Occurrence: Early spring

Damage Caused: Gall-like swellings on canes are caused by the oviposition injury. Galls are usually twice as thick as the cane and 2.5 to 4 cm long. In newly planted vineyards gallmaker can destroy canes necessary for developing a training system, resulting in an extra year being necessary before a crop can be harvested from the vine. Galls usually have little effect on vigor and growth of mature vines but they can weaken the mechanical strength of the cane and cause breakage. In cases of severe infestations, shoot length can be severely stunted resulting in the loss of the crop on infested canes and the loss of the shoot for canopy management for next year.

% Acres Affected: <5%

Pest Life Cycles: The grape cane gallmaker has only one generation per year.

Timing of Control: 4 to 6-inches of shoot growth

Yield Losses: In newly planted vineyards gallmaker can destroy canes necessary for developing a training system, resulting in an extra year being necessary before a crop can be harvested from the vine. Galls usually have little effect on vigor and growth of mature vines but they can weaken the mechanical strength of the cane and cause breakage. In cases of severe infestations, shoot length can be severely stunted resulting in the loss of the crop on infested canes and the loss of the shoot for canopy management for next year.

Regional Differences: No regional differences are readily apparent.

Cultural Control Practices: Removal of infected canes below the galls during dormant pruning. This is not always feasible if infestation was severe or if canes are needed to maintain training system.

Biological Control Practices: None available

Post-Harvest Control Practices: Removal of infected canes below the galls during dormant pruning. This is not always feasible if infestation was severe or if canes are needed to maintain training system.

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	Avg # of Appl.	PHI	REI
<i>phosmet</i> (Imidan)	1	Foliar, ground	2-3 lb per acre	3 to 5 inch shoot growth	1	14	24

12. Grape Cane Girdler

Type of Pest: Insect

Frequency of Occurrence: 10 to 12-inch shoot growth.

Damage Caused: The girdling by the female causes the terminal growth of the new shoots to bend over above the upper girdle and drop to the ground. Later the whole infested shoot dies back to the lower girdle and falls from the vine. Vines 'pruned' by the grape cane girdler have a ragged appearance suggesting serious injury to the plant. However, the actual damage is usually minor. Girdling of the terminal growth has little or no effect on the crop unless fruit-producing nodes are close to attacked shoot tips.

% Acres Affected: <1%

Pest Life Cycles: Adult beetles emerge from infested canes during August and subsequently overwinter in trash on the ground. In May of the following year the adults leave their overwintering sites. When grape shoots are 30 to 50 cm long, usually in late May, the female begins to lay her eggs and girdle new canes. Egg-laying continues for about one month.

Timing of Control: 10 to 12-inches of shoot growth

Yield Losses: Girdles are generally beyond the last grape cluster, so there is usually no loss of fruit, except in years of heavy infestation.

Regional Differences: No regional differences are apparent.

Cultural Control Practices: Removal and burning of infested canes below the girdle prior to the emergence of adults in late summer.

Biological Control Practices: None available

Post-Harvest Control Practices: None available

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>azinphosmethyl (Guthion)</i>	1	Foliar, ground	0.5 lb per acre	10 to 12-inches of shoot growth	1	0-10	48

13. Grape Flea Beetles

Type of Pest: Insect

Frequency of Occurrence: A sporadic pest which does it damage at bud swell to 3-inches of shoot growth. This pest is most damaging in years with cool springs which prolong the time which buds remain in the bud swell to 3-inch shoot growth stage.

Damage Caused: Overwintering adults attack the swelling buds by boring into them and hollowing out the inside. In contrast, the larvae and summer adults feed on the tender leaf tissues but avoid the leaf veins. Feeding on the primary buds is by far the more serious damage by this insect, causing yield loss and stunted growth from secondary or tertiary

% Acres Affected: <1%

Pest Life Cycles: The grape flea beetle is one of the first insect pests to appear in vineyards in the spring. There is only one generation per year. Overwintering adults become active and migrate to the grapevines at about the time grape buds begin to swell. Overwintering adults attack the swelling buds by boring into them and hollowing out the inside. Eggs are placed on the hardened scales surrounding the buds, but most are laid under the loose bark of the canes and near the buds. As foliage develops some eggs are laid on the upper side of the leaves but none are deposited on the underside. The larvae and summer adults feed on the tender leaf tissues but avoid the leaf veins.

Timing of Control: Bud swell

Yield Losses: The amount of yield loss varies from year to year. It is more serious in years when bud development is prolonged by unfavorable climatic conditions. Feeding on the primary buds is by far the more serious damage by this insect, causing yield loss and stunted growth by the secondary and tertiary buds. No fruit develops on canes where the primary and secondary buds were destroyed.

Regional Differences: No regional differences are readily apparent.

Cultural Control Practices: Cleaning up wasteland and woodland areas located near cultivated vineyards eliminates or reduces hibernating sites. Frequent disking to control weeds between grape rows can also break the pupal cells in the soil. However, the practice of disking has been reduced in recent years due to concerns over erosion, poor economics as a weed management method and the need for a firm vineyard floor for various vineyard operations occurring throughout the summer (especially after heavy rainfalls)

Biological Control Practices: None available

Post-Harvest Control Practices: None available

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>carbaryl (Sevin)</i>	1	Foliar, ground	1.25-4 lb depending on formulation	Bud swell	1	7	12

14. Grape Leafhoppers

Type of Pest: Insect

Frequency of Occurrence: One to two generations per year depending on growing degree day accumulations. Leafhoppers are present every year at varying levels.

Damage Caused: Both the adults and nymphs feed on the underside of grape leaves by piercing the tissue and sucking out the plant juices. Damaged leaves become mottled with yellow dots. Excessive feeding can result in necrosis of large areas of leaf surface. A moderate infestation of grape leafhopper does not affect yield and quality significantly.

% Acres Affected: 50%

Pest Life Cycles: Adults overwinter in leaves and litter and enter vineyards in the spring and feed on sucker leaves. These overwintered adults generally do not cause serious damage. Depending on growing degree day (heat units) accumulations, one to two generations occur. Rapid population increases are most likely in hot, dry years.

Timing of Control: Timing of control measures is determined using the leafhopper scouting protocol. Control measures are typically timed in conjunction with grape berry moth scouting with insecticide applications specifically for leafhoppers necessary only if an insecticide for grape berry moth is not required.

Yield Losses: Research has shown that the only time significant yield losses (up to 30%) occur are during seasons which are hot (which drives increases in leafhopper populations) and dry enough to put vines under water stress. Moderate to heavy feeding by leafhoppers in a “normal” year can produce a slight decrease in sugar accumulation causing grapes to be harvested later in the season and reducing the time period vines have to recover prior to the first frost.

Regional Differences: Regional differences are not as critical as differences between varieties. Different species of leafhopper are found on Vinifera and Hybrid grapes than on Labrusca-type cultivars. Labrusca-type grapes (i.e. Concord, Niagara, Catawba, Delaware) have *Erythroneura comes*, also known as Eastern grape leafhopper. Hybrids and Vinifera grapes are infested by other *Erythroneura* leafhopper species, principally *Erythroneura bistrata*. This distinction may be important in the Finger Lakes, where resistance of Eastern grape leafhopper to carbaryl, and possibly PennCap-M, is suspected in isolated vineyards. The species of leafhoppers found on hybrid and vinifera grapes are not affected by resistance at this time.

Cultural Control Practices: None available

Biological Control Practices: Research has been conducted using *Anagrus epos*, a wasp which parasitizes leafhopper eggs. This wasp is found in the wild but has not been shown to be effective in keeping leafhopper population below economic levels during years of high infestations.

Post-Harvest Control Practices: None available

Other Issues: New York State has a FIFRA 2(ee) recommendation allowing the application of lower rates of carbaryl and PennCap-M to manage Eastern grape leafhopper on grapes. Trials in New York State vineyards have shown these reduced rates to provide effective management of leafhoppers. However, if grape berry moth management is also needed, a full rate of insecticide is required to ensure adequate management of this pest.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
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<i>Carbaryl (Sevin)</i>	58	foliar, ground	.75 lb - 2 lb or 0.5-1 qt depending on formulation	Immediate prebloom or end of July. Timing of control measures is linked to grape berry moth risk assessment protocol scouting. Treatment for leafhopper is only necessary if leafhopper populations exceed threshold and no insecticide is required for grape berry moth. In most vineyards, which are classified as being at high or intermediate risk for grape berry moth damage, insecticide applications for grape berry moth also control leafhopper populations.	1.4	7	12
Use in IPM Programs:	Leafhopper is typically only a problem in vineyards which are classified as being at low risk for grape berry moth and where scouting does not indicate a need for control of berry moth. Scouting protocols have been established and are used by growers in determining the need for insecticide applications for leafhoppers.						
Efficacy Issues:	In the Finger Lakes there are some vineyards which have documented Eastern grape leafhopper resistance to Carbaryl and possibly PennCap-M						
<i>Insecticidal Soap (M-Pede)</i>		?	?	?	?	?	?
<i>imidcloprid (Provado)</i>	<1	foliar, ground	0.75 - 1 oz	Immediate prebloom or end of July. Timing of control measures is linked to grape berry moth risk assessment protocol scouting. Treatment for leafhopper is only necessary if leafhopper populations exceed threshold and no insecticide is required for grape berry moth. In most vineyards, which are classified as being at high or intermediate risk for grape berry moth damage, insecticide applications for grape berry moth also control leafhopper populations.	1	0	12
Use in IPM Programs:	Provado is a selective insecticide which works effectively against leafhopper without harming beneficial mite predators. In situations where only leafhopper management is necessary (grape berry moth is under threshold), Provado is a good alternative to the broad spectrum insecticides such as Sevin, PennCap, or Guthion which have been shown to decrease the predatory mite populations in some vineyards resulting in damaging populations of European red mite.						
Use in Resistance Management:	Provado has been shown to be effective in controlling leafhopper populations where resistance to Carbaryl or methyl parathion has developed.						

<i>methomyl</i> (<i>Lannate</i>)	1	foliar, ground	0.5 - 1 lb	Immediate prebloom or end of July. Timing of control measures is linked to grape berry moth risk assessment protocol scouting. Treatment for leafhopper is only necessary if leafhopper populations exceed threshold and no insecticide is required for grape berry moth. In most vineyards, which are classified as being at high or intermediate risk for grape berry moth damage, insecticide applications for grape berry moth also control leafhopper populations.	1	14	168
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15. Grape Rootworm

Type of Pest: Insect

Frequency of Occurrence: Mid- to late May through July

Damage Caused: Grape rootworm is a beetle that feeds on grape foliage as an adult, producing chain-like feeding patterns on the leaves. Immature stages, however, feed on grape roots, and can cause serious damage and vineyard decline over a period of years if left untreated.

% Acres Affected: 10%

Pest Life Cycles: The grape rootworm produces only one generation per year. During its lifetime, a rootworm will begin as an eggs which is deposited under the bark of grape vines by an adult female. It will spend the following 9 to 10 months of its life in the immature grub stage in the soil feeding on roots, and will spend the ultimate month or so of its life as an adult feeding on grape foliage and laying eggs. The grape rootworm requires at least one year to complete its life cycle.

Timing of Control: An insecticide is applied when the chain-like feeding of the adult is first seen in the vineyard.

Yield Losses: If uncontrolled, root feeding by the immature stage of rootworm can lead to vineyard decline and 30% crop loss or more.

Regional Differences: Grape rootworm has historically been of a concern more in the Lake Erie Region of New York State than other areas.

Cultural Control Practices: None available

Biological Control Practices: None available

Post-Harvest Control Practices: Not applicable

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>carbaryl</i> (<i>Sevin</i>)	10	Foliar, ground	1.25-2 lb depending on formulation	10 to 12 inches of shoot growth or when adult feeding is first seen on leaves (feeding is typically seen on leaves of suckers first)	1	7	12
Use in IPM Programs:	Scouting for leaf feeding by adults is the trigger for an insecticide application.						

16. Japanese Beetles

Type of Pest: Insect

Frequency of Occurrence: Mid-summer

Damage Caused: Damage is caused by direct feeding on the leaves

% Acres Affected: 20%

Pest Life Cycles: This pest overwinters as a larva below the soil surface. During late spring, larvae move closer to the soil surface and complete their development, with the larvae feeding principally on roots. Adults emerge in late-June or early-July and begin feeding on foliage. Mating occurs at this time and eggs are laid in the thatch layer of soil and take approximately 10 days to hatch. Young grubs begin feeding on plant roots and continue to feed until cold weather, at which time they tunnel 3 to

12 inches down into the soil where they construct overwintering cells. There is one generation per year.

Timing of Control: After beetles appear in early to mid-July

Yield Losses: Damage is mostly cosmetic in vigorously growing vines. Excessive foliar feeding in newly planted vineyards can result in delayed root and canopy development resulting in a delay of one year or more in terms of full crop production.

Regional Differences: No regional differences are apparent

Cultural Control Practices: None available

Biological Control Practices: No economically effective biological control is available at this time.

Post-Harvest Control Practices: Not applicable

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	Avg # of Appl.	PHI	REI
<i>Carbaryl (Sevin)</i>	10	Foliar, ground	2.5 - 4 lb or 2 qt per acre depending on formulation	Early to mid-July when damage from feeding is considered to be detrimental.	1	7	12
<i>Azinphosmethyl (Guthion)</i>	1	Foliar, ground	1.5 lb per acre	Early to mid-July when damage from feeding is considered to be detrimental.	1	0-10	48
<i>Phosmet (Imidan)</i>	1	Foliar, ground	3 lb	Early to mid-July when damage from feeding is considered to be detrimental.	1	14	24

17. Rose Chafer

Type of Pest: Insect

Frequency of Occurrence: Yearly, although severity varies widely from year to year. Feeding is typically confined to the bloom period.

Damage Caused: Damage from these insects occurs around bloom from direct feeding on flower clusters and leaves.

% Acres Affected: 5%

Pest Life Cycles: Adult rose chafer become active in northeastern North America from late May to early June. The adults appear suddenly with the entire population maturing at approximately the same time. Beetles feed directly on the clusters and leaves and mate soon after emerging from the soil. Females deposit eggs singly a few centimeters below the soil surface. Mating and egg laying occur continuously for about two weeks with each female depositing 24 to 36 eggs. The average life-span of the adult is about three weeks. Approximately two weeks after being deposited, eggs hatch into tiny, white, C-shaped grubs. The larvae feed on the roots of grasses, weed, and other plants throughout the summer, becoming fully developed by autumn. Larvae move downward in the soil as soil temperatures decline and form an earthen cell in which they overwinter. In the spring, larvae return to the soil surface, feed for a short time, and pupate in May. After two weeks in the pupal stage, the adults emerge and crawl to the soil surface to begin their cycle again. There is only one generation per year. (Information from Bulletin 861, Midwest Small Fruit Pest Management Handbook, Ohio State University, 1997.)

Timing of Control: 7 to 10 days prior to bloom or when the first beetles appear.

Yield Losses: 30% crop loss from direct feeding on flowers.

Regional Differences: Rose chafer is more problematic in the Lake Erie region of New York. Problems are most severe in vineyards planted in light, sandy soil.

Cultural Control Practices: None available

Biological Control Practices: None available

Post-Harvest Control Practices: None available

Other Issues:

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates/Acre	Timing	# of Appl.	PHI	REI
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<i>Carbaryl</i> (<i>Sevin</i>)	1	Foliar, ground	2. - 4 lb per acre depending on formulation	When beetles first appear or 7-10 days prior to bloom	1	7	12
<i>azinphosmethyl</i> (<i>Guthion</i>)	1	Foliar, ground	0.5 lb per acre	When beetles first appear or 7-10 days prior to bloom	1	0-10	48

18. Broadleaf weeds

Type of Pest: Weed

Frequency of Occurrence: Yearly, throughout the season

Damage Caused: Weeds compete directly with the vine for water and nutrients. Weed growth during the summer months, both between and under the rows, has been shown to be responsible for reduced vine size and yield.

% Acres Affected: 100%

Pest Life Cycles: Variable due to species of broadleaf weed

Timing of Control: Prior to emergence, prebloom, and/or postemergence.

Yield Losses: Up to 40% dependent on species of weeds present and degree of ground surface covered. Reduction in vine size due to competition of weeds for water and nutrients can result in decreased yield capacity over the next several growing seasons.

Regional Differences: None

Cultural Control Practices: The practice of “hilling up” or pushing a berm of soil against the vine and “pulling away”, or the removal of the berm, can reduce weed populations under the row. However, these practices are labor intensive and less cost efficient than traditional pesticide based practices, increase the hazard of erosion in hill-side vineyards, and may damage vine root systems.

Biological Control Practices: None available

Post-Harvest Control Practices: Not applicable

Other Issues: Grape growers in New York have relatively few pre-emergence herbicides available to them. Research has shown weed species, when treated over an extended period of time with repeated applications of a single herbicide, can develop tolerance or resistance to a particular herbicide resulting in the need to increase rates to reduce weed populations to economic levels or switch to alternative herbicides to achieve control. Reducing the already limited number of herbicides available could result in resistant or tolerant weed species developing over a shorter time frame through more repeated exposure to individual herbicides.

Preplant vineyard preparation requires the use of systemic herbicides such as Roundup and Touchdown to effectively control perennial broadleaves and woody perennials such as brambles, Virginia creeper and poison ivy. No alternative methods are available for preplant control of these perennial weeds. Cultural practices such as plowing and discing often result in tearing the weed’s root system apart, which can result in each piece of root system developing into a new plant, often times increasing weed pressure rather than reducing it.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	Avg # of Appl.	PHI	REI
<i>oxyflourfen</i> (<i>Goal 2X</i>)	<1	Soil applied, ground	5-8 pt per acre surface sprayed	Prior to bud swell. Application must be made prior to the emergence of weeds to be controlled.	1	N/A	24
<i>paraquat</i> (<i>Gramoxone Extra</i>)	36	Weed foliage, ground	2-3 pt per acre surface sprayed	Gramoxone should be applied to emerged weeds when they are small. Weeds 1 to 6-inches tall are easiest to control	1.2	0	48

Use in IPM Programs:	Gramoxone has been successfully used in a post emergence weed management program which uses no pre-emergence herbicides. Weeds are allowed to grow to an average height of 6-inches prior to the first application of Gramoxone. A second application (and possibly a third), if necessary, is applied when regrowth of weeds reaches 6-inches in height. This program has been shown to provide weed management comparable to that of a conventional weed management program that uses both pre- and post emergence herbicides. Gramoxone is used to remove unwanted shoot growth (suckers) coming from the crown (base) of the vine. The use of herbicides for sucker removal results in tremendous cost and labor savings for growers in an industry where labor is difficult to find during the time frame for sucker removal and economic margins for the production of Labrusca grapes requires inputs to be limited.						
Efficacy Issues:	The use of post emergence herbicides is limited in Vinifera and French Hybrid vineyards where sucker growth is required for training system maintenance.						
<i>diuron</i> (<i>Karmex</i>)	57	Soil applied, ground	2-6 lb per acre surface sprayed	Apply in the spring just prior to the germination and growth of annual weeds.	1	0	12
Efficacy Issues:	The label urges caution for use on soils low in clay or organic matter (1-2%) and limits the rate to 2-3 lb/A under those conditions. Tank mix with Solicam or Surflan for improved annual grass control. Use only in vineyards established for at least 3 years.						
<i>simazine</i> (<i>Princep Caliber 90, Princep 4L</i>)	57	soil applied, ground	2.2-5.3 lb or 2.0-4.8 qt per acre surface sprayed depending on formulation	Apply between harvest and early spring.	1	0	12
Efficacy Issues:	Use the lower rate of material per acre surface sprayed on coarse-textured soils low in organic matter. New York has a FIFRA 2(ee) recommendation allowing Princep for pre-emergence control of plantains. Season-long control of annual grasses may be obtained by tank mixing with Karmex, Solicam, or Surflan. Do not use in vineyards established less than 3 years.						
<i>glufosinate</i> (<i>Rely</i>)	3	Weed foliage, ground	3-6 qt per acre surface sprayed. Rate is based on height and species of weeds present.	Best results are obtained when applications are made to actively growing weeds. Repeat applications may be necessary.	1	14	12
Use in IPM Programs:	Rely has been successfully used in a post emergence weed management program which uses no pre-emergence herbicides. Weeds are allowed to grow to an average height of 6-inches prior to the first application of Rely. A second application of Rely is applied when regrowth of weeds reaches 6-inches in height. This program has been shown to provide weed management comparable to that of a conventional weed management program that uses both pre-and post emergence herbicides. Rely is used to remove unwanted shoot growth (suckers) coming from the crown (base) of the vine. The use of herbicides for sucker removal results in tremendous cost and labor savings for growers in an industry where labor is difficult to find during the time frame for sucker removal and economic margins for the production of Labrusca grapes requires inputs to be limited.						
Efficacy Issues:	The use of post emergence herbicides is limited in Vinifera and French Hybrid vineyards where sucker growth is required for training system maintenance. Tank mixes with appropriate residual herbicides are recommended for broad-spectrum control and residual activity. Rely herbicide is not registered for use in Nassau and Suffolk Counties and must not be used in these locations.						

<i>glyphosate</i> (Roundup)	65	Weed foliage, ground	0.5-5 qt per surface acre sprayed in 40 or fewer gal of water. Proper rate is dependent upon many factors including weed species present, growth stage, and environmental factors.	Roundup applications should not be made when green shoots, canes or foliage are in the spray zone. Roundup should be applied prior to the end of bloom stage to avoid injury, or with shielded sprayers or wiper equipment, but not within 14 days of harvest. Perennial grasses can be controlled with fall Roundup applications which can be made after 100 percent natural grape leaf fall after harvest. Roundup applications should not be made when green shoots, canes, or foliage are in the spray zone. Roundup should be applied prior to the end of bloom stage to avoid injury, or with shielded sprayers or wiper equipment, but not within 14 days of harvest. Perennial grasses can be controlled with fall Roundup applications which can be made after 100 percent natural grape leaf fall after harvest.	1.2	14	12
Use in IPM Programs:	Roundup can be used as a substitute for cultivation of the vineyard row middles. Roundup is used as a lower cost alternative than mowing or discing. The use of Roundup is less costly and labor intensive than either mowing or discing. Discing also increases the hazard of erosion on hill-side vineyards and can injure the root systems of vines. (see Pool, R.M., R.M. Dunst, and J.S. Kamas. 1990. Managing Weeds in New York Vineyards. V. Managing Vineyard Floors Using No-tillage. Cornell GrapeFacts I-5).						
Use in Resistance Management:	Roundup may be tank mixed with pre-emergence herbicides according to label instructions to control both emerged and non-emerged weeds.						
Efficacy Issues:	Efficacy depends upon absorption into mature leaves. Addition of dry ammonium sulfate at 8.5 to 17 pounds per 100 gallons water may increase performance of Roundup when tank-mixed with residual herbicides. Roundup is most effective applied at lower gallonage and higher concentration.						
<i>oryzalin</i> (Surflan A.S.)	<1	soil applied, ground	2-6 qt per acre surface sprayed.	May be applied in the fall or spring prior to weed germination.	1	0	12
Efficacy Issues:	Provides control of only some of the broadleaf weeds. Length of control depends on rate applied. It is not recommended for use on soils with organic matter content greater than 5 percent. Do not apply to newly planted vines until soil has settled.						
<i>sulfosate</i> (Touchdown)	?	weed foliage, ground	0.8-6.4 pt in 3 to 30 gal of water per surface acre sprayed. Proper rate is dependent upon many factors including weed species present, growth stage, and environmental factors.	Touchdown applications should not be made when green shoots, canes, or foliage are in the spray zone. Touchdown should be applied prior to the end of bloom stage to avoid injury, or with shielded equipment after bloom, but not within 14 days of harvest.	?	14	12
Use in IPM Programs:	Touchdown can be used as a substitute for cultivation of the vineyard row middles. Touchdown is used as a lower cost alternative than mowing or discing. The use of Touchdown is less costly and labor intensive than either mowing or discing. Discing also increases the hazard of erosion on hill-side vineyards and can injure the root systems of vines.						

Efficacy Issues:	Addition of 8.5 to 17 lb dry ammonium sulfate (AMS), or equivalent rate of a liquid formulation of AMS, may improve control of annual and perennial weeds.
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19. Grasses

Type of Pest: Weed

Frequency of Occurrence: Yearly, throughout the season

Damage Caused: Weeds compete directly with the vine for water and nutrients. Weed growth under, and between, the row in vineyards has been shown to be responsible for stunted vine size and crop reduction.

% Acres Affected: 100%

Pest Life Cycles: Variable due to species of grass

Timing of Control: Prior to emergence, prebloom, and/or postbloom

Yield Losses: Up to 40% dependent on species of weeds present and degree of ground surface covered. Reduction in vine size due to competition of weeds for water and nutrients can result in decreased yield capacity over the next several growing seasons.

Regional Differences: None

Cultural Control Practices: The practice of “hilling up” or pushing a berm of soil against the vine and “pulling away”, or the removal of the berm, can reduce weed populations under the row. However, these practices are labor intensive and less cost efficient than traditional pesticide based practices, increase the hazard of erosion in hill-side vineyards, and may damage vine root systems.

Biological Control Practices: None available

Post-Harvest Control Practices: Not applicable

Other Issues: Grape growers in New York have relatively few pre-emergence herbicides available to them. Research has shown weed species, when treated over an extended period of time with repeated applications of a single herbicide, can develop tolerance or resistance to a particular herbicide resulting in the need to increase rates to reduce weed populations to economic levels or switch to alternative herbicides to achieve control. Reducing the already limited number of herbicides available could result in resistant or tolerant weed species developing over a shorter time frame through more repeated exposure to individual herbicides.

Preplant vineyard preparation requires the use of systemic herbicides such as Roundup and Touchdown to effectively control perennial broadleaves and woody perennials such as brambles, Virginia creeper and poison ivy. No alternative methods are available for preplant control of these perennial weeds. Cultural practices such as plowing and discing often result in tearing the weed’s root system apart, which can result in each piece of root system developing into a new plant, often times increasing weed pressure rather than reducing it.

Chemical Controls:

Pesticide	% Trt.	Type of Appl.	Typical Rates	Timing	Avg # of Appl.	PHI	REI
<i>oxyfluorfen</i> (<i>Goal 2X</i>)	<1	Soil applied, ground, prior to weed emergence	5-8 pt per acre surface sprayed	prior to bud swell	1	N/A	24
Efficacy Issues:	Tank mix with Solicam or Surflan for improved annual grass control. Cannot be applied to vines established less than 3 years unless vines are on a trellis wire at least 3 feet above the soil surface.						
<i>paraquat</i> (<i>Gramoxone Extra</i>)	36	Soil applied, ground	2-3 pt per sprayed acre	Gramoxone should be applied to emerged weed when they are small. Weeds 1 to 6-inches tall are easiest to control.	1.2	0	48

Use in IPM Programs:	Gramoxone has been successfully used in a post emergence weed management program that uses no pre-emergence herbicides. Weeds are allowed to grow to an average height of 6 inches prior to the first application of Gramoxone. A second application of Gramoxone is applied when regrowth of weeds reaches 6-inches in height. This program has been shown to provide weed management comparable to that of a conventional weed management program that uses both pre- and post emergence herbicides. Gramoxone is used to remove unwanted shoot growth (suckers) coming from the crown (base) of the vine. The use of herbicides for sucker removal results in tremendous cost and labor savings for growers in an industry where labor is difficult to find during the time frame for sucker removal and economic margins for the production of Labrusca grapes requires inputs to be limited.						
Efficacy Issues:	The use of post emergence herbicides is limited in Vinifera and French Hybrid vineyards where sucker growth is required for training system maintenance.						
<i>diuron</i> (<i>Karmex</i>)	57	Soil applied, ground	2-6 lb per acre surface sprayed	Apply in the spring just prior to germination and growth of annual weeds.	1	0	12
Efficacy Issues:	The label urges caution for use on soils low in clay or organic matter (1-2%) and limits the rate to 2-3 lb/A on soils high in clay or organic matter. Tank mix with Solicam or Surflan for improved annual grass control. Use only in vineyards established for at least 3 years.						
<i>sethoxydim</i> (<i>Poast</i>)	<1	Soil, ground	1.5-2.5 pt per acre surface sprayed	Application timing and rates are adjusted according to the species and growth stage of the weed.	1	50	12
Efficacy Issues:	Control is best when the weeds have not exceeded recommended growth stages and are not subject to environmental stresses. Addition of crop oil concentrate is recommended.						
<i>simazine</i> (<i>Princep Caliber 90, Princep 4L</i>)	57	Soil, ground	2.2-5.3 lb or 2.0-4.8 qt depending on formulation	Apply between harvest and early spring.	1	0	12
Efficacy Issues:	Use the lower rate of material per acre surface sprayed on coarse-textured soils low in organic matter. New York has a FIFRA 2(ee) recommendation allowing Princep for pre-emergence control of plantains. Season-long control of annual grasses may be obtained by tank mixing with Karmex, Solicam, or Surflan. Do not use in vineyards established less than 3 years.						
<i>glufosinate</i> (<i>Rely</i>)	3	Soil, ground	3-6 qt per acre surface sprayed. Rate is based on height and species of weeds present.	Best results are obtained when applications are made to actively growing weeds. Repeat applications may be necessary.	1	14	12
Use in IPM Programs:	Rely has been successfully used in a post emergence weed management program which uses no pre-emergence herbicides. Weeds are allowed to grow to an average height of 6 inches prior to the first application of Gramoxone. A second application of Gramoxone is applied when regrowth of weeds reaches 6-inches in height. This program has been shown to provide weed management comparable to that of a conventional weed management program that uses both pre- and post emergence herbicides. Rely is used to remove unwanted shoot growth (suckers) coming from the crown (base) of the vine. The use of herbicides for sucker removal results in tremendous cost and labor savings for growers in an industry where labor is difficult to find during the time frame for sucker removal and economic margins for the production of Labrusca grapes requires inputs to be limited.						
Efficacy Issues:	The use of post emergence herbicides is limited in Vinifera and French Hybrid vineyards where sucker growth is required for training system maintenance. Tank mixes with appropriate residual herbicides are recommended for broad-spectrum control and residual activity. Rely herbicide is not registered for use in Nassau and Suffolk Counties and must not be used in these locations.						

<i>glyphosate</i> (Roundup)	65	Soil, ground	0.5-5 qt per surface acre sprayed in 40 or fewer gal of water. Proper rate is dependent upon many factors including weed species present, growth stage, and environmental factors.	Roundup applications should not be made when green shoots, canes, or foliage are in the spray zone. Roundup should be applied prior to the end of blooms stage to avoid injury, or with shielded sprayers or wiper equipment, but not within 14 days of harvest. Perennial grasses can be controlled with fall Roundup applications which can be made after 100 percent natural grape leaf fall after harvest. Roundup applications should not be made when green shoots, canes, or foliage are in the spray zone. Roundup should be applied prior to the end of blooms stage to avoid injury, or with shielded sprayers or wiper equipment, but not within 14 days of harvest. Perennial grasses can be controlled with fall Roundup applications which can be made after 100 percent natural grape leaf fall after harvest.	1.2	14	12
Use in IPM Programs:	Roundup can be used as a substitute for cultivation of the vineyard row middles. Roundup is used as a lower cost alternative than mowing or discing. The use of Roundup is less costly and labor intensive than either mowing or discing. Discing also increases the hazard of erosion on hill-side vineyards and can injure the root systems of vines. (see Pool, R.M., R.M. Dunst, and J.S. Kamas. 1990. Managing Weeds in New York Vineyards. V. Managing Vineyard Floors Using No-tillage. Cornell GrapeFacts I-5).						
Use in Resistance Management:	Roundup may be tank mixed with pre-emergence herbicides according to label instructions to control both emerged and non-emerged weeds.						
Efficacy Issues:	Efficacy depends upon absorption into mature leaves. Addition of dry ammonium sulfate at 8.5 to 17 pounds per 100 gallons may increase performance of Roundup when tank-mixed with residual herbicides. Roundup is most effective when applied at lower gallonage and higher concentration.						
<i>norflurazon</i> (Solicam DF)	16	soil, ground	2.5-5.0 lb per acre surface sprayed. Rate is dependent upon soil texture.	Apply in fall or early spring prior to weed germination.	1	0	12
Efficacy Issues:	Solicam provides excellent season-long control of annual grasses and will also control several annual broadleaf species and provide some suppression of yellow nutsedge, plantains, and perennial grasses. Tank mixes with Karmex, Princep, or Surflan are needed to attain season-long, broad-spectrum weed control. Vines must be established at least 2 years.						
<i>oryzalin</i> (Surflan A.S.)	<1	soil, ground	2-6 qt per surface acre sprayed.	May be applied in the fall or spring prior to weed germination.	1	0	12
Efficacy Issues:	Length of control depends on rate applied. It is not recommended for use on soils with organic matter content greater than 5 percent. Do not apply to newly planted vines until soil has settled.						

<i>sulfosate</i> (<i>Touchdown</i>)	?	weed foliage, ground	0.8-6.4 pt in 3 to 30 gal of water per surface acre sprayed. Proper rate is dependent upon many factors including weed species present, growth stage, and environmental factors.	Touchdown applications should not be made when greens hoots, canes, or foliage are in the spray zone. Touchdown should be applied prior to the end of bloom stage to avoid injury, or with shielded equipment after bloom, but not within 14 days of harvest.	?	14	12
Use in IPM Programs:	Touchdown can be used as a substitute for cultivation of the vineyard row middles. Touchdown is used as a lower cost alternative than mowing or discing. The use of Touchdown is less costly and labor intensive than either mowing or discing. Discing also increases the hazard of erosion on hill-side vineyards and can injure the root systems of vines.						
Efficacy Issues:	Addition of 8.5 to 17 lb dry ammonium sulfate (AMS), or equivalent rate of a liquid formulation of AMS, may improve control of annual and perennial weeds.						

VI. References

1. 1999 New York and Pennsylvania Pest Management Recommendations for Grapes.
2. Grape IPM Disease Identification Fact Sheets No.'s 1-8. New York State Experiment Station, Geneva, NY.
3. Grape IPM Insect Identification Sheets No.'s 1-8. New York State Agricultural Experiment Station. Geneva, NY
4. Midwest Small Fruit Pest Management Handbook, Bulletin 861, Ohio State University, 1997.