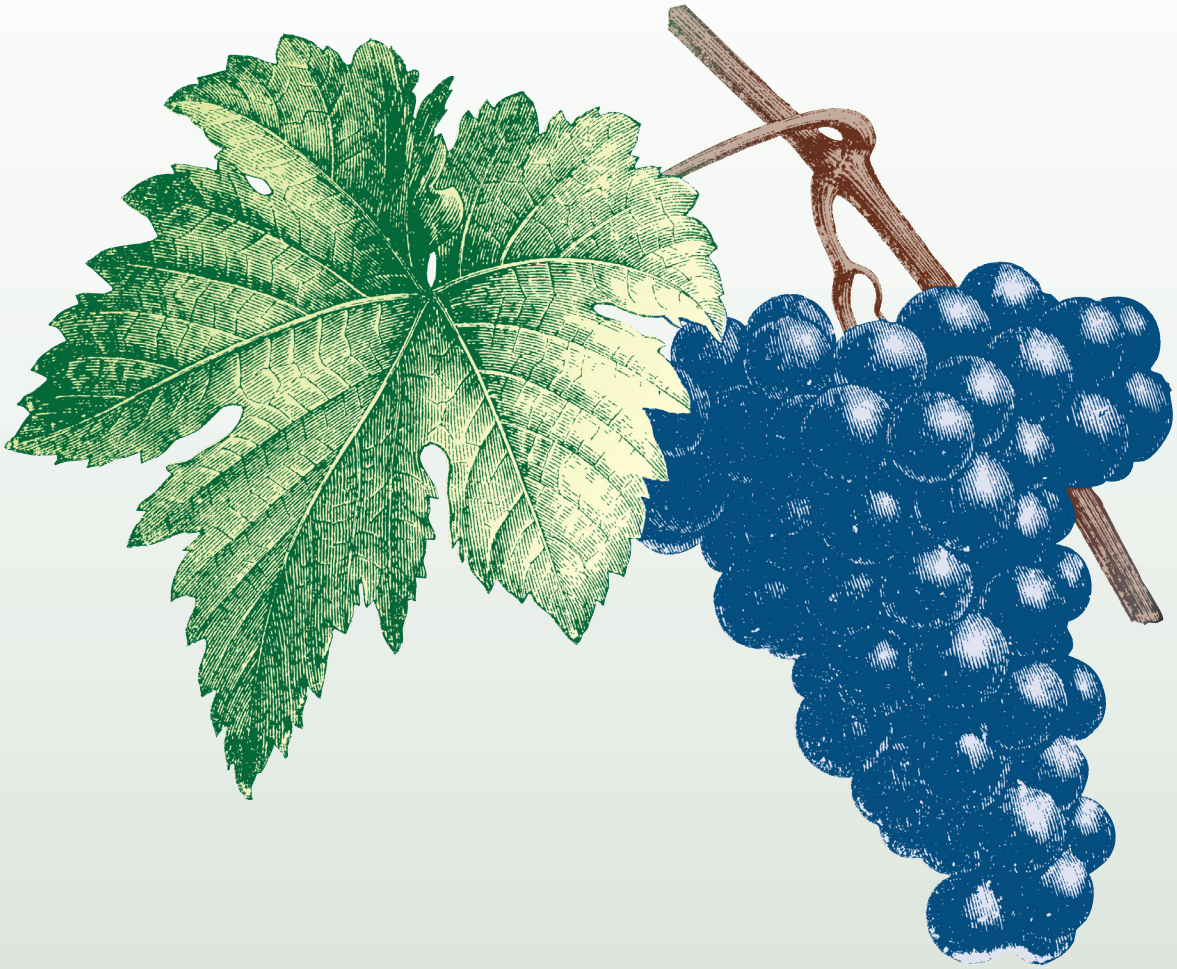
2022

Organic Production and IPM Guide for Grapes



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2022 Organic Production and IPM Guide for **Grapes**

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INTRODUCTION

This guide for organic grape production is an outline of cultural and pest management practices and includes topics that have an impact on improving plant health and reducing pest problems. The guide is divided into sections, but the interrelated quality of organic cropping systems makes each section relevant to the others.

More research on growing perennial crops organically is needed, especially in the area of pest management. This guide attempts to compile the most current information available, but acknowledges that effective means of organic control are not available for many pests. Future revisions to this guide will incorporate new information providing organic growers with a complete set of useful practices to help them achieve success.

This guide uses the term Integrated Pest Management (IPM), which like organic production, emphasizes cultural, biological, and mechanical practices to minimize pest outbreaks. With limited pest control products available for use in many organic production systems, an integrated approach to pest management is essential. IPM techniques such as identifying and assessing pest populations, keeping accurate pest history records, selecting the proper site, and preventing pest outbreaks through use of crop rotation, resistant varieties and biological controls are important to producing a high quality crop.

1. GENERAL ORGANIC MANAGEMENT PRACTICES

1.1 Organic Certification

The United States Department of Agriculture Agricultural Marketing Service (USDA AMS) National Organic Program (NOP) is the federal regulatory program that develops and enforces uniform national standards for organically produced agricultural products sold in the United States. The USDA AMS NOP website contains valuable resources for organic operations, including an electronic copy of the NOP Handbook, *Guidance & Instructions for Accredited Certifying Agents & Certified Operations.*

Who needs to be certified?

- Operations or portions of operations that produce or handle agricultural products that are intended to be sold, labeled, or represented as "100 percent organic," "organic," or "made with organic ingredients" or food group(s).
- Farming operations that gross more than $5,000 per year in organic products and want to use the organic label must be certified by a USDA NOP accredited certifying agency. The choice of certifier may be dictated by the processor or by the target market. A list of accredited certifiers operating in New York can be found on the New York State Department of Agriculture and Markets Organic Foods and Farming web page. See more certification details in this guide under Section 4.1, Organic Certification Site Requirements.

Who does NOT need to be certified?

- Producers and handling (processing) operations that sell less than $5,000 a year in organic agricultural products do not need to be certified. Although exempt from certification, these producers and handlers must abide by the national standards for organic products and may label their products as organic.
- Handlers, including final retailers, that: do not process or repackage products; only handle products with less than 70 percent organic ingredients; process or prepare, on the premises of the establishment, raw and ready-to-eat food labeled organic; choose to use the word organic only on the information panel; and handle products that are packaged or otherwise enclosed in a container prior to being received by the operation and remain in the same package.

1.2 Organic System Plan

An organic system plan (OSP) is a central requirement to the certification process. The OSP describes production, handling, and record-keeping systems, and demonstrates to certifiers an understanding of organic practices for a specific crop. The process of developing the plan helps producers to anticipate potential issues and challenges, and fosters thinking of the farm as a whole system. Soil, nutrient, pest, and weed management are all interrelated on organic farms and must be managed in concert for success. Comprehensive instructions and a list of requirements for the OSP is provided in the *Instruction Organic System Plans, Organic System Plan Updates, and Notification of Changes* pdf document.

Resources are available to help develop the OSP. Some certifying organizations, such as the Northeast Organic Farming Association of New York (NOFA-NY), guide you through the process of creating an OSP as part of the application process. The National Center for Appropriate Technology, ATTRA Sustainable Agriculture, has published a Guide for Organic Crop Producers that includes a chapter on writing the organic system plan. The USDA has also published a Streamlined Organic System Plan for Crop Production.

It is important to note that section 205.103 of the USDA NOP requires that applicants for certification must keep accurate post-certification records for 5 years concerning the production, harvesting, and handling of agricultural products that are to be sold as organic. These records must document that the operation is in compliance with the regulations and verify the information provided to the certifying agent. Access to these records must be provided, upon request, to authorized representatives of the USDA including the certifying agent.

An excellent companion resource available for growers looking into developing a farm plan is the VineBalance: Sustainable Viticulture in the Northeast website, which includes a free online Grower Self-Assessment Workbook and a VineBalance newsletter series. Also consult PA VinES update of the Grower's Self Assessment Workbook, geared for juice growers, https://www.erieconservation.com/assets/documents/PA-VinES-Workbook-and-Scoresheet-Edit.pdf and the New York Wine and Grape Foundation's Sustainable Winegrowing program https://newyorkwines.org/industry/sustainability/ .

2. SOIL HEALTH

Healthy soil is the basis of organic farming. Regular additions of organic matter in the form of cover crops, compost, or manure create a soil that is biologically active, with good structure and capacity to hold nutrients and water (any raw manure applications should occur at least 120 days before harvest). Decomposing plant materials will support a diverse pool of microbes, including those that break down organic matter into plant-available nutrients as well as others that compete with plant pathogens in the soil and on the root surface. Preplant site preparation, including establishment of a cover crop to manage weeds in the year before planting is crucial for organic production. In established vineyards, several floor management practices including cover crops (row middles or under-trellis options), application of straw mulch to row middles, and addition of composted materials can be used to enhance soil health. Organic growers must attend to the connection between soil, nutrients, pests, and weeds to succeed. An excellent resource for additional information on soils and soil health is *Building Soils for Better Crops, 3rd edition*, by Fred Magdoff and Harold Van Es, 2010, available from the Sustainable Agriculture Research and Education (SARE) website. For more information, refer to *Comprehensive Assessment of Soil Health: The Cornell Framework*, a pdf document.

3. COVER CROPS

Cover crops are grown for their valuable effect on soil properties, such as organic matter, and, in grapes, on their ability to provide nutrients to the vine, control weeds both between and under the rows, prevent erosion and leaching on vineyard slopes and to assist in the manipulation of soil moisture. They can also improve water infiltration into the soil, maintain populations of beneficial fungi, and may help control insects, diseases and nematodes. A cover crop (or vegetation of some sort) should always be maintained between vine rows to reduce soil erosion and leaching. There is little to no viticultural reason to maintain bare soil between vine rows in the Northeastern U.S.

To be effective, cover crops should be treated as any other valuable crop on the farm, with their cultural requirements carefully considered including susceptibility, tolerance, or antagonism to root pathogens and other pests; life cycle; and mowing/incorporation methods. See Table 3.1.1 for more information on specific non-leguminous cover crops.

A certified organic farmer is required to plant certified organic cover crop seed. If, after contacting at least three suppliers, organic seed is not available, then the certifier may allow conventional seed to be used. Suppliers should provide a purity test for cover crop seed. Always inspect the seed for contamination with weed seeds and return if it is not clean. Cover crop seed is a common route for introduction of new weed species onto farms.

3.1 Goals and Timing for Cover Crops

Cover crops play an important role throughout the life of a vineyard, particularly in the Northeastern U.S. where ample precipitation can result in soil erosion and leaching. In the years prior to planting, cover crops can be used to improve soil organic matter, break up compaction layers, and suppress or eliminate weeds. These goals will be reached more readily if the cover crop is in place for the entire growing season prior to vineyard establishment. Cover crops can also be used to manage vine vigor in established vineyards by providing competition for water and/or nutrients. Goals should be established for choosing a cover crop; for example, the crop can add nitrogen, compete with weeds, or increase equipment mobility.

Cover crops planted in late summer will suppress annual weed growth, improve soil texture, provide organic matter, and may increase soil nitrogen. The cover crop can be incorporated in late fall or in the spring before planting. Certain cover crops are considered biofumigants (marigold, sudangrass, brassicas) because they will either suppress or resist nematode populations, weeds or pathogens when chopped and incorporated into the soil. Cover crops with biofumigant properties should be considered where reduction of nematode populations is needed. See Tables 3.1.1. In addition to producing large amounts of biomass that out-compete other plant species, some cover crops (annual rye, ryegrass) can inhibit weed growth through allelopathy, the chemical inhibition of one plant species by another. Rye provides allelopathic suppression of weeds when used as a cover crop, and when crop residues are retained as mulch. Rye residues retained on the soil surface release chemicals that inhibit germination and seedling growth of many grass and broadleaf weed species. Retention of residue on the soil surface can be accomplished by mowing after seed head formation.

Vegetation should always be maintained in the row middles to stabilize the soil and reduce/prevent soil erosion. This between-row area can be planted with annual or perennial cover crops, or can be maintained as 'natural vegetation' (i.e., weeds). While in a young vineyard the under-vine area should be kept weed-free to reduce the competition for water and nutrients, in a mature vineyard the under-vine strip can be maintained with weeds that are mowed or planted with a cover crop. For more information on adopting under-vine cover crops see *Expanding the Use of Under-Vine Cover Crops in New York Vineyards* from Cornell Viticulture and Enology.

Table 3.1.1 Non-leguminous Cover Crops: Cultural Requirements and Crop Benefits

Species	Planting dates	Life Cycle	Cold Hardiness Zone	Heat tolerance	Drought Tolerance	Shade Tolerance	pH Preference	Soil Type Preference	Seeding (Lb/A)	Comments
Brassicas e.g. mustards, rapeseed	April OR late Aug.-early Sept.	Annual / Biennial	6-8	4	6	NI	5.3-6.8	Loam to clay	5-12	+Good dual purpose cover & forage +Establishes quickly in cool weather +Biofumigant properties
Buckwheat	Late spring-summer	Summer annual	NFT	7-8	4	6	5.0-7.0	Most	35-134	+Rapid grower (warm season) +Good catch or smother crop +Good short-term soil improver for poor soils
Cereal Rye	August-early October	Winter annual	3	6	8	7	5.0-7.0	Sandy to clay loams	60-200	+Most cold-tolerant cover crop +Excellent allelopathic weed control +Good catch crop +Rapid germination & growth +Temporary N tie-up when turned under
Fine Fescues	Mid March-mid May OR late Aug.-late Sept.	Long-lived perennial	4	3-5	7-9	7-8	5.3-7.5 (red) 5.0-6.0 (hard)	Most	16-100	+Very good low-maintenance permanent cover, especially in infertile, acid, droughty &/or shady sites
Oats	Mid Sept-early October	Summer annual	8	4	4	4	5.0-6.5	Silt & clay loams	110	+Rapid growth +Ideal quick cover and nurse crop
Ryegrasses	August-early Sept.	Winter annual (AR)/ Short-lived perennial (PR)	6 (AR) 4 (PR)	4	3	7 (AR) 5 (PR)	6.0-7.0	Most	14-35	+Temporary N tie-up when turned under +Rapid growth +Good catch crop +Heavy N & moisture users
Sorghum-Sudangrass	Late spring-summer	Summer Annual	NFT	9	8	NI	Near neutral	NI	10-36	+Tremendous biomass producers in hot weather +Good catch or smother crop +Biofumigant properties

NI-No Information, NFT-No Frost Tolerance. Drought, Heat, Shade Tolerance Ratings: 1-2=low, 3-5=moderate, 6-8=high, 9-10=very high. AR=Annual Rye, PR=Perennial Rye. Reprinted with permission from M. Sarrantonio. 1994. *Northeast Cover Crop Handbook*.

Table 3.1.2. Suitable cover crops to grow the year before planting grapes

Cover crop	Last day to plant	Seeding rate (lb/a)
Winter Rye	October 1	80-100
Oats[a]	September 15	60-100
Wheat	September 15	80-100
Vetch	September 1	30-40
Ryegrass	August 15	15
Barley[a]	August 15	75-100
Sweet Clover	August 15	20
Red clover	August 15	10-20
Buckwheat[a]	August 1	75
Marigold[a]	July 1	5-10
Sudangrass[a]	July 1	50-90

[a] Will winter-kill.

See Cornell's online cover crop decision tool to match goals, season, and cover crop. Although written for vegetable growers it has comprehensive information on various cover crops. Another resource for determining the best cover crop for your situation is the *Northeast Cover Crop Handbook*, by Marianne Sarrantonio.

3.2 Legumes

There has been little research done with legume cover crops in Northeastern United States vineyards. Legumes are looked to as a potential nitrogen source, but work at the Fredonia Vineyard Lab, Cornell University, found that row middle legumes competed more for water with the vines than the vines benefitted from the increased nitrogen availability. Row middles planted to either crown vetch or clover resulted in lower total yield when compared to vines where row middles were cultivated or managed using conventional herbicides. This was especially true in dry years and the effect was lessened or eliminated in wet years. A review of this work can be found in the *Third N.J. Shaulis Symposium: Organic Grape and Wine Production Symposium* pdf document. Legumes such as red clover and hairy vetch will often benefit from having a nurse crop planted simultaneously, usually a small cereal grain such as wheat or rye. These nurse crops establish faster than legumes and provide soil stability and reduce weed pressure during establishment, and provide support for the newly growing legumes before winter. To receive the full nitrogen benefit from planting legumes, they need to be incorporated into the soil just as they start to bloom, which is usually in late spring. (Source: Bjorkman, T. Cover Crop Guide for NY Growers website). Legumes growing as an under-vine cover crop have had variable results around NYS so are not recommended.

3.3 Non-legumes

Buckwheat, rye grass, chicory, fescue, tillage radish, permanent sod, and natural vegetation can be used as groundcover, depending on the goals that have been established for the row middles and under-vine region.

3.4 Mulching

While technically not a cover crop, use of straw or hay mulch in the vineyard row middles or under vines is another option for suppression of weed growth and is an excellent method of water conservation and increasing the soil organic matter. For mulch to be an effective weed management tool it must be applied at a much heavier rate than is needed if only water conservation or improving soil organic matter is desired. In two experiments conducted in Western New York, straw or hay mulch was applied at approximately 5 tons per acre per year in order to provide effective weed control. Hay mulch is typically applied using round bales, which can be rolled out between vineyard rows. Growers have developed simple implements that attach to their tractors to hold these large bales, making the job of applying the mulch much easier. Financial assistance may be available from your county's Soil and Water Conservation District office to help pay for mulch. See section 7.9 for more information on weed management. Organic mulch is typically not used under the row as it can create a more suitable environment for rodents which may feed upon and damage the vines.

4. SITE SELECTION

For organic grape production, the importance of proper site selection cannot be over-emphasized. Grapes are a perennial crop, so decisions made on site selection and improvement prior to planting will affect all aspects of production for years to come. The ideal site will have excellent air drainage (consistent slope that extends below the vineyard to allow cold air to 'drain' from the vineyard), well-drained soils, and in many cases proximity to bodies of water that moderate winter low temperatures. Preplant site preparation (drainage tiles, amendments to adjust soil pH, tillage, including 'deep ripping' to break up hard pans and cover crops to suppress weeds) is often crucial for successful vineyard establishment. Once a vineyard is planted and trellis is installed, it is very difficult to make major changes to improve soil and air drainage or soil tilth. Improving soil structure or eliminating soil compaction layers in an established vineyard rarely proves successful. Consider that an ideal vineyard soil should have three feet or more of rooting depth and be well-drained and conduct needed site improvements prior to vineyard establishment.

Weather plays a critical role in vineyard site selection. The macroclimate and mesoclimate of a vineyard site often determine which (if any) varieties can be grown successfully at a given site. Of particular importance are the length of the growing season, growing season heat accumulation, potential for spring frosts and winter minimum temperatures. Grape varieties vary in their ability to withstand cold temperatures in midwinter, ranging from the most cold-sensitive *Vitis vinifera* cultivars such as 'Merlot' that suffer winter injury at sub-zero (F) temperatures to very cold-hardy "Minnesota varieties" that survive midwinter temperatures down to -20 to -30 ° F. More detailed information on the site selection information presented here also can be found in the *Wine Grape Production Guide for Eastern North America*, NRAES -145.

4.1 Organic Certification Site Requirements

The National Organic Program has requirements that affect site selection. Fields must not have been treated with prohibited products for three years prior to harvest of the certified organic crop. Other practices outlined in the NOP Regulations such as crop rotation, weed control practices and addition of soil amendments must also be followed during the three year transition of a field from conventional to organic production. Adequate buffer zones must exist between certified organic and conventionally grown crops to prevent drift of prohibited materials onto certified organic crops, even if the non-certified farm is not yours. The buffer zones must be either a barrier (diversion ditch or dense hedgerow) or an area

of sufficient size and should be under the management control of the certified farmer. The buffer zone needed will vary depending on equipment used on adjacent non-certified land. For example, use of high-pressure spray equipment or aerial pesticide applications in adjacent fields will increase the buffer zone size. Check with your certifier for specific buffer requirements. Buffer zone sizes commonly range from 20 to 250 ft, depending on adjacent field practices. Buffers can include windbreaks and living barriers such as a dense hedgerow. A dense hedgerow less than 50 ft wide may offer better protection from contamination than a 50-ft-wide open buffer zone. The Northeast Organic Farming Association of New York also states in the *USDA National Organic Program Regulations & NOFA-NY Certified Organic, LLC Guidance and Policy Manuals* pdf document "If the buffer is planted to the same crop as the field, documentation of what is done with the non-certified buffer crop is required. If harvested, non-certified harvest records and equipment cleanout logs should be maintained." Crops grown in the buffer zone may not be marketed as certified organic, or used for feed or bedding for certified organic livestock or dairy cattle.

4.2 Soil and Air Drainage and Soil Depth

Grapes need good internal soil drainage to grow. Wet soils restrict root growth and respiration, resulting in weak growth, reduced yields and small vine size. Coarse-textured and gravelly soils have excellent soil drainage, but heavier soils, or soils with perched water tables often need drainage tiles to remove excess water and improve internal soil drainage. Drainage tile is best installed before planting. Where possible, tile layout should be coordinated with vineyard design, so that tile lines run parallel to rows. Local soil and water conservation districts and private tiling contractors can provide technical assistance in designing a drainage plan, but keep in mind that many base their designs on annual row crops. Vineyards often require more intensive drainage than row crops, particularly in clay soils, where it may be necessary and cost-effective to run lateral tile lines every second or fourth row.

Air drainage is an important consideration in choosing a vineyard site. Cold air, like water, runs downhill, and collects in low areas or areas where trees or hedgerows obstruct airflow. These 'frost pockets' increase the risk of both mid-winter cold injury and spring or fall frosts. Selecting a site with a gentle slope and good air drainage will reduce the risk of cold or frost injury. Good air drainage will also promote faster drying of foliage which will reduce the duration and frequency of disease infection periods. Good air drainage is essential to an organic disease management strategy.

Although grapes can be grown on a wide variety of soils, shallow soils have less water holding capacity and will limit root development, resulting in small vines with smaller crops. Rooting depth of 2.5 feet or more is considered important for adequate vine growth and cropping levels. Digging test soil pits can help you evaluate potential rooting depth and drainage issues and evaluate what measures to take to address soil management issues before planting.

4.3 Soil Testing

Knowing all you can about the soil of a potential vineyard site will allow for better management decisions prior to planting. Soil testing is recommended to provide information on pH, availability of major and minor nutrients, organic matter and cation exchange capacity. A pH of 5.5 to 6.0 is suggested for Labrusca grapes and 6.0 to 6.5 is suggested for hybrids and Vinifera varieties. A Comprehensive Assessment of Soil Health from the Cornell Soil Health Lab prior to planting will provide field-specific information on constraints in biological and physical processes, in addition to standard soil nutrient analysis. See Table 6.2 for soil and tissue testing laboratories and refer to section 6, Vineyard and Nutrient Management, for more information.

5. VARIETY SELECTION

The market destination, bulk juice or wine, premium wine, or table grape is one of the primary factors when making the decision on which variety to plant no matter what management strategy is chosen. Another consideration is whether you are considering conversion of an existing vineyard planting or are planting a new vineyard. In organic grape production the variety's relative resistance or susceptibility to fungal diseases is vital because of the limited number of organic fungicides that are available for vineyard disease management, the potential negative impacts of repeatedly applying copper and sulfur, and the potential for complete crop loss if the primary diseases of grapes are not controlled. The susceptibility to black rot (see Disease Management, section 7.6) should be one of the major considerations when choosing a variety to grow organically.

Varieties vary widely in their susceptibility to fungal diseases and in their sensitivity to sulfur and copper fungicides that are used to control the powdery and downy mildews, respectively. Table 7.5.1, *Relative disease susceptibility and sensitivity to sulfur and copper among grape varieties*, includes many of the grape varieties grown in the Northeast. It is generally understood that Concord and Niagara (American or Labrusca varieties) are susceptible to a much smaller complex of diseases than are most Vinifera varieties. Even when powdery mildew is actively growing on Labrusca varieties, the fruit are often more resistant and the leaves are tolerant to the effects of the disease. Hybrid grapes, on the other hand, were often developed to combine disease resistance with good wine quality. They descend from a large number of native American species hybridized with Vinifera grapes, and their disease resistance varies greatly from variety to variety and from disease to disease. Since Labrusca grapes co-evolved with many of the diseases of importance in the Northeast, it should be no surprise that the fungicide programs for Labrusca and hybrid varieties are generally less intensive than those required for Vinifera varieties. Because copper and sulfur are key fungicides in an organic disease management program, prior to choosing a variety, know its sensitivity to injury from either one.

Varieties which have the best potential for organic production across New York State, based primarily on resistance to black rot, bunch rot, and low sensitivity to copper, include:

Labrusca Grapes
Concord

Vinifera Grapes
None

Hybrid Grapes
Arandell
Cayuga White
Corot noir
Noiret
Traminette

Table Grapes
Mars

This is not an inclusive list and does not represent all varieties that are, or have been grown organically in New York State. Ratings for best potential for organic production are based primarily on resistance to black rot, bunch rot and low sensitivity to copper. However, if other varieties are considered, the importance of site, canopy management, sanitation and the selection of proper fungicides and application procedures will increase in accordance to the variety's susceptibility to the complex of diseases. Organic grape growing is challenging in the Northeast climate, and the presence of disease may reduce the maximal level of winter hardiness and could lead to increased bud and/or vine mortality due to winter injury. An excellent resource on the factors involved in cold hardiness and winter injury, as well as the management practices to reduce the risk of winter injury, can be found in *Winter Injury to Grapevines and Methods of Protection*, a pdf document from Michigan State University.

Researchers at Cornell University are developing new hybrid varieties with highly elevated levels of resistance to powdery mildew, downy mildew and black rot. Testing is taking place under "no-spray" conditions, and new breeding program selections are now being sent to cooperating researchers to confirm observations of disease resistance in additional locations. These new selections show great promise in expanding the spectrum of quality varieties that may be more suitable for organic production methods. Information on the process of creating these new selections as well as complete information on grape varieties for cool climates can be found at the Cornell-Geneva Grapevine Breeding and Genetics Program website.

Growers must also consider where they obtain their planting stock. According to USDA-NOP regulation §205.204

- The producer must use organically grown seeds, annual seedlings, and planting stock.
- The producer may use untreated nonorganic seeds and planting stock when equivalent organic varieties are not commercially available.
- Seed and planting stock treated with substances that appear on the National List may be used when an organically produced or untreated variety is not commercially available.
- Planting stock used to produce a perennial crop may be sold as organically produced planting stock after it has been maintained under a system of organic management for at least 1 year.
- Seeds, annual seedlings, and planting stock treated with prohibited substances may be used to produce an organic crop when the application of the substance is a requirement of Federal or State phytosanitary regulations.

The National Clean Plant Network for Grapes produces and maintains grapevine stocks that are extensively tested for pathogens. Sourcing plant material from these stocks offers benefits. Planting material derived from pathogen-tested stocks may be certified by state certification programs. However, this material may not have been organically produced. With the limited availability of organically certified vines, growers will likely be able justify the use of non-organic sources to their certifying agency.

6. VINEYARD NUTRIENT MANAGEMENT

To produce a healthy crop, soluble nutrients must be available from the soil in amounts that meet the minimum requirements for the whole plant. The challenge in organic systems is balancing soil fertility to supply required plant nutrients at a time and at sufficient levels to support healthy plant growth. Restrictions in any one of the needed nutrients will slow growth and can reduce crop quality and yields.

Organic growers often speak of feeding the soil rather than feeding the plant. A more accurate statement is that organic growers focus their fertility program on feeding soil microorganisms rather than the plant. Soil microbes decompose organic matter to release nutrients and convert organic matter to more stable forms such as humus. This breakdown of soil organic matter occurs throughout the growing season, depending on soil temperatures, water availability and soil quality. The released nutrients are then held on soil particles or humus making them available to crops or cover crops for plant growth. Amending soils with compost, cover crops, or crop residues also provides a food source for soil microorganisms and when turned into the soil, starts the nutrient cycle again.

In vineyards, the key considerations when managing vine nutrition organically include filling the trellis without promoting excess vine vigor, meeting crop demand, managing soil pH to optimize the potassium and magnesium balance, understanding carbon to nitrogen ratios in compost, and selecting appropriate rootstocks.

6.1 Fertility—Vine Size, Vigor, and Demand

In vineyards, the goal is to optimize resource use efficiency (land, water, nutrients) to maximize light interception and minimize internal canopy shading. Weak vines with undersized canopies will intercept insufficient available sunlight to ripen the fruit in the current season or to develop

buds for the next season. Conversely, over-stimulated vines with excessively large canopies have low water use efficiency and shade the fruit zone, leading to lower fruit quality. Canopy size is strongly influenced by soil water and nutrient availability and the ability of the vine root system to take up water and nutrients. Therefore, organic vineyards should strive to balance soil nutrient availability—organic matter content, cation exchange capacity, soil pH, and microbial activity—with vine canopy growth and vineyard goals. Grapevine rootstocks differ in their ability to take up water and nutrients and can be used in an organic management program to help achieve desired vine canopy growth, see section 6.5 for information on rootstocks.

Research has indicated that the fertilization needs of grapes can vary greatly depending on whether you are growing Labrusca grapes for juice, hybrids for the bulk wine market, or Vinifera for the premium wine market. Vine nutrient demand is greatest during green shoot and fruit development from about two weeks pre-bloom until veraison. Overall vine size (vegetative growth) and fruit yield are the deciding factors in the need for nutrients during the growing season. Juice and bulk wine vineyards tend to be cropped at a higher level and therefore tend to have a higher nutrient demand than lower cropped premium wine grape vineyards. Table 6.1.1 provides an example of the annual nutrient demands of high-yielding Concord vines.

The primary challenge in organic systems is synchronizing nutrient release from organic sources, particularly nitrogen, with crop requirements. In cool soils, microorganisms are less active, and nutrient release may be too slow to meet the crop needs. Once the soil warms, nutrient release may exceed crop needs. In a long-term organic nutrient management approach, most of the required crop nutrients would be in place as organic matter before the growing season starts. Nutrients needed by the crop in the early season can be supplemented by highly soluble organic amendments such as poultry manure composts or organically approved bagged fertilizer products (e.g. Chilean nitrate). These products can be expensive, so are most efficiently used if banded. Be sure to review National Organic Program rules that govern use of Chilean nitrate and confirm the practice with your organic certifier prior to field application.

Table 6.1.1 Annual Nutrient Demand of High-Yielding Concord Vines

Nutrient	Annual Nutrient Demand (lbs/Acre)	Nutrient Carryover in Vines (lbs/Acre)	Annual Soil Nutrient Demand (lbs/Acre)
N (nitrogen)	160.1	106.7	53.4
K (potassium)	117.8	67.6	50.2
Ca (calcium)	118.2	75.7	42.5
P (phosphorus)	17.9	11.1	6.8
Mg (magnesium)	17.1	11.4	5.7
S (sulfur)	12.8	8.7	4.1
Na (sodium)	4.2	2.6	1.6
Al (aluminum)	3.9	2.4	1.5
Fe (iron)	4.0	2.5	1.5
Mn (manganese)	3.7	2.4	1.3
Zn (zinc)	1.5	1.2	0.3
B (boron)	0.2	0.1	0.1
Cu (copper)	0.2	0.1	0.1

6.2 Managing Fertility

Regular soil testing and petiole testing will help monitor nutrient levels. Choose a reputable nutrient testing lab (see Table 6.2.1) and use it consistently to avoid discrepancies caused by different extraction methods. It is recommended that regular petiole testing be incorporated into a fertility management program with soil testing to assist in determining the vines' nutrient status and to make sure that what is in the soil is making it into the vines in the proper amounts. It is recommended that soil and petiole tests be completed in each block a minimum of every three years. Petiole testing is especially crucial in getting the information needed to make management decisions in problem areas of the vineyard and should be used on a more frequent basis, if needed.

Maintaining a soil pH of 5.5 to 6.0 is suggested for Labrusca grapes and 6.0 to 6.5 is suggested for hybrids and Vinifera varieties to maximize the availability of nutrients. It is important to have the soil pH between 5.5 and 6.5 to balance potassium (K) and magnesium (Mg) availability with crop demand. Below 5.5, there is aluminum toxicity, cation imbalance, and lower biological activity (lower N release). Above 6.5, excessive calcium and Mg can inhibit K uptake and lead to K deficiency. However, this situation is more evident in high producing vineyards because of the high K demand by the fruit. This should be true for most grape varieties but is usually only documented in Concord because economics push for high yields. There is usually a conservative range of ideal pH between 5.8 and 6.2 for vineyard soils.

Table 6.2.1. Nutrient Testing Laboratories

Testing Laboratory	Web url	Soil	Leaf	Compost/ Manure	Forage
Analytical Lab and Maine Soil Testing Service	anlab.umesci.maine.edu/	x	x	x	
Cornell Soil Health Lab (Cornell Recommendations)	soilhealth.cals.cornell.edu/	x			
Dairy One (Cornell Recommendations)	http://dairyone.com/analytical-services/agronomy-services/about-agro-one/	x	x	x	x
Penn State Agricultural Analytical Services Laboratory	https://agsci.psu.edu/aasl	x	x	x	
Soil and Plant Nutrient Testing Laboratory, University of Massachusetts Amherst	http://www.umass.edu/soiltest/	x	x		
Waypoint Analytical	https://www.waypointanalytical.com/AGServices	x	x	x	x

Table 6.2.2 gives the target values for soil, bloom petiole, and veraison petiole analysis results for grape production in the Northeast. Regular soil testing helps monitor nutrient levels, in particular phosphorus (P) and potassium (K). The source of these nutrients depends on soil type and historic soil management. Some soils are naturally high in P and K, or have a history of manure applications that have resulted in elevated levels. As described above, additional plant available nutrients are supplied by decomposed soil organic matter or through specific soluble nutrient amendments applied during the growing season in organically managed systems. Many types of organic fertilizers are available to supplement the nutrients supplied by the soil. ALWAYS check with your certifier before using any product to be sure it is approved.

Table 6.2.2 Sufficiency ranges for nutrient concentrations in vineyard soil and petiole analyses

		Target values (ppm, unless otherwise noted)		
Nutrient	**Symbol**	**Soil Nutrients**	**Bloom Petiole**	**Late-Summer Petiole[1]**
Total Nitrogen	N	— [a]	1.2-2.2%	0.8-1.2%
Phosphorus	P	20-50	0.17-0.30%	0.14-0.30%
Potassium	K	75-100	1.5-2.5%	1.2-2.0%
Calcium	Ca	500-2,000 [b]	1.0-3.0%	1.0-2.0%
Magnesium	Mg	100-250	0.3-0.5%	0.35-0.75%
Boron	B	0.3-2.0	25-50	25-50
Iron	Fe	20	30-100	30-100
Manganese	Mn	20	25-,000	100-1,500
Copper	Cu	0.5	5-15	5-15
Zinc	Zn	2	30-60	30-60
Molybdenum	Mo	— [c]	0.5	0.5
Aluminum	Al	< 100 [b]		
Organic Matter		3-5%		
pH for Labrusca		5.5		
pH for hybrids		6.0		
pH for Vinifera		6.5		

Adapted from: Bates and Wolf (2008) Vineyard Nutrient Management. In: *Wine Grape Production Guide for Eastern North America*. T. Wolf (ed.). Natural Resource, Agriculture, and Engineering Service. Ithaca, NY.
Note: ppm is parts per million.
[1] (70–100 days after bloom)
[a] Soil nitrogen is not normally evaluated for vineyards in eastern North America.
[b] Calcium level is normally adequate when pH is in the proper range for the grape variety. The same is true for aluminum.
[c] Adequacy of soil molybdenum for grapevines is uncertain.

The carbon to nitrogen (C/N) ratio in compost can provide a guide for nitrogen release into the soil solution. When a decomposing material has a low C/N ratio (a lot of nitrogen) microbes release the excess nitrogen into the soil solution. When a decomposing material has a high C/N ratio (very little nitrogen) microbes will immobilize nitrogen through assimilation until the decomposition process lowers the C/N ratio. Immobilization of nitrogen for high C/N ratio organic matter decomposition can lead to vine nitrogen deficiency. The rule of thumb is that if the C/N ratio is lower than 20 or the material's nitrogen content is above 2.5%, nitrogen will be released. If the C/N ratio is above 20, nitrogen will be immobilized until sufficient decomposition has taken place.

To create a robust organic fertility management plan, develop a plan for estimating the amount of nutrients that will be released from soil organic matter, cover crops, compost, and manure. A strategy for doing this is outlined in section 6.3. As these practices are integrated into field and farm management, the goal is to support diverse microbial communities that will help release nutrients from the organic matter additions. To assess overall impact of these practices on soil health, consider selecting a few target or problem fields for soil health

monitoring over time via the Cornell Standard Soil Health Analysis Package. This suite of eight tests complements a standard soil chemical nutrient analysis by focusing on biological and physical soil health indicators. While the test results will provide feedback on how the soil sample compares to other New York soils, the real power is in the baseline readings for comparison in the future after implementing new soil health management strategies.

Included in the Soil Health Test is an analysis of soil protein content. As with the other soil health tests, this serves as an indicator of soil management and amendment history. The test measures organic soil N that is in the form of proteins- an important food source for soil microbes. Use this test to help monitor impact and target future investments of legume cover crops and compost / manure applications.

6.3 Preparing an Organic Nitrogen Budget

Management of N, and ensuring adequate supply at the times of crop need, requires some planning. Prepare an Organic Nitrogen Budget to estimate the amount of N released by various organic amendments as well as native soil organic matter. Compost and manure should be tested for nutrient content at an analytical lab, and cover crops can be tested at a forage testing lab (Table 6.2.1). Knowing these values will help evaluate if the budget plan is providing appropriate amounts of N during the season. Examples of manures and their nutrient content are shown in Table 6.3.1.

Using the values from your soil test, estimate that 20 lbs. of nitrogen will be released from each percent organic matter in the soil. From the test of total N in any manure applied, estimate that 50% is available in the first year, and then 50% of the remaining is released in each of the next two years. So, for an application rate of 100 lbs. of N as manure, in year one 50 lbs. would be available, 25 lbs. in year 2, and 12.5 lbs. in year 3. Remember to check with your certifier on the days-to-harvest interval when using raw manure and allow a minimum of 120 days between application and harvesting. To prevent run-off, do not apply raw manure to bare ground in established vineyards.

Table 6.3.1. Estimated Nutrient Content of Common Animal Manures

	N	P_2O_5	K_2O	N1[1]	N2[2]	P_2O_5	K_2O
	Nutrient content lb/ton			*Available nutrients lb/ton in first season*			
Dairy (with bedding)	9	4	10	6	2	3	9
Horse (with bedding)	14	4	14	6	3	3	13
Poultry (with litter)	56	45	34	45	16	36	31
Compost (from dairy manure)	12	12	26	3	2	10	23
Composted poultry manure	17	39	23	6	5	31	21
Pelleted poultry manure[3]	80	104	48	40	40	83	43
Swine (no bedding)	10	9	8	8	3	7	7
	Nutrient content lb/1000 gal.			*Available nutrients lb/1000 gal first season*			
Swine finishing (liquid)	50	55	25	25*	20+	44	23
Dairy (liquid)	28	13	25	14*	11+	10	23

[1] N1 is the total N available for plant uptake when manure is incorporated within 12 hours of application,
[2] N2 is the total N available for plant uptake when manure is incorporated after 7 days.
[3] Pelletized poultry manure compost. Available in New York from Kreher's.
* injected, + incorporated.
Adapted from *"Using Manure and Compost as Nutrient Sources for Fruit and Vegetable Crops"* by Carl Rosen and Peter Bierman and Penn State Agronomy Guide 2007-8.

Estimate that between 10% and 25% of the N contained in compost will be available the first year. It is important to test each new mix of compost for actual amounts of the different nutrients available. Compost maturity will influence how much N is available. If the material is immature, more of the N may be available to the crop in the first year. A word of caution: Using compost to provide for a crop's nutrient needs is not generally a financially viable strategy. The total volume, trucking, and application can be very expensive for the units of N available to the crop. Most stable composts should be considered as soil conditioners, improving soil health, microbial diversity, tilth, and nutrient retaining capacity. Also keep in mind that manure-based composts are potentially high in salts that could become a problem if used yearly. Request a measure of electrical conductivity when compost is submitted for testing. This will provide the level of salts present in the finished product.

Add together the various N values from these different organic sources to estimate the N supplying potential of the soil. There is no guarantee that these amounts will actually be available in the season, since soil temperatures, water, and crop physiology all impact the release and uptake of these soil nutrients. If early in the organic transition, a grower may consider increasing the N budget supply by 25%, to help reduce some of the risk of N being limiting to the crop. Remember that with a long-term approach to organic soil fertility, the N mineralization rates of the soil will increase. This means that more N will be available from organic amendments because of increased soil microbial activity and diversity. Feeding these organisms different types of organic matter is essential to helping build this type of diverse biological community and ensuring long-term organic soil and crop productivity.

Additional information on the use of animal manures and organic amendments can be found in the *Third N.J. Shaulis Symposium: Organic Grape and Wine Production Symposium* pdf document.

6.4 Organic Fertilizers

Tables 6.4.1, 6.4.2, and 6.4.3 list some commonly available fertilizers, their nutrient content, and the amount needed to provide different amounts of available nutrients, adapted by Vern Grubinger from the University of Maine soil testing lab.

Table 6.4.1 Available Nitrogen in Organic Fertilizers

	Pounds of Fertilizer/Acre to Provide X Pounds of N Per Acre				
Sources	**20**	**40**	**60**	**80**	**100**
Blood meal 13% N	150	310	460	620	770
Soy meal 6% N (x 1.5)[1], also contains 2% P and 3% K_2O	500	1000	1500	2000	2500
Fish meal 9% N, also contains 6% P_2O_5	220	440	670	890	1100
Alfalfa meal 2.5% N also contains 2% P and 2% K_2O	800	1600	2400	3200	4000
Feather meal 15% N (x 1.5)[1]	200	400	600	800	1000
Chilean nitrate 16% N cannot exceed 20% of crop's need.	125	250	375	500	625

[1] Application rates for some materials are multiplied to adjust for their slow to very slow release rates. Should be broadcast and incorporated prior to planting.

Table 6.4.2 Available Phosphorous in Organic Fertilizers

	Pounds of Fertilizer/Acre to Provide X Pounds of P_2O_5 Per Acre				
Sources	**20**	**40**	**60**	**80**	**100**
Bonemeal 15% P_2O_5	130	270	400	530	670
Rock Phosphate 30% total P_2O_5 (x4)[1]	270	530	800	1100	1300
Fish meal 6% P_2O_5 (also contains 9% N)	330	670	1000	1330	1670

[1] Application rates for some materials are multiplied to adjust for their slow to very slow release rates. Should be broadcast and incorporated prior to planting.

Table 6.4.3 Available Potassium in Organic Fertilizers

	Pounds of Fertilizer/Acre to Provide X Pounds of K_2O per acre:				
Sources	**20**	**40**	**60**	**80**	**100**
Sul-Po-Mag 22% K_2O also contains 11% Mg	90	180	270	360	450
Wood ash (dry, fine, grey) 5% K_2O, also raises pH	400	800	1200	1600	2000
Alfalfa meal 2% K_2O, also contains 2.5% N and 2% P	1000	2000	3000	4000	5000
Greensand or Granite dust 1% K_2O (x 4)[1]	8000	16000	24000	32000	40000
Potassium sulfate 50% K_2O	40	80	120	160	200

[1] Application rates for some materials are multiplied to adjust for their slow to very slow release rates. Should be broadcast and incorporated prior to planting.

6.5 Rootstocks

Rootstocks have great potential utility in organic grape production. Most commercial rootstocks have some degree of phylloxera resistance. However, they also have different nutrient uptake profiles and impart different vigor to the vine. Selecting the right rootstock for your soil environment and vineyard goals could nearly eliminate the need for supplemental fertilizers. See Table 6.5.1. Vigorous rootstocks can also reduce the need for minimizing weed competition in the vineyard. See section 7.9, Weed Management, for additional information. It is important to note that rootstocks should not be viewed as a cure for a poor site but rather as a tool for further improving vineyard practices such as water, weed, and nutrition management.

Table 6.5.1 Rootstocks Commonly Used in New York and Their Characteristics

Rootstock[1]	Influence on Scion Vigor	Influence on Scion Mineral Nutrition[2]	Soil Adaptation	Drought Tolerance	Wet Soil Tolerance	Lime Tolerance
Riparia Gloire	Low-med	N, P: Low K, Mg: Low-med	Med to deep or well drained	Low	Low	Low
SO4	Med-high	N: Low-med P: Med K: Med-high Mg: Med	Moist clay soils	Low-med	Med-high	Med
5BB	Med-high	N: Med-high P, K: Med Mg: Med-high	Shallow dry to deep or well drained	Med	Low	Med-high
420A	Low	N, P, K: Low Mg: Med	Med to deep or well drained	Med	Low-med	Med-high
101-14	Med	N, K: Med-high P, Mg: Low	Shallow moist to deep or well drained	Low-med	Med	Low-med
3309	Low-med	N: Med-high P: Low K, Mg: Med	Shallow dry to deep or well drained	Low-med	Low-med	Low-med

[1] The rootstocks listed are highly resistant to phylloxera.
[2] Influence on scion mineral nutrition refers to comparative petiole tissue levels of nutritional elements.
Adapted from *"Wine Grape Varieties in California"* by Peter Christensen et al. and *ASEV Rootstock Seminar: A Worldwide Perspective*. (1992). J. Wolpert, M. Ealker and E. Weber.

7. ORGANIC VINEYARD IPM

Organic production of grapes is challenging in New York State given the abundant rainfall during the growing season leading to increased pressure from diseases. However, growers in New York and the eastern United States, through proper variety and site selection, strict attention to canopy management and sanitation, and increased attention paid to scouting vineyards on a weekly basis to catch pest outbreaks early, have succeeded in producing quality organic grapes. In contrast, a failure to appreciate the risk of disease development, and to devise and implement a season-long (and multiyear) management strategy, can lead to serious crop and even vine losses in particular years. Successful disease management is essential to the sustainable production of organic grapes.

7.1 Developing a Vineyard IPM Strategy

1. Examine your vineyard operation closely. Break it down into specific vineyards, or "vineyard blocks."
2. Produce a map of each vineyard (or vineyard block) to record pest outbreaks, nutrient deficiencies, drainage problems, missing vines, and any other abnormalities you find.
3. Develop a record-keeping system for each vineyard or vineyard block.
4. Develop a scouting plan for each vineyard block and record results.
5. Monitor and record weather factors and understand basic weather patterns of the area.
6. Keep accurate records of spray applications, tools, or tactics used to manage pests.
7. Properly maintain your spray equipment, calibrate the sprayer at the beginning of every season at a minimum, select appropriate nozzles, and reduce spray drift. Consult the national Pesticide Environmental Stewardship website for more information
8. Develop a thorough knowledge of the vineyard pests you are likely to encounter during the year. This includes basic pest biology, symptoms or damage, whether they are a primary or secondary pest, scouting thresholds, and the best time to apply management practices.
9. Choose a pest management strategy for the vineyard (or vineyard block) that is based on all of the information you've gathered. Use the options that make the most sense for your operation.
10. Continue your pest management education.

Other resources available online, include:
New York State Integrated Pest Management: Fruits website: nysipm.cornell.edu/fruits/
Pest Management Strategic Plan for Grapes in the Northeast 2017: https://ipmdata.ipmcenters.org/documents/pmsps/Grape-PMSP-for-Northeast-2017.pdf
Cornell Cooperative Extension Pesticide Safety Education Program: psep.cce.cornell.edu
Pesticide Environmental Stewardship. Center for Integrated Pest Management. https://pesticidestewardship.org/
Elements of IPM for Grapes in New York State: https://ecommons.cornell.edu/handle/1813/42720
Network for Environment and Weather Applications (NEWA): newa.cornell.edu
VineBalance: Sustainable Viticulture in the Northeast website: www.vinebalance.com/

7.2 Pesticide use in organic grape production

Organic production primarily focuses on cultural, biological, and mechanical techniques to manage pests on the farm, but in some cases pesticides, which include repellents, allowed for organic production are needed. Given the high cost of many pesticides and the limited efficacy data available for many of them, the importance of developing an integrated approach based on cultural practices for disease and insect management, as described in section 7.5 Disease Management, cannot be emphasized strongly enough. **Pesticides should not be relied**

on as a primary method of pest control. Scouting, forecasting, or trapping pests are important for detecting infestations at an early stage. When conditions do warrant an application, proper choice of materials, proper timing, and excellent spray coverage are essential.

Some organic-approved pesticide products that contain aromatic active ingredients, such as essential oils or garlic, could potentially affect fruit flavor or wine quality. Therefore, these should be used in a manner that avoids covering fruit with spray residue close to harvest.

7.2.1 BIOPESTICIDES

Biopesticides are materials with pesticidal properties that originate from natural living organisms, including microorganisms, plants, and animals. The United States Environmental Protection Agency (USEPA) defines two types of biopesticides that may be used in organic production. These include naturally occurring substances that control pests (biochemical/herbal pesticides) and microorganisms that control pests (microbial pesticides). Microbial pesticides contain fungi, bacteria, or viruses that control pests. These biopesticides may contain living, dead, or inactivated microbes. Biochemical pesticides contain substances naturally occurring in the environment to control pests. These biopesticides may include botanical extracts or insect pheromones that interfere with mating. When using biopesticides, follow the same steps for safe and legal use as for non-biological pesticides. Read and follow the label. The USEPA maintains a list of Biopesticide Active Ingredients.

Biopesticides are most likely to be effective if used while pest populations are low and when combined with other IPM strategies. Especially if they contain living microorganisms, biopesticides may require special storage, may lose efficacy if stored too long prior to use, or may be incompatible with other pesticides. Some biopesticides may be most effective within certain temperature ranges, or when applied at certain times of day. Read the label and consult the manufacturer with questions. While many biopesticides are permitted in organic production, not all of them are. Always check with your certifier before using a new product.

7.3 Pesticide Regulatory Considerations

Pesticides mentioned in this organic production guide are registered by the USEPA or meet the USEPA requirements for a "minimum risk" pesticide. At the time of publication, pesticides mentioned in this guide also meet New York State Department of Environmental Conservation (NYSDEC) registration requirements for use in New York State. See NYSDEC Bureau of Pesticides Management – Information Portal for pesticides currently registered for use in NYS. Additional products may be available for use in other states.

To maintain organic certification, products applied must also comply with the National Organic Program (NOP) regulations as set forth in the USDA NOP standards, sections 205.600-606. The Organic Materials Review Institute (OMRI) is one organization that reviews products for compliance with the NOP regulations and has a searchable database of compliant products, but other entities also make product assessments. The authors relied mainly on the OMRI list for pesticides to include. Organic growers are not required to use only OMRI listed materials, but the list is a good starting point when searching for allowed pesticides.

Finally, farms grossing more than $5,000 per year and labeling products as organic must be certified by a NOP accredited certifier who must approve any material applied for pest management. ALWAYS check with the certifier before applying any pest control products. Some certifiers will review products for NOP compliance.

Note that "home remedies" may not be used. Home remedies are substances commonly found around the home that may have pest control properties. Examples include beer used to reduce slug damage in strawberries or a dilute dish detergent solution used to reduce aphids on plants. Home remedies are not regulated as pesticides, are not exempt from registration, and are therefore not legal to use.

Do you need to be a certified pesticide applicator? Pesticides are classified as general-use or restricted use by either the USEPA or the NYSDEC. For those producing agricultural commodities, pesticide applicator certification is required to purchase and use restricted-use pesticides. Restricted-use pesticides mentioned in this guide are marked with an asterisk (*). Farmers who purchase and use only general-use pesticides in producing an agricultural commodity on property they own or rent do not need to be a certified pesticide applicator. However, we encourage agricultural producers who use pesticides to become certified. Find more information on pesticide applicator certification from the list of State Pesticide Regulatory Agencies or, in New York State, on the NYSDEC Pesticide Applicator/Technician Certification website.

Worker Protection Standard training. If the farm has employees who will be working in fields treated with a pesticide, they must be trained as workers or handlers as required by the federal government under Title 40 Protection of Environment, Part 170. Worker Protection Standard. Training materials must be approved by the USEPA and all trainers must be qualified either by having a pesticide applicator certification or by completing a USEPA-approved train-the-trainer course. For more information on complying with the Worker Protection Standard (WPS) see *How to Comply with the 2015 Revised Worker Protection Standard for Agricultural Pesticides* manual published by the USEPA or online at http://pesticideresources.org/wps/htc/index.html.

7.4 Optimizing Pesticide Effectiveness

Information on the effectiveness of a particular pesticide against a given pest can sometimes be difficult to find. Some university researchers include pesticides approved for organic production in their trials; some manufacturers provide trial results on their web sites; some farmers have conducted trials on their own. Efficacy ratings for pesticides listed in this guide were summarized from university trials and are only provided for some products.

In general, pesticides allowed for organic production may kill a smaller percentage of the pest population, could have a shorter residual, and may be more quickly broken down in the environment than synthetic pesticides. Read the pesticide label carefully to determine if water pH or hardness

will negatively impact the pesticide's effectiveness. Use of a surfactant may improve organic pesticide performance. Adjuvants can be found on OMRI's searchable product database using the Filter function.

Regular scouting and accurate pest identification are essential for effective pest management. Thresholds used for conventional production may not be useful for organic systems because of the typically lower percent mortality and shorter residual of pesticides allowed for organic production. When pesticides are needed, it is important to target the most vulnerable stages of the pest. Thoroughly cover plant surfaces, especially in the case of insecticides, since many must be ingested to be effective. The use of pheromone traps or other monitoring or prediction techniques can provide an early warning for pest problems and help effectively focus scouting efforts.

Pesticide resistance may develop in pathogens, insects, mites, etc. following repeated exposure to the same or similar mode-of-action materials and result in reduced or complete loss of pesticide efficacy against the resistant pest. During the growing season and across growing seasons, pesticides of one mode-of-action should be alternated with those of different modes-of-action to lower the risk of pests developing resistance to the pesticides. See the product label for more information.

7.5 Disease Management

Managing Diseases Organically—The Basics

An organic disease management strategy must recognize the limitations of organic spray products. Although some of these may play a significant role in the management of certain specific diseases, organic pesticides should be viewed as secondary supplements to a primary disease management program founded on four basic pillars: (1) site selection; (2) variety selection; (3) canopy management; and (4) sanitation. When these cultural tools are not implemented effectively, an organic grower cannot compensate for the omission by simply applying sprays, as growers with access to highly effective "conventional" fungicides often can. Indeed, these four basic tools are the only effective means of managing several of our common and important diseases.

• ***Site selection***. Most disease-causing fungi thrive in damp environments and require a film of water for their spores to germinate and infect the grapevine. In general, the longer that leaves and fruit remain wet after a rain or dew, and the more humid that it is at other times, the more severe that disease will be. Therefore, disease pressure is reduced significantly at sites where air is allowed to move freely and prevailing breezes blow through the vines to dry them; conversely, pressure is significantly increased at sites where air movement is impeded.

In addition to suffering restricted air movement, sites adjacent to woodlots are also at risk for certain diseases and insects that attack wild grapes that live in these locations. Such locations act as "reservoirs" for these pests, which can then move into the vineyard and damage the vines and crop. To the extent possible, it is useful to avoid or at least minimize situating new vineyards directly next to wood lots.

• ***Variety selection***. There are many reasons to choose specific varieties to plant in addition to their disease susceptibility. For example, businesses that wish to produce wines from Vinifera varieties, or growers who seek to supply them, may decide to plant these varieties despite the fact that all of them are highly susceptible to most fungal diseases. However, where flexibility of variety choice is an option, it is often extremely useful for an organic grower to include disease susceptibility as a major factor in choosing the variety or varieties to plant. For example, black rot is often considered the "Achilles heel" of organic grape production in the eastern half of North America, yet there is a wide range of susceptibilities to this disease among hybrid and Labrusca grape varieties. Over the course of multiple seasons, a grower with a variety that is only slightly susceptible (moderately resistant) to this disease will have a much easier time, and be far less likely to sustain losses in challenging years, than will a grower with a highly susceptible variety.

Similarly, it should be recognized that copper and sulfur are key fungicides in an organic program (sulfur primarily for good control of powdery mildew, copper for good control of downy mildew and modest control of other diseases). However, some Labrusca and hybrid varieties are injured by one or both of these materials. In addition to recognizing relative disease susceptibility, it is very useful to also recognize a variety's sensitivity to sulfur and copper before choosing it for an organic production system. For example, cv. Chancellor—highly susceptible to both powdery and downy mildew, plus injured by both copper and sulfur—would not be a recommended choice for an organic producer. Table 7.5.1 lists relative susceptibilities to various diseases and sensitivities to copper and sulfur among most varieties grown in New York and surrounding regions.

Researchers at Cornell University are developing new hybrid varieties with highly elevated levels of resistance to powdery mildew, downy mildew and black rot. Testing is taking place under "no-spray" conditions, and new breeding program selections are now being sent to cooperating researchers to confirm observations of disease resistance and wine quality in additional locations. These new selections show great promise in expanding the spectrum of quality varieties that may be more suitable for organic production methods. New variety releases are planned in the near future. Though testing is carried out under "no-spray" conditions, it's likely that one to three sprays will be recommended commercially to safeguard the strong activity of resistance genes against diseases.

• ***Canopy management***. Good air circulation through vines, to reduce humidity and speed drying, is promoted not only by the choice of a good vineyard site but also by canopy management techniques. In fact, the value of good canopy management in disease control, especially in the absence of highly effective fungicides, cannot be overstated. In addition to providing good air circulation, an open canopy structure that exposes the berries to good sunlight penetration will also allow better coverage of the berries with any sprays that are applied. Furthermore, sunlight itself helps to minimize some diseases (especially powdery mildew), in addition to improving fruit quality. Canopy management techniques can also incorporate aspects of sanitation, as discussed next.

• ***Sanitation***. Disease-causing fungi persist between seasons ("overwinter") within infected vine residue or in the perennial wood of the vine itself, depending on the particular organism and disease that it causes. The first infections of the year ("primary" infections) come from these overwintering sources, then typically spread to other parts of the vine and to neighboring vines throughout the season, as weather and

management conditions permit (think in terms of an initial "deposit" in a bank, which then grows over time with interest). Therefore, any technique that reduces the level of overwintering disease-causing fungi—that is, the initial deposit—will help to reduce the amount of disease that develops during the ensuing year. The sanitation procedures—such as removal of diseased clusters, cluster stems, and wood—that will help with specific diseases are discussed, for each, below. For some diseases, such as black rot, sanitation is a critical component of disease management in an organic system. For diseases that overwinter on or in the bark and wood of the grapevine (powdery mildew, Phomopsis; bitter rot and ripe rot; black rot, occasionally), an application of liquid lime sulfur (calcium polysulfide) near the end of dormancy may help to reduce the numbers of infectious fungal spores produced after growth begins.

Assessing Disease Risk

Disease risk should be assessed on a block-by-block basis. Just as one would not put drainage tile into all vineyards because one site held water throughout the year, so one should not assume that all blocks have the same potential for disease. Disease risk in any given year is determined by that season's weather, the grape variety, and the level of overwintering inoculum present in the vineyard. Therefore, disease risk in a given block is often indicated by the level of disease that was present prior to harvest in the previous growing season. Over time, vineyards, blocks, and varieties will be recognized as being particularly disease-prone or relatively disease-free through a range of weather conditions.

Table 7.5.1. Relative disease susceptibility and sensitivity to sulfur and copper among grape varieties[1]

	Disease susceptibility or chemical sensitivity[a]									
Variety	**BR**	**DM**	**PM**	**Bot**	**Phom**	**Eu**	**CG**	**ALS**	**S[c]**	**C[d]**
Arandell	+++	+	+	+	+++	?	++	?	Yes	?
Aromella	+	++	++	+	?	?	++	?	No	?
Aurore	+++	++[b]	+++	+++	++	+++	++	+++	No	++
Baco noir	+++	+	++	+++	+	++	++	++	No	?
Cabernet Franc	+++	+++	+++	+	?	?	+++	?	No	+
Cabernet Sauvignon	+++	+++	+++	+	+++	+++	+++	?	No	+
Canadice	+++	+	+	++	?	?	++	++	Slight	?
Cascade	+	+	++	+	++	++	+	?	No	?
Catawba	+++	+++	++	+	+++	+	+	+	No	++
Cayuga White	+	++	+	++	+	+	++	++	No	+
Chambourcin	++	++	++	++	++	?	++	?	Yes	?
Chancellor	+	+++	+++	+	+++	+++	++	+++	Yes	+++
Chardonel	++	++	++	++	?	?	++	++	No	?
Chardonnay	+++	+++	+++	+++	+++	+++	+++	++	No	+
Chelois	+	+	+++	+++	+++	+++	++	+++	Slight	+
Concord	+++	+	++	+	+++	+++	+	++	Yes	+
Corot noir	+++	++	+	+	+++	?	+	?	No	?
De Chaunac	+	++	++	+	+++	+++	++	+++	Yes	+
Delaware	++	+++[b]	++	+	+++	+	+	+	No	+
Dutchess	+++	++	++	+	++	+	++	+	No	?
Elvira	+	++	++	+++	+	+	+	++	No	++
Einset Seedless	+++	+++	++	+	?	?	+	?	No	?
Foch	++	+	++	+	?	+++	+	+	Yes	?
Fredonia	++	+++	++	+	++	?	+	+	No	?
Frontenac	++	+	++	+	?	?	+	?	Slight	?
Frontenac gris, Frontenac blanc	++	+	++	+	?	?	+	?	Slight	?
Gewürztraminer	+++	+++	+++	+++	?	?	+++	+	No	+
Geneva Red	+	++	++	++	+	+	+	?	No	?
Gruner Veltliner	+++	+++	+++	?	?	?	+++	?	No	+
Himrod	+++	++	++	+	?	?	?	+	No	?
Itasca	++	+	+	++	?	?	+	?	?	?
Ives	+	+++	+	+	?	++	+	+	Yes	?
La Crescent	++	++	++	+	?	?	+	?	No	?
Marquette	+	+	++	+	+	?	+	?	Slight	?
Marquis	+++	++	++	+	+	?	?	?	Slight	?
Melody	+++	++	+	+	?	?	+	+++	No	?
Merlot	++	+++	+++	++	+++	++	+++	?	No	++
Moore's Diamond	+++	+	+++	++	?	++	?	?	Slight	?
Niagara	+++	+++	+	+	+++	+	++	+	No	+
Noiret	+++	++	+	+	+++	?	++	+++	No	?
Pinot blanc	+++	+++	+++	++	?	?	+++	?	No	+
Pinot gris	+++	+++	+++	+++	?	?	+++	+++	No	+

Table 7.5.1. Relative disease susceptibility and sensitivity to sulfur and copper among grape varieties[1]

	Disease susceptibility or chemical sensitivity[a]									
Variety	**BR**	**DM**	**PM**	**Bot**	**Phom**	**Eu**	**CG**	**ALS**	**S[c]**	**C[d]**
Pinot noir	+++	+++	+++	+++	?	?	+++	++	No	+
Riesling	+++	+++	+++	+++	++	++	+++	+++	No	+
Rosette	++	++	+++	+	++	++	++	++	No	+++
Rougeon	++	+++	+++	++	+++	+	++	+++	Yes	+++
Sauvignon blanc	+++	+++	+++	+++	?	+++	+++	?	No	+
Seyval	++	++	+++	+++	+++	+	++	++	No	+
Steuben	++	+	+	+	?	?	+	++	Yes	?
Traminette	++	++	+	++	?	?	+	?	No	?
Valvin Muscat	++	+	++	+	?	?	+	?	No	?
Vanessa	+++	++	++	+	+	?	+	?	No	?
Ventura	++	++	++	+	+	?	+	+++	No	?
Vidal blanc	+	++	++	+	+	+	++	+	No	+
Vignoles	+	++	+	+++	+++	++	++	++	No	?

Key: + Slightly susceptible or sensitive; ++ Moderately susceptible or sensitive; +++ Highly susceptible or sensitive; No Not sensitive; ? Relative susceptibility or sensitivity not established

[1] The relative ratings in this chart apply to an average growing season. Under conditions favorable for disease development, any given variety may be more severely affected.

[a] BR=Black rot, DM=Downy mildew, PM=Powdery mildew, Bot=Botrytis, Phom=Phomopsis, Eu=Eutypa, CG=Crown gall, ALS=Angular Leaf Scorch, S=Sulfur, C=Copper

[b] Berries only weakly susceptible

[c] Slight to moderate sulfur injury may occur even on tolerant varieties when temperatures are 85F or higher during or immediately following the application

[d] Copper is most likely to cause injury when applied under cool, or very humid, slow drying conditions

As the vine grows, its tissues become more or less susceptible to various diseases. Different growth stages, combined with the life cycle of the fungus result in changing levels of disease risk during the growing season. Management tactics should be precisely timed to correspond to these changing risk levels. Knowing when primary infections occur and factors that promote disease spread allow the matching of available fungicides to the growth stage and the disease.

Weather conditions impact the development of the grapevine, the pathogen, and the disease. Most diseases are favored by warm, moist conditions. For many, the specific conditions required for infection have been identified, allowing tracking and prediction of infection events. Consult the grape disease models for Phomopsis, black rot, powdery mildew and downy mildew on Network for Environment and Weather Applications (NEWA) for information on infection events.

7.6 Diseases of Primary Concern

Several important diseases that occur in the temperate climate of the Northeastern U.S. are described below to help growers manage them with appropriate organic practices.

7.6.1 BLACK ROT *Guignardia bidwellii*

Black rot is one of the most serious diseases of grapes in the eastern United States and has the potential to be the "Achilles heel" for organic producers. Fruit rot is the most damaging phase of the disease, but all green tissues of the vine are susceptible to infection. This disease can be especially damaging in organic production because organic-approved fungicides are largely ineffective. Therefore, strict implementation of sanitation practices and other available horticultural techniques is essential, especially on moderately to highly susceptible varieties. Black rot can cause complete crop loss in warm, wet years if it is not properly managed.

Infected leaves develop relatively small, brown circular lesions surrounded by distinct dark margins; black, pimple-like fruiting bodies ("pycnidia") are scattered within these spot-like lesions. Black, elongated lesions on petioles (leaf stems) may cause affected leaves to wilt and drop. Large, black, elliptical lesions on infected shoots may contribute to breakage by wind. The disease is most common and damaging on berries which appear chocolate brown when first infected, but soon become dark brown with numerous black, pimple-like pycnidia on the surface. Berries eventually shrivel into hard, black raisin-like mummies, most of which remain firmly attached to the berry stem. The black rot fungus overwinters primarily in these mummified fruit, either on the vineyard floor or in clusters retained within the vine. It can also overwinter within cane lesions when these develop.

Rain triggers the release of infective spores from all sources, and infection occurs if susceptible tissues remain wet for a sufficient length of time, which depends on temperature (Table 7.6.1). Spores within cane lesions are available for infection starting at bud break; however, the majority of overwintering spores in most vineyards (those within mummified fruit on the ground) first become available about 2–3 weeks after bud break, reach peak levels about 1–2 weeks before bloom, and are usually depleted within one to several weeks after the start of bloom, depending on the season. However, in years with dry spring weather when only a few rains occur, the fungus does not discharge all of its spores as early as usual, and significant spore discharge may extend several weeks beyond bloom if this is when rains finally develop.

Pycnidia develop within lesions caused by current season infections and release a new crop of spores during the late spring and summer, beginning about 2–3 weeks after infection first occurs. These secondary rounds of spore release and infection are responsible for disease spread and are the cause of most economic loss when it occurs. Fruit are highly susceptible to infection for the first 2–3 weeks after bloom.

They become progressively less susceptible as they continue to develop, finally becoming highly resistant about 5–8 weeks after bloom, depending on the variety and year. In general, "Concord" fruit appear to become resistant about 1–2 weeks earlier than those of Vinifera varieties. Thus, the most critical time to control berry infections is during the first few weeks after the start of bloom.

Table 7.6.1 Hours of leaf wetness required for a black rot infection period at various temperatures following a rain.

Temp (°F)	Hours[a]
50	24
55	12
60	9
65	8
70	7
75	7
80	6
85	9
90	12

Source: R. A. Spotts. 1977. The Ohio State University
[a] Hours of continual wetness from rain.

Removal of mummified clusters from the canopy during pruning significantly reduces disease pressure for the coming season; burying mummies on the ground before or soon after budbreak, by cultivation or covering them with mulch, also can contribute to a reduction of inoculum if disease was severe the previous season. **CAUTION:** When mummified fruit are not dropped to the ground during dormant pruning operations, large numbers of spores will be produced within the canopy throughout the period of berry development. Research has shown that this prolonged period of high spore production, combined with the closeness of the spores to newly-developing berries, significantly increases the pressure for berry rot. **Therefore, complete removal of mummies from the canopy is an absolutely critical component of a black rot management program for organic growers.**

All fungicides currently approved for organic production are weak against black rot, although copper has moderate efficacy if applied very regularly. Therefore, growers of organic grapes should pay strict attention to the above sanitation procedures, because they are the most important defenses against this disease, which can be the "Achilles heel" of organic grape production in eastern viticulture. Cultural practices that open the canopy also are beneficial because they promote drying and improve spray coverage. See Table 7.5.1 for varietal susceptibility to this disease.

IPM fact sheet on Black Rot.

Black Rot Management Options	
Scouting/thresholds	Severe loss is usually the result of disease spread within and among clusters after it first gets established on a few berries in the early stages of fruit development. Scout for symptoms of black rot regularly beginning 10 days to 2 weeks after cap fall. Remove diseased clusters and/or consider regular copper applications during wet weather periods on varieties where this material can be used, especially if more than a trace level of disease is found.
Slightly susceptible varieties	Aromella, Cascade, Cayuga White, Chancellor, Chelois, DeChaunac, Elvira, Geneva Red, Ives, Marquette, Vidal blanc, and Vignoles. (See Table 7.5.1)
Cultural management	***Sanitation*.** Remove all mummies from the canopy and drop to the ground during dormant pruning operations. Around bud break, cultivate beneath the vines to bury mummies or cover them with mulch. ***Canopy management*.** Prune and train the vines to promote air circulation and speed drying of the leaves and fruit. Establish new plantings away from wooded areas, where wild grapes can serve as a source of black rot spores.
Chemical treatment	Copper products on varieties not sensitive to this material. (See Table 7.5.1)

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.6.1 Pesticides Labeled for Management of Black Rot

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Badge X2 (copper hydroxide, copper oxychloride)	0.75-3.5 lb/acre	0	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products

Table 7.6.1 Pesticides Labeled for Management of Black Rot					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
					are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot. Use the higher rates when conditions favor disease development.
Basic Copper 53 (basic copper sulfate)	4-5.6 lb/acre	UDH	24	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot.
Champ WG (copper hydroxide)	2-6 lb/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot.
ChampION++ (copper hydroxide)	.75-1.75 lb/acre	0	48	?	
CS 2005 (copper sulfate pentahydrate)	19.2-32 oz/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	UDH	4	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot.
Dart Fungicide EC (capric acid, caprylic acid)	0.2-0.35 % W/W	UDH	24	?	
ET-F Algicide/ Bactericide/ Fungicide (copper sulfate pentahydrate)	19.2-32 fl oz/acre	-	48	?	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot.

Table 7.6.1 Pesticides Labeled for Management of Black Rot					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Kalmor (copper hydroxide)	0.75-1.5 lb/acre	0	48	?	Either test for sensitivity or add 1 to 3 pounds of hydrated lime per pound of product.
Kentan DF (copper hydroxide)	2-4 lb/acre	-	48	?	
Kocide 2000-O (copper hydroxide)	1.5-3 lb/acre	0	48	?	
Kocide 3000-O (copper hydroxide)	0.75-1.5 lb/acre	0	48	?	
LifeGard WG (Bacillus mycoides isolate J*)	1-4.5 oz/acre	0	4	1	
Nordox 75 WG (cuprous oxide)	1.25 lb/acre	-	12	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot.
Nu-Cop 50 WP (copper hydroxide)	2 lb/acre	-	24	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Label states to use with hydrated lime. Copper products are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot.
Nu-Cop 50DF (copper hydroxide)	2-6 lb/acre	1	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot.
Nu-Cop HB (copper hydroxide)	1-3 lb/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Either test for sensitivity or add 1 to 3 pounds of hydrated lime per pound of product. Copper products are relatively weak against black rot, nevertheless, coppers are still among the most effective organically-acceptable materials against black rot.
OSO 5% SC Fungicide (polyoxin D zinc salt)	6.5-13 fl oz/acre	0	4	?	Suppression only.

Table 7.6.1 Pesticides Labeled for Management of Black Rot

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	128 fl oz/100 gal water curative	0	Until Dry	?	Apply at first sign of disease. Continue with consecutive applications until control is achieved or use when conditions favor rapid disease development.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32-64 fl oz/100 gal water preventative	0	Until Dry	?	Start preventative sprays early when conditions favor disease development. Spray on a 5-10 day schedule with thorough coverage.
Oxidate 5.0 (hydrogen peroxide, peroxyacetic acid)	1:256 dilution	0	Until Dry	?	Apply at first sign/symptom of disease. Maintain a 3-10 day spray schedule until control is achieved.
Serenade ASO (Bacillus subtilis str QST 713)	2-4 qt/acre	0	4	?	
Sporan EC2 (rosemary oil, clove oil, peppermint oil, thyme oil)	1.5-3 pt/acre	0	-	?	
Stargus (Bacillus amyloliquefaciens str. F727)	1-4 qt/100 gal water	0	4	1	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.6.2 BOTRYTIS *Botrytis cinerea*

Botrytis is a fungus that causes a bunch rot of berries and also may blight blossoms, leaves, and shoots. The bunch rot phase of the disease can cause severe economic losses, particularly on tight-clustered hybrid and Vinifera varieties. Ripe berries are susceptible to direct attack and are particularly susceptible to infection through wounds such as those caused by insects, hail, or rain cracking. Once established, infections can spread rapidly throughout the cluster during the preharvest period, causing extensive loss in yield and quality. This disease can be distinguished from other causes of bunch rot by the characteristic masses of gray "fuzzy" spores produced by the Botrytis fungus on infected plant parts, especially during humid weather.

The fungus overwinters in debris on the vineyard floor or on the vine. Old cluster stems are a particularly important source of carry-over between seasons. Spores are produced throughout the growing season, although their numbers appear to be greatest near bloom and after veraison. Production of spores and subsequent infection are greatly favored by prolonged periods of wetness or very high humidity, particularly at moderate temperatures (60–75°F).

The Botrytis fungus is most capable of attacking injured or senescing tissues; hence, infections usually occur as blossoms wither, as fruit ripens, or through wounds. Wounds caused by the grape berry moth are particularly common sites of infection. Under wet conditions, blossom parts can become infected between cap fall and bunch closing; such infections can lead to latent (dormant) infections of the young berries, which then become active as the berries begin to ripen. Although direct losses from these early infections appear to be modest, they often provide a starting point for sudden and significant disease spread within the clusters if wet weather occurs before harvest. Berries infected by powdery mildew between fruit set and bunch closing also can serve as starting points for a Botrytis epidemic; hence, good control of powdery mildew during this period is an important component of a good Botrytis management program.

In organic production, Botrytis management is best accomplished through cultural practices. In fact, even for growers who use conventional fungicides, consistent control of Botrytis requires the conscientious use of cultural management practices. Any practice that improves air circulation and thereby reduces humidity within the canopy is of significant benefit. Such practices include site selection to avoid fog pockets and heavily wooded areas; management of canopy densities through pruning, shoot positioning, and selectively removing leaves in the cluster zone immediately after fruit have set; and avoiding excessive nitrogen fertilization. Loose clusters also significantly reduce Botrytis development, and the use of clones (e.g., the 'Mariafeld' clones of cv. Pinot noir) or viticultural techniques that provide loose clusters can greatly aid in its control.

IPM fact sheet on Botrytis Bunch Rot and Blight.

Botrytis Bunch Rot Management Options	
Scouting/thresholds	Damaging levels of Botrytis are due to extensive disease spread throughout a cluster and to neighboring clusters after a few berries first become diseased. Regularly scout for the presence of Botrytis starting shortly after veraison, and consider treatment to slow spread of the disease if it is detected.
Slightly susceptible varieties	Arandell, Aromella, Cabernet Franc, Cabernet Sauvignon, Cascade, Catawba, Chancellor, Concord, Corot noir, De Chaunac, Delaware, Dutchess, Einset Seedless, Foch, Fredonia, Frontenac, Frontenac gris, Frontenac blanc, Himrod, Ives, La Crescent, Marquette, Marquis, Melody, Niagara, Noiret, Rosette, Steuben, Valvin Muscat, Vanessa, Ventura, and Vidal blanc. (See Table 7.5.1)
Cultural management	***Sanitation***. Remove old cluster stems from the canopy and drop to the ground during dormant pruning operations. Around bud break, cultivate beneath the vines to bury infected debris or cover with mulch. ***Fruit management***. Thin clusters to promote open cluster architecture on tight-clustered varieties. Prevent grape berry moth damage. Protect against powdery mildew infections between fruit set and bunch closure. ***Canopy management***. Prune and train the vines to promote air circulation, reduce humidity, and speed drying of the clusters. On highly susceptible varieties or clones, thin or remove leaves immediately surrounding the cluster zone. This technique is most beneficial if practiced early in the fruiting period, soon after berries have set. ***Vineyard management***. Orient rows to improve air movement within the vineyard. Avoid sites prone to fog or heavily wooded areas.
Chemical treatment	Organically approved pesticides have provided little control under high disease pressure conditions, but some have been beneficial under more moderate conditions. The possible times for application are bloom, bunch closure, veraison, and pre-harvest, depending on the weather and current presence of disease. Wounds caused by grape berry moth are common sites of infection, as are powdery mildew infections occurring on fruit between fruit set and bunch closure. Good management of berry moth and powdery mildew will contribute to a good Botrytis management program.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.6.2 Pesticides Labeled for Management of Botrytis Bunch Rot

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Actinovate AG (Streptomyces Lydicus WYEC 108)	3-12 oz/acre	0	4	3	
BotryStop (Ulocladium oudemansii (U3 Strain))	2-4 lb/acre	-	4	?	
Carb-o-nator (potassium bicarbonate)	2.5-5 lb/100 gal water	0	4	?	
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	UDH	4	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Damoil (mineral oil)	1-3 gal/acre	-	4	?	Dormant and summer use.
Double Nickel 55 (Bacillus amyloliquefaciens str. D747)	0.25-3 lb/acre	0	4	1+	

Table 7.6.2 Pesticides Labeled for Management of Botrytis Bunch Rot					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Double Nickel LC (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	1+	
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
Falgro 4L (gibberillic acid)	0.4-16 grams AI/acre	0	4	?	Growth regulator. Affects stretching, thinning and sizing of clusters which may help reduce Botrytis bunch rot. Rate varies depending on goals and grape varieties. See label for details.
GibGro 4LS (gibberillic acid)	0.4-16 grams AI/acre	-	4	?	Growth regulator. Affects stretching, thinning and sizing of clusters which may help reduce Botrytis bunch rot. Rate varies depending on goals and grape varieties. See label for details.
Howler (Pseudomonas chloroaphis strain AFS009)	5-15 lb/acre	0	4	1	
JMS Stylet-Oil (mineral oil)	1-2 gal/100 gal water	see comment	4	2	Provides significant control of powdery mildew, and for this reason treated vines will have less Botrytis. Has no direct effect on the Botrytis fungus nor will it control infections that develop through sites other than powdery mildew injuries. Do not apply sulfur within 10 days of an oil application. PHI is 2 weeks for table grapes; 0 days for other grapes.
LALSTOP G46 WG (Gliocladium catenulatum str J1446)	See label.	0	4	?	Rate used depends on volume applied per acre. See label.
Mastercop (copper sulfate pentahydrate)	1-3 pt/acre	UDH	48	?	
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	3	Provides significant control of powdery mildew, and for this reason treated vines will have less Botrytis. Has no direct effect on the Botrytis fungus nor will it control infections that develop through sites other than powdery mildew injuries.
OSO 5% SC Fungicide (polyoxin D zinc salt)	6.5-13 fl oz/acre	0	4	?	
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	128 fl oz/100 gal water curative	0	Until Dry	?	Apply at first sign of disease. Continue with consecutive applications until control is achieved or use when conditions favor rapid disease development.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32-64 fl oz/100 gal water preventative	0	Until Dry	?	Start preventative sprays early when conditions favor disease development. Spray on a 5-10 day schedule with thorough coverage.
Oxidate 5.0 (hydrogen peroxide, peroxyacetic acid)	1:256 dilution	0	Until Dry	1	Apply at first sign/symptom of disease. Maintain a 3-10 day spray schedule until control is achieved.

Table 7.6.2 Pesticides Labeled for Management of Botrytis Bunch Rot					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
PerCarb (sodium carbonate peroxyhydrate)	1-3 lb/100 gal water	0	Until Dry	?	See label for specific application volumes.
PerCarb (sodium carbonate peroxyhydrate)	3-4 lb/100 gal water dormant spray	0	Until Dry	?	Apply in early and late dormancy prior to bud break. Do not apply to blooming crops. See label for specific application volumes.
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Curative	-	Until Dry	?	See label for specific, curative or preventative, use directions.
PERpose Plus (hydrogen peroxide)	0.25-0.33 fl oz/gal Preventative	-	Until Dry	?	See label for specific, curative or preventative, use directions.
Prestop WG (Gliocladium catenulatum str J1446)	0.33 oz/5 gal water foliar spray	-	4	?	
ProBlad Verde (Banda de Lupinus albus doce (BLAD))	18.1-45.7 fl oz/acre	1	4	1+	Requires 2-4 hours drying time on plant foliage for the active ingredient to be fixed into the plant tissue before rain or irrigation occurs.
ProGibb LV PLUS (gibberillic acid)	See comments.	0	4	?	Growth regulator. Affects stretching, thinning and sizing of clusters which may help reduce Botrytis bunch rot. Rate varies depending on goals and grape varieties. See label for details.
PureSpray Green (white mineral oil)	0.5-2 gal/acre	see comment	4	?	Do not apply sulfur within 10 days of an oil application. Table grapes must not be sprayed within 2 weeks of harvest. Do not use copper and oil together with fruit present. Do not tank-mix oil and copper more than once/season. All other grapes can be sprayed up to day of harvest.
Regalia (Reynoutria sachalinensis)	1-4 qt/acre	0	4	1+	A preventative fungicide.
Regalia CG (Reynoutria sachalinensis)	1-4 qt/acre foliar spray	0	4	?	
Romeo (Saccharomyces cerevisiae)	0.23 lb/acre	0	4	?	
Serenade ASO (Bacillus subtilis str QST 713)	2-4 qt/acre	0	4	2	
Serenade MAX (Bacillus subtilis str QST 713)	1-3 lb/acre	0	4	2	
Serenade Opti (Bacillus subtilis str QST 713)	14-20 oz/acre	0	4	1+	Apply in sufficient water to provide full coverage.
Serifel (Bacillus amyloliquefaciens str. MBI 600)	4-16 oz/acre	0	4	?	
Sporan EC2 (rosemary oil, clove oil, peppermint oil, thyme oil)	1.5-3 pt/acre	0	-	?	

Table 7.6.2 Pesticides Labeled for Management of Botrytis Bunch Rot

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Stargus (Bacillus amyloliquefaciens str. F727)	1-4 qt/100 gal water	0	4	?	
SuffOil-X (mineral oil)	1-2 gal/100 gal water	UDH	4	?	Do not mix with sulfur products.
Taegro 2 (Bacillus subtilis var. amyloliquefaciens str. FZB2)	2.6-5.2 oz/acre	-	4	?	Suppression only.
TerraNeem EC (cold pressed neem oil)	1-1.5% solution	0	4	?	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.
Timorex Act (tea tree oil)	13-35 fl oz/acre	2	4	?	
Triathlon BA (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	?	
Trilogy (neem oil)	0.5-1% solution.	UDH	4	?	Provides significant control of powdery mildew, and for this reason treated vines will have less Botrytis. Has no direct effect on the Botrytis fungus nor will it control infections that develop through sites other than powdery mildew injuries. Do not use after bloom on table grapes or following bunch closure on wine grapes. The maximum labeled rate is 2 gal/acre /application.
TriTek (mineral oil)	1-2 gal/100 gal water	UDH	4	?	Apply as needed.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI – pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.6.3 DOWNY MILDEW *Plasmopara viticola*

Downy mildew is caused by a fungus-like organism that can infect berries, leaves, and young shoots. Leaf lesions appear as yellow or reddish-brown areas on the upper surface, with corresponding white, downy, or cottony growth directly opposite on the lower surface (note that downy mildew growth appears only on the lower surface of a leaf lesion and looks cottony, whereas powdery mildew can occur on both sides of the lesion and looks more like baby powder). Leaf lesions become brown and dead with age, and severely infected leaves drop prematurely. Young, infected shoots and cluster stems may curl and are characteristically covered with the white, "downy" growth of the pathogen on mornings following rain or dew the night before. Berries on infected cluster stems may fail to set or can turn brown and eventually shrivel, depending on the time of infection. Berries that are directly infected while very young may become entirely covered with a fuzzy white growth when wet from evening rain or early morning dew. Cluster infections that occur later in the season cause berries to remain hard, with a mottled light green to brown or red appearance.

Frequent rainfall and high humidity are the most important environmental factors promoting downy mildew epidemics. The downy mildew organism overwinters as dormant spores within infected leaves on the vineyard floor or (more commonly) within the upper soil layer, and first becomes active in the spring about 2–3 weeks before bloom. Infective spores are then produced during rainy periods if temperatures are above 52°F, and are splashed from the soil onto susceptible tissues to cause the season's first (primary) infections. (Note that inoculum for such early-season infections come strictly from within the vineyard.) Epidemic disease development can then result from repeated cycles of new infections, which are caused by new spores produced within the white downy growth on diseased 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 for just a few hours. (Note that such disease spread can also originate from nearby vines outside the vineyard.)

The generation period for the pathogen (time from spore germination and infection to the production of a new "crop" of secondary spores) is only 4 to 5 days at optimum temperatures in the mid- to upper-70s, allowing explosive disease development during extended periods of warm, humid weather with periodic rain showers. On some varieties, including all Vinifera varieties, this can be particularly destructive during the several week period before and after bloom, when fruit clusters are highly susceptible to infection. Young leaves remain highly susceptible to infection so long as they continue to be produced, although even older leaves can become diseased under high-pressure conditions. Uncontrolled infections can cause extensive defoliation in wet years, limiting both fruit ripening and vine winter hardiness. Winter kill of buds or even entire vines is not uncommon when spraying stops too early on susceptible varieties in a bad downy mildew season. Disease can develop at a wide range of temperatures, from the low 50s to the mid-80s (°F), although the rate of spread is slower while at the edges of the range.

Downy mildew management programs should focus on (a) preventing early disease establishment and destructive cluster infections during the prebloom and early postbloom periods and (b) limiting secondary spread on the foliage during the summer and early fall. Any practice that improves air circulation and speeds drying within vine canopies will help to control downy mildew.

Because primary infections can first occur 2–3 weeks before bloom, protection may need to start at this time on Vinifera varieties and on highly susceptible hybrid and Labrusca varieties (e.g., Chancellor, Catawba, Niagara) if the weather is wet. This is particularly true if significant disease occurred the previous year which would contribute to high levels of overwintering inoculum within the vineyard. Clusters should be protected on all but the most highly resistant varieties from the immediate prebloom period through the first or second postbloom spray, depending on the weather.

Continued protection against disease spread during the summer should be based on variety susceptibility, the extent of favorable weather conditions, and the amount of disease already in the vineyard (secondary inoculum). Downy mildew has the potential for "explosive" spread if the disease is active and weather conditions favor its development. However, in many years, hot, drier weather causes the downy mildew fungus to become inactive during mid-summer. Thus, it is worthwhile to scout vineyards during this time for the presence of active disease and to determine the need for protective sprays based on such findings. Also, recognize that fruit lose their susceptibility to infection by midsummer, although protection against leaf infections and consequent defoliation may need to continue throughout the summer, depending on weather conditions. See Table 7.5.1 for varietal susceptibility to this disease.

IPM fact sheet Downy Mildew.

Downy Mildew Management Options	
Scouting/thresholds	Scout vineyards in mid-summer for the presence of sporulating lesions that may spread infections to leaves during warm, wet weather.
Slightly susceptible varieties	Arandell, Baco noir, Canadice, Cascade, Chelois, Concord, Foch, Frontenac, Frontenac gris, Frontenac blanc, Itasca, Marquette, Moore's Diamond, Steuben, and Valvin Muscat. (See Table 7.5.1)
Cultural management	***Canopy management*.** Prune and train the vines to promote air circulation, reduce humidity, and speed drying of the leaves and fruit. ***Vineyard management*.** Orient rows to improve air movement within the vineyard. Avoid sites prone to fog or heavily wooded areas.
Chemical treatment	Copper products are very effective, although they must be reapplied frequently (7- to 10-day intervals) during periods of wet weather in order to provide continued protection. (See Table 7.5.1 for copper-sensitive varieties.)

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.6.3 Pesticides Labeled for Management of Downy Mildew

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Badge X2 (copper hydroxide, copper oxychloride)	0.75-3.5 lb/acre	0	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Use the higher

Table 7.6.3 Pesticides Labeled for Management of Downy Mildew					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
					rates when conditions favor disease development.
Basic Copper 53 (basic copper sulfate)	4-5.6 lb/acre	UDH	24	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Carb-o-nator (potassium bicarbonate)	2.5-5 lb/100 gal water	0	4	?	
Champ WG (copper hydroxide)	2-6 lb/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
ChampION++ (copper hydroxide)	.75-1.75 lb/acre	0	48	?	
*Copper Sulfate Crystals (copper sulfate pentahydrate)	Used in Bordeaux mixture.	-	24	1	Prepare and apply 2-6-100 Bordeaux spray beginning when downy mildew is detected. Use of this mixture will exhibit some phytotoxicity on most varieties.
CS 2005 (copper sulfate pentahydrate)	19.2-32 oz/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	UDH	4	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Dart Fungicide EC (capric acid, caprylic acid)	0.2-0.35 % W/W	UDH	24	?	
Double Nickel 55 (Bacillus amyloliquefaciens str. D747)	0.25-3 lb/acre	0	4	?	Suppression only.
Double Nickel LC (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	1+	Suppression only.
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
ET-F Algicide/ Bactericide/ Fungicide (copper sulfate pentahydrate)	19.2-32 fl oz/acre	-	48	?	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Kalmor (copper hydroxide)	0.75-1.5 lb/acre	0	48	?	Either test for sensitivity or add 1 to 3 pounds of hydrated lime per pound of product.
Kentan DF (copper hydroxide)	2-4 lb/acre	-	48	?	

Table 7.6.3 Pesticides Labeled for Management of Downy Mildew					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Kocide 2000-O (copper hydroxide)	1.5-3 lb/acre	0	48	?	
Kocide 3000-O (copper hydroxide)	0.75-1.5 lb/acre	0	48	?	
LifeGard LC (Bacillus mycoides isolate J)	1 gal/100 gal water	0	4	?	
LifeGard WG (Bacillus mycoides isolate J*)	1-4.5 oz/acre	0	4	1+	
Mastercop (copper sulfate pentahydrate)	1-3 pt/acre	UDH	48	?	
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	1	
Nordox 75 WG (cuprous oxide)	1.25 lb/acre	-	12	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Nu-Cop 50 WP (copper hydroxide)	2 lb/acre	-	24	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Label states to use with hydrated lime.
Nu-Cop 50DF (copper hydroxide)	2-6 lb/acre	1	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Nu-Cop HB (copper hydroxide)	1-3 lb/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Either test for sensitivity or add 1 to 3 pounds of hydrated lime per pound of product.
OSO 5% SC Fungicide (polyoxin D zinc salt)	6.5-13 fl oz/acre	0	4	?	
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	128 fl oz/100 gal water curative	0	Until Dry	?	Apply at first sign of disease. Continue with consecutive applications until control is achieved or use when conditions favor rapid disease development.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32-64 fl oz/100 gal water preventative	0	Until Dry	?	Start preventative sprays early when conditions favor disease development. Spray on a 5-10 day schedule with thorough coverage.
Oxidate 5.0 (hydrogen peroxide, peroxyacetic acid)	1:256 dilution	0	Until Dry	?	Apply at first sign/symptom of disease. Maintain a 3-10 day spray schedule until control is achieved.
PerCarb (sodium carbonate peroxyhydrate)	1-3 lb/100 gal water	0	Until Dry	?	See label for specific application volumes.

Table 7.6.3 Pesticides Labeled for Management of Downy Mildew

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
PerCarb (sodium carbonate peroxyhydrate)	3-4 lb/100 gal water dormant spray	0	Until Dry	?	Apply in early and late dormancy prior to bud break. Do not apply to blooming crops. See label for specific application volumes.
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Curative.	-	Until Dry	?	See label for specific, curative or preventative, use directions.
PERpose Plus (hydrogen peroxide)	0.25-0.33 fl oz/gal Preventative.	-	Until Dry	?	See label for specific, curative or preventative, use directions.
Quimag Quimicos Aguila Copper Sulfate Crystal (copper sulfate pentahydrate)	Used in Bordeaux mixture.	-	48	1	Prepare and apply 2-6-100 Bordeaux spray beginning when downy mildew is detected. Use of this mixture will exhibit some phytotoxicity on most varieties.
Regalia (Reynoutria sachalinensis)	1-4 qt/acre	0	4	1	
Regalia CG (Reynoutria sachalinensis)	1-4 qt/acre foliar spray	0	4	?	
Romeo (Saccharomyces cerevisiae)	0.23 lb/acre	0	4	2	
Serenade ASO (Bacillus subtilis str QST 713)	2-4 qt/acre	0	4	1	Suppression only.
Serenade MAX (Bacillus subtilis str QST 713)	1-3 lb/acre	0	4	1	Suppression only.
Serifel (Bacillus amyloliquefaciens str. MBI 600)	4-16 oz/acre	0	4	?	
Sporan EC2 (rosemary oil, clove oil, peppermint oil, thyme oil)	1.5-3 pt/acre	0	-	?	
Stargus (Bacillus amyloliquefaciens str. F727)	1-4 qt/100 gal water	0	4	1	
TerraNeem EC (cold pressed neem oil)	1-1.5% solution	0	4	?	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.
Triathlon BA (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	?	
Trilogy (neem oil)	0.5-1% solution.	UDH	4	3	Do not use after bloom on table grapes or following bunch closure on wine grapes. The maximum labeled rate is 2 gal/acre /application.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI – pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.6.4 PHOMOPSIS CANE AND LEAF SPOT AND FRUIT ROT *Phomopsis viticola*

Phomopsis cane and leaf spot and fruit rot are most likely to become problems when the Phomopsis fungus is allowed to build up on dead canes or pruning stubs in the vines and effective early-season sprays for this disease are omitted. In conventionally managed vineyards,

economic losses have been especially severe on Niagara, and to a lesser extent, Concord, although many other Labrusca, hybrid, and Vinifera varieties are susceptible as well (see Table 7.5.1).

Infected rachises and shoots develop black lesions that may split the green tissue (shoots) or appear sunken (rachises). Numerous lesions give the shoot surface a blackened, scabby appearance, and may coalesce to girdle the rachises. Severe infection weakens the tissues at these spots and can cause infected shoots to break off during high winds, or infected clusters to break before and during harvest. Small, pinprick-sized lesions, with brown or black centers surrounded by a small and often yellow margin, can be numerous on the leaves early in the season. These infections cause little harm themselves, but provide a good indication that the fungus is present in the vine and capable of causing more serious losses on other organs if not effectively managed.

Infected berries remain symptomless until late summer or preharvest, when they turn brown, often beginning at the point of attachment to the pedicel (berry stem) and become covered with black, pimple-like fruiting bodies. Such berries eventually shrivel up into raisin-like "mummies", at which time they look very similar to berries infected with black rot. On fruit, the two diseases are best distinguished by the initial location, timing, and development of symptoms. Phomopsis lesions typically (but not always) start where the berry is attached to its stem, whereas black rot lesions start at random locations on the fruit. Also, Phomopsis lesions do not appear until late summer or early fall on the fruit, often just before harvest; in contrast, most black rot symptoms appear by late July or early August, and all diseased berries should be evident by veraison. Finally, berries infected with Phomopsis are usually quite easy to detach from their stem by lightly touching them or giving a gentle pull, whereas those with black rot typically remain attached firmly to the berry stem.

Black fruiting bodies of the Phomopsis fungus overwinter in infected wood (diseased canes or pruning stubs) and rachises. During wet periods, spores ooze from the fruiting bodies and are distributed by raindrops onto nearby susceptible tissues. For this reason, young shoots and clusters directly beneath old canes and pruning stubs are at greater risk than those that are trained to grow above these sources.

Extended periods of wet weather are particularly favorable for disease development. Shoot and leaf infections can occur anytime between bud break and early summer, although they are most common during the first few weeks of growth. Shoot and leaf lesions appear within 3 to 4 weeks after infection, but they do not serve as a source of disease spread during the current season. Rachises can be infected anytime after the young clusters first emerge until fungal spores are depleted in early summer, although infections that occur soon after cluster emergence in the early growing season are the most damaging. Infections that occur on the pedicels (berry stems) during this period can also move into the fruit, causing them to rot before harvest.

Fruit appear to be most susceptible to direct infection from bloom through pea-sized berries, after which few spores are available for new infections. Fruit infection occurs sporadically, since it requires extended periods of rain and wetness; however, serious losses can result if the growing season is excessively wet and protection is not maintained with an effective Phomopsis fungicide from the early shoot growth period through fruit set.

Diseased canes should be removed during pruning to reduce inoculum. Research has shown that dead canes and pruning stubs can produce extremely high levels of Phomopsis spores, and these sources should be specifically targeted for removal as part of a Phomopsis management program. Recent research from Ohio suggests that when inoculum is present, moderately-severe infection can develop after about 26 hr. of wetness at an average temperature of 48°F, 16 hr. at 54°F, and 12 hr. at 60–68°F (shorter and longer periods of wetness should reduce and increase disease severity, respectively).

Copper and sulfur are only weakly effective; thus, organic growers should pay strict attention to the removal of infected wood from within the canopy.

IPM fact sheet Phomopsis Cane and Leaf Spot.

Phomopsis Management Options	
Scouting/thresholds	Note "hot spots" of disease activity within individual vines; try to identify the likely source of the fungus causing these infections (pruning stubs, dead canes) and target for removal.
Slightly susceptible varieties	Baco Noir, Cayuga White, Elvira, Geneva Red, Marquette, Marquis, Vanessa, Ventura, and Vidal blanc. (See Table 7.5.1)
Cultural management	***Sanitation***. Remove all dead wood, infected wood and pruning stubs from the canopy during dormant pruning operations. ***Canopy management***. Prune and train the vines to promote air circulation and speed drying of the shoots and clusters. In some instances performing "cane pruning" rather than "spur or cordon pruning" in vinifera and hybrids will result in ensuring new wood is laid down on the fruiting wire every year. ***Vineyard management***. Orient rows to improve air movement within the vineyard.

Phomopsis Management Options	
Chemical treatment	Copper and sulfur are weakly effective and may cause injury on sensitive varieties (See Table 7.5.1). Early-season copper use may also injure more tolerant varieties if applied under cool and/or humid, slow-drying conditions.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.6.4 Pesticides Labeled for Management of Phomopsis Cane and Leaf Spot and Fruit Rot

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Acoidal (sulfur)	2-10 lb/acre	-	24	2	
Auron DF (sulfur)	2-10 lb/acre	-	24	?	Not recommended within 2 weeks of an oil application nor if temperatures are expected to exceed 90 degrees during or within 3 days following the application.
Badge X2 (copper hydroxide, copper oxychloride)	0.75-3.5 lb/acre	0	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against Phomopsis, nevertheless, coppers are still among the most effective organically-acceptable materials against Phomopsis. Use the higher rates when conditions favor disease development.
*Brandt Lime Sulfur (calcium polysulfide)	15-20 gal/acre	-	48	?	Apply prior to bud swell in the spring.
Champ WG (copper hydroxide)	2-6 lb/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against Phomopsis, nevertheless, coppers are still among the most effective organically-acceptable materials against Phomopsis.
ChampION++ (copper hydroxide)	.75-1.75 lb/acre	0	48	?	
CS 2005 (copper sulfate pentahydrate)	19.2-32 oz/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against Phomopsis, nevertheless, coppers are still among the most effective organically-acceptable materials against Phomopsis.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	UDH	4	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against Phomopsis, nevertheless, coppers are still among the most effective

Table 7.6.4 Pesticides Labeled for Management of Phomopsis Cane and Leaf Spot and Fruit Rot					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
					organically-acceptable materials against Phomopsis.
Dart Fungicide EC (capric acid, caprylic acid)	0.2-0.35 % W/W	UDH	24	?	
Defend DF (sulfur)	2-10 lb/acre	-	24	2	
Double Nickel 55 (Bacillus amyloliquefaciens str. D747)	0.25-3 lb/acre	0	4	?	
Double Nickel LC (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	?	
ET-F Algicide/ Bactericide/ Fungicide (copper sulfate pentahydrate)	19.2-32 fl oz/acre	-	48	?	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against Phomopsis, nevertheless, coppers are still among the most effective organically-acceptable materials against Phomopsis.
Kalmor (copper hydroxide)	0.75-1.5 lb/acre	0	48	?	Either test for sensitivity or add 1 to 3 pounds of hydrated lime per pound of product.
Kentan DF (copper hydroxide)	2-4 lb/acre	-	48	?	
Kocide 2000-O (copper hydroxide)	1.5-3 lb/acre	0	48	?	
Kocide 3000-O (copper hydroxide)	0.75-1.5 lb/acre	0	48	?	
LifeGard WG (Bacillus mycoides isolate J*)	1-4.5 oz/acre	0	4	?	
Mastercop (copper sulfate pentahydrate)	1-3 pt/acre	UDH	48	?	
Microthiol Disperss (sulfur)	3-10 lb/acre	-	24	2	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Has relatively little residual activity and must be reapplied frequently, even if it does not rain. Do not apply within 2 weeks of an oil application nor at temperatures over 90 degrees.
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	2	
Nordox 75 WG (cuprous oxide)	1.25 lb/acre	-	12	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against Phomopsis, nevertheless, coppers are still among the most effective

Table 7.6.4 Pesticides Labeled for Management of Phomopsis Cane and Leaf Spot and Fruit Rot					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
					organically-acceptable materials against Phomopsis.
Nu-Cop 50DF (copper hydroxide)	2-6 lb/acre	1	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Copper products are relatively weak against Phomopsis, nevertheless, coppers are still among the most effective organically-acceptable materials against Phomopsis.
Nu-Cop HB (copper hydroxide)	1-3 lb/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Either test for sensitivity or add 1 to 3 pounds of hydrated lime per pound of product. Copper products are relatively weak against Phomopsis, nevertheless, coppers are still among the most effective organically-acceptable materials against Phomopsis.
OSO 5% SC Fungicide (polyoxin D zinc salt)	6.5-13 fl oz/acre	0	4	?	
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	128 fl oz/100 gal water curative	0	Until Dry	?	Apply at first sign of disease. Continue with consecutive applications until control is achieved or use when conditions favor rapid disease development.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32-64 fl oz/100 gal water preventative	0	Until Dry	?	Start preventative sprays early when conditions favor disease development. Spray on a 5-10 day schedule with thorough coverage.
Oxidate 5.0 (hydrogen peroxide, peroxyacetic acid)	1:256 dilution	0	Until Dry	?	Apply at first sign/symptom of disease. Maintain a 3-10 day spray schedule until control is achieved.
Serenade ASO (Bacillus subtilis str QST 713)	2-4 qt/acre	0	4	3	
Serenade MAX (Bacillus subtilis str QST 713)	1-3 lb/acre	0	4	3	
Serenade Opti (Bacillus subtilis str QST 713)	14-20 oz/acre	0	4	?	Begin applications when shoots are ½ to 1 ½ inches long and repeat when shoots are 6-8 inches long.
Serifel (Bacillus amyloliquefaciens str. MBI 600)	4-16 oz/acre	0	4	?	
Stargus (Bacillus amyloliquefaciens str. F727)	1-4 qt/100 gal water	0	4	?	
Sulfur 80 WDG (sulfur)	2-10 lb/acre	-	24	?	
Timorex Act (tea tree oil)	13-35 fl oz/acre	2	4	?	

Table 7.6.4 Pesticides Labeled for Management of Phomopsis Cane and Leaf Spot and Fruit Rot

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Triathlon BA (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	?	
Trilogy (neem oil)	0.5-1% solution.	UDH	4	3	Do not use after bloom on table grapes or following bunch closure on wine grapes. The maximum labeled rate is 2 gal/acre /application.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI – pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.6.5 POWDERY MILDEW *Erisyphe necator*

Powdery mildew is a fungal disease that affects all green tissues. Diseased tissues appear to be covered with a white to grayish-white powder. Severe leaf infection can result in cupping and drying of leaves and premature leaf drop. Infected berries may fail to ripen properly; remain covered with a dusty mass of the fungus; turn dark brown; and/or shrivel and split, depending on the time and severity of infection. Fruit infection may promote growth of spoilage microorganisms and reduce wine quality on grapes intended for that use, even when symptoms are relatively mild.

The powdery mildew fungus overwinters on the bark of the vine as tiny black fruiting bodies ("chasmothecia"). Spores ("ascospores") contained in the chasmothecia are released during rains of approximately 1/10-inch or more, from bud break until shortly after bloom. They are wind-dispersed to young leaves and clusters, and can infect wet or dry tissue at temperatures of 50°F or higher. These primary mildew colonies produce masses of white, powdery secondary spores ("conidia"). Conidia are wind-dispersed throughout the vineyard and do not require rain for release or infection, although humid conditions particularly favor disease development. New colonies that result from these secondary infections produce additional conidia, which can continue to spread the disease.

This repeating cycle of infection, spore production, spore dispersal, and re-infection continues throughout the season if susceptible tissue is present, at a rate that is driven by temperature (Table 7.6.5.1). Thus, at optimum temperatures in the mid-60s to mid-80s (°F), a new generation of the fungus can multiply every 5–7 days, resulting in an epidemic of powdery mildew unless it is managed efficiently. Disease development also is strongly favored by high humidity and cloudy weather. Therefore, management programs may need to be intensified (e.g., shorter spray intervals, higher fungicide rates, more effective materials) during periods when such conditions occur. Conversely, the harmful impact of sunlight on the powdery mildew fungus can be exploited by pruning and training practices that promote good light exposure throughout the canopy, thereby utilizing this natural "fungicide" to help manage the disease.

Table 7.6.5.1 Approximate generation period for powdery mildew (time from infection by a spore until production of a colony with new spores) at different constant temperatures[a]

Temp (°F)	Days
44	32
48	25
52	16
54	18
59	11
63	7
74	6
79	5
86	6
90	--[b]

a. Data of C.J. Delp (University of California, Davis; 1954)
b. Little or no disease development while temperatures remain above 90 degrees.

Berries are highly susceptible to infection from the immediate prebloom stage until about two to three weeks after fruit set. Severe fruit damage observed later in the season almost always is the result of infections that occurred during this peak period of susceptibility. Berries of Concord become almost completely resistant to infection after this time (about 1/4-inch diameter fruit). Concord rachises remain susceptible until harvest, but the economic importance of mid- or late-summer rachis infections on processing fruit is questionable. On berries of Vinifera and certain hybrid varieties, infections can continue to occur until bunch closure or slightly thereafter. Such midsummer infection usually results in the development of sparse, inconspicuous infections that can be especially important as entry points for Botrytis and sour rot organisms that become apparent at harvest, or for spoilage microorganisms (e.g., *Brettanomyces*) that reduce wine quality.

Leaf infections that occur beyond the fruit set period are much less serious on Concord and similar varieties than on Vinifera and susceptible hybrids. On low to moderately cropped Concord vines, such infections appear to have relatively little effect on yield and Brix levels. However, on more heavily cropped Concord vines they can suppress both Brix levels and yield, particularly in years with poor ripening conditions. Thus, on this variety, the need for fungicide sprays after

fruit set should be heavily influenced by both crop size and weather factors. On Vinifera and highly susceptible hybrid varieties, continued suppression of foliar mildew is required throughout the summer to avoid poor ripening, premature defoliation, and reduced winter hardiness.

Good management of leaf infections throughout the season significantly reduces disease pressure the following year, by limiting the number of cleistothecia (fungal fruiting structures) that form, overwinter, and initiate infection in the spring. Limiting the level of overwintering inoculum has been shown to have a particularly positive impact on the control of cluster infections the following season.

To protect against powdery mildew infections of the fruit, management programs should be at their peak from just before bloom through fruit set, emphasizing the use of effective fungicides, full rates, appropriate spray intervals, and superior spray coverage (every row, proper speed, sufficient gallonage). The risk of berry infection is particularly high when days and nights remain warm during this period (see Table 7.6.5.1) and/or weather is cloudy and humid, and spray programs may need to be especially "tight" under these circumstances. Protection of Concord berries is not required after fruit are 1/4-inch in diameter, although continued foliar protection may be beneficial under high-crop-load or poor-ripening conditions. For Vinifera and susceptible hybrids, it is important to maintain excellent protection of the clusters through the bunch closure period, since powdery mildew infections at this time can promote the later development of bunch rots and/or wine spoilage.

Maintenance programs to protect foliage throughout the summer are necessary for attaining maximum fruit and vine quality on Vinifera and susceptible hybrid varieties. In years or locations where several weeks may elapse between harvest and frost, additional postharvest protection of the foliage may benefit vines of highly susceptible Vinifera varieties, especially if disease is active in the vineyard and the weather is reasonably warm. See Table 7.5.1 for varietal susceptibility to this disease.

IPM fact sheet Grapevine Powdery Mildew.

Powdery Mildew Management Options	
Scouting/thresholds	Scout foliage shortly before bloom and apply eradicative fungicide if disease is observed. Continue to scout foliage and young berries soon after fruit set and apply eradicative fungicide if disease is observed.
Slightly susceptible varieties	Arandell, Canadice, Cayuga White, Corot noir, Itasca, Ives, Melody, Niagara, Noiret, Steuben, Traminette and Vignoles. (See Table 7.5.1)
Cultural management	***Canopy management***. Prune and train the vines to maximize sunlight exposure, promote air circulation, reduce humidity, and speed drying of the leaves and clusters. ***Vineyard management***. Orient rows to maximize sunlight exposure and reduce humidity within the vineyard. Avoid sites prone to fog or heavily wooded areas. On highly susceptible varieties, thinning or removing leaves around clusters soon after fruit set will help to control this disease by exposing them to sunlight and, furthermore, will improve spray coverage of the fruit.
Chemical treatment	Unlike other fungal diseases of grapes, the powdery mildew fungus lives almost entirely on the ***outside*** of diseased tissues. Therefore, it is sensitive to topical applications of many products—oils, potassium salts (e.g., Kaligreen, Milstop), hydrogen dioxide (Oxidate), etc.—that have no effect on other diseases, whose causal fungi live ***within*** diseased tissues, where they are protected from these materials. With the exception of sulfur, these other materials have relatively little residual activity, and must be reapplied frequently, even if it does not rain. Sulfur washes off in rains and must be reapplied after rain wash-off, but persists during dry periods.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.6.5 Pesticides Labeled for Management of Powdery Mildew

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Acoidal (sulfur)	2-10 lb/acre	-	24	1	
Actinovate AG (Streptomyces Lydicus WYEC 108)	3-12 oz/acre	0	4	1	Has relatively little residual activity and must be reapplied frequently, even if it does not rain.
Auron DF (sulfur)	2-10 lb/acre	-	24	?	Not recommended within 2 weeks of an oil application nor if temperatures are

Table 7.6.5 Pesticides Labeled for Management of Powdery Mildew					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
					expected to exceed 90 degrees during or within 3 days following the application.
Badge X2 (copper hydroxide, copper oxychloride)	0.75-3.5 lb/acre	0	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Use the higher rates when conditions favor disease development.
*Brandt Lime Sulfur (calcium polysulfide)	4-10 gal/acre	-	48	?	Dormant application.
Carb-o-nator (potassium bicarbonate)	2.5-5 lb/100 gal water	0	4	?	
Champ WG (copper hydroxide)	2-6 lb/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
ChampION++ (copper hydroxide)	.75-1.75 lb/acre	0	48	?	
Cinnerate (cinnamon oil)	13-35 fl oz/100 gal water	0	-	1	25(b) pesticide. Conduct phytotoxicity test prior to application. See label for specific application volumes.
Companion Biological Fungicide (Bacillus amyloliquefaciens)	1/2-1 1/2 lb/acre	0	4	?	
*Copper Sulfate Crystals (copper sulfate pentahydrate)	4-8 lb/100 gal water	-	24	1	Dormant application. Apply prior to bud swell in the spring before any green tissue is present. Thoroughly wet the dormant vine.
CS 2005 (copper sulfate pentahydrate)	19.2-32 oz/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	UDH	4	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Damoil (mineral oil)	1-3 gal/acre	-	4	?	Dormant and summer use.
Defend DF (sulfur)	2-10 lb/acre	-	24	1	
DES-X (insecticidal soap)	2% solution sprayed at 75-200 gallons/acre	1/2	12	?	Do not use on table grapes once they're 6-7 mm in diameter or use at lowest rate
Double Nickel 55 (Bacillus amyloliquefaciens str. D747)	0.25-3 lb/acre	0	4	1	

Table 7.6.5 Pesticides Labeled for Management of Powdery Mildew					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Double Nickel LC (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	2	
Drexel Suffa (sulfur)	0.8-1.0 gal/acre	UDH	24	?	Do not apply when temperatures exceed or are likely to exceed 90°F. Do not use sulfur with oil or within 14 days of an oil spray. Concord and other Labrusca type Grapes may be injured.
EcoSwing Botanical Fungicide (extract of Swinglea glutinosa)	1.5-2 pts/acre	0	4	2	
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
ET-F Algicide/ Bactericide/ Fungicide (copper sulfate pentahydrate)	19.2-32 fl oz/acre	-	48	?	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Fungout (citric acid)	2.1% v/v	0	-	?	25(b) pesticide.
Glacial Spray Fluid (mineral oil)	1-2 gal/100 gal water	UDH	4	1	Although all oil products have not been tested, each works in the same general way.
JMS Stylet-Oil (mineral oil)	1-2 gal/100 gal water	See comment	4	1	Do not apply sulfur within 10 days of an oil application. Although all oil products have not been tested, each works in the same general way. PHI is 2 weeks for table grapes; 0 days for other grapes.
Kaligreen (potassium bicarbonate)	2.5-5 lb/acre	1	4	1	Has relatively little residual activity and must be reapplied frequently, even if it does not rain.
Kalmor (copper hydroxide)	0.75-1.5 lb/acre	0	48	?	Either test for sensitivity or add 1 to 3 pounds of hydrated lime per pound of product.
Kentan DF (copper hydroxide)	2-4 lb/acre	-	48	?	
Kocide 2000-O (copper hydroxide)	1.5-3 lb/acre	0	48	?	
Kocide 3000-O (copper hydroxide)	0.75-1.5 lb/acre	0	48	?	
KOPA Insecticidal Soap (potassium salts of fatty acids)	2 gal/100 gal water	1/2	12	?	See label for specific application volumes.
LALSTOP G46 WG (Gliocladium catenulatum str J1446)	See label.	0	4	?	Rate used depends on volume applied per acre. See label.
LifeGard LC (Bacillus mycoides isolate J)	1 gal/100 gal water	0	4	?	
LifeGard WG (Bacillus mycoides isolate J*)	1-4.5 oz/acre	0	4	1	

Table 7.6.5 Pesticides Labeled for Management of Powdery Mildew					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Mastercop (copper sulfate pentahydrate)	2-3 pt/acre	UDH	48	?	Dormant application.
Microthiol Disperss (sulfur)	3-10 lb/acre	-	24	1	
Mildew Cure (garlic oil, cottonseed oil, corn oil)	1 gal/100 gal water	-	-	1	25(b) pesticide. Although all oil products have not been tested, each works in the same general way. Conduct phytotoxicity test prior to application.
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	1	Has relatively little residual activity and must be reapplied frequently, even if it does not rain.
M-Pede (insecticidal soap)	1-2% vol/vol solution	0	12	?	
Nordox 75 WG (cuprous oxide)	1.25 lb/acre	-	12	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Nu-Cop 50 WP (copper hydroxide)	2 lb/acre	-	24	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Label states to use with hydrated lime.
Nu-Cop 50DF (copper hydroxide)	2-6 lb/acre	1	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient.
Nu-Cop HB (copper hydroxide)	1-3 lb/acre	-	48	1	May cause injury on sensitive varieties. See Table 7.5.1 for varietal sensitivity. Although all copper products have not been tested, each contains essentially the same active ingredient. Either test for sensitivity or add 1 to 3 pounds of hydrated lime per pound of product.
Nuke Em (citric acid)	Normal: 1 fl oz/32 fl oz water. Strong: 2 fl oz/32 fl oz water.	0	-	?	25(b) pesticide. Use the normal strength mix first. If needed, use the next stronger strength.
Omni Supreme Spray (mineral oil)	0.25-1 gal/acre	-	12	?	Summer application. Do not exceed 1 gallon of oil per acre during summer applications. Do not spray near the time of sulfur application.
OSO 5% SC Fungicide (polyoxin D zinc salt)	6.5-13 fl oz/acre	0	4	1	
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	128 fl oz/100 gal water curative	0	Until Dry	?	Apply at first sign of disease. Continue with consecutive applications until control is achieved or use when conditions favor rapid disease development.

Table 7.6.5 Pesticides Labeled for Management of Powdery Mildew

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32-64 fl oz/100 gal water preventative	0	Until Dry	?	Start preventative sprays early when conditions favor disease development. Spray on a 5-10 day schedule with thorough coverage.
Oxidate 5.0 (hydrogen peroxide, peroxyacetic acid)	1:256 dilution	0	Until Dry	1	Apply at first sign/symptom of disease. Maintain a 3-10 day spray schedule until control is achieved.
PerCarb (sodium carbonate peroxyhydrate)	1-3 lb/100 gal water	0	Until Dry	?	See label for specific application volumes.
PerCarb (sodium carbonate peroxyhydrate)	3-4 lb/100 gal water dormant spray	0	Until Dry	?	Apply in early and late dormancy prior to bud break. Do not apply to blooming crops. See label for specific application volumes.
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Curative	-	Until Dry	?	See label for specific, curative or preventative, use directions.
PERpose Plus (hydrogen peroxide)	0.25-0.33 fl oz/gal Preventative	-	Until Dry	?	See label for specific, curative or preventative, use directions.
ProBlad Verde (Banda de Lupinus albus doce (BLAD))	18.1-45.7 fl oz/acre	1	4	2	Requires 2-4 hours drying time on plant foliage for the active ingredient to be fixed into the plant tissue before rain or irrigation occurs.
PureSpray Green (white mineral oil)	0.5-2 gal/acre	see comment	4	1	Do not apply sulfur within 10 days of an oil application. Table grapes must not be sprayed within 2 weeks of harvest. Do not use copper and oil together with fruit present. Do not tank-mix oil and copper more than once/season. All other grapes can be sprayed up to day of harvest.
Quimag Quimicos Aguila Copper Sulfate Crystal (copper sulfate pentahydrate)	4-8 lb/100 gal water	-	48	?	Dormant application. Apply prior to bud swell in the spring before any green tissue is present. Thoroughly wet the dormant vine.
Regalia (Reynoutria sachalinensis)	1-4 qt/acre	0	4	1	
Regalia CG (Reynoutria sachalinensis)	1-4 qt/acre foliar spray	0	4	?	
Romeo (Saccharomyces cerevisiae)	0.23 lb/acre	0	4	2	
Serenade ASO (Bacillus subtilis str QST 713)	2-4 qt/acre	0	4	3	Has relatively little residual activity and must be reapplied frequently, even if it does not rain.
Serenade MAX (Bacillus subtilis str QST 713)	1-3 lb/acre	0	4	3	Has relatively little residual activity and must be reapplied frequently, even if it does not rain.
Serenade Opti (Bacillus subtilis str QST 713)	14-20 oz/acre	0	4	2	Apply in sufficient water to provide full coverage.
Serifel (Bacillus amyloliquefaciens str. MBI 600)	4-16 oz/acre	0	4	?	

Table 7.6.5 Pesticides Labeled for Management of Powdery Mildew

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Sil-Matrix (potassium silicate)	0.5-1% solution	0	4	?	Mix 2-4 qts in 100 gallons of water and apply at 20 gallons finished spray/acre.
Sil-Matrix LC (potassium silicate)	1-4 qt/100 gal water	UDH	4	1	Mix 1-4 qts in 100 gallons of water and apply at 50-250 gallons finished spray/ac.
Solawit 80DF (sulfur)	3-10 lb/acre	-	24	?	Do not apply if temperatures during or within 3 days after application are expected to exceed 90°F. Do not use within 2 weeks of an oil spray except for dormant, delayed dormant or post-harvest applications.
Sporan EC2 (rosemary oil, clove oil, peppermint oil, thyme oil)	1.5-3 pt/acre	0	-	?	
Stargus (Bacillus amyloliquefaciens str. F727)	1-4 qt/100 gal water	0	4	1	
SuffOil-X (mineral oil)	1-2 gal/100 gal water	UDH	4	1	Do not mix with sulfur products. Although all oil products have not been tested, each works in the same general way.
Sulfur 80 WDG (sulfur)	2-10 lb/acre	-	24	?	
Taegro 2 (Bacillus subtilis var. amyloliquefaciens str. FZB2)	2.6-5.2 oz/acre	-	4	?	Suppression only.
TerraNeem EC (cold pressed neem oil)	1-1.5% solution	0	4	?	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.
Thiolux (sulfur)	3-10 lb/acre	-	24	1	
Triathlon BA (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	?	
Trilogy (neem oil)	0.5-1% solution.	UDH	4	1	Do not use after bloom on table grapes or following bunch closure on wine grapes. The maximum labeled rate is 2 gal/acre /application. Although all oil products have not been tested, each works in the same general way.
TriTek (mineral oil)	1-2 gal/100 gal water	UDH	4	1	Although all oil products have not been tested, each works in the same general way.
Ultra-Pure Oil (mineral oil)	0.5-2 gal/acre	see comment	4	2	Do not apply sulfur within 10 days of an oil application. Pre-harvest interval is 60 days for table grapes; up to day of harvest for others.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI – pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.7 Other Diseases of Note

7.7.1 ANTHRACNOSE *Elsinoë ampelina*

Anthracnose is a disease that occurs primarily in very wet years, with damage typically being limited to a few highly susceptible cultivars. In NY, most outbreaks have occurred on 'Vidal blanc' and a few minor seedless table grape varieties, especially 'Reliance'. There is also some indication that the new cold-hardy cultivar La Crescent may be in this category. Symptoms occur on leaves, green shoots, and clusters. On leaves, numerous small, circular brown spots appear, which later turn gray in the center and develop dark brown to black margins. In severe attacks, lesions may coalesce and cause distortion of the leaf blade and eventually death of the entire leaf. Infected shoots develop dark, noticeably sunken lesions; a slightly raised area may form around the margins of the lesions, whose centers may extend into the pith of the shoots. Severely infected shoots are often stunted. On berries, spots approximately 1/4-inch in diameter develop, with whitish-gray centers surrounded by reddish brown to black margins, producing an appearance that superficially resembles a bird's eye. Sometimes, severely affected berries may shrivel and dry into mummies.

The fungus overwinters primarily on infected canes. In spring, spores are produced from the overwintering fungal structures and are dispersed by splashing raindrops to young, susceptible tissues. Infection can occur across a wide range of temperatures, but temperatures in the mid-70's to low 80's (°F) are optimal. Additional spores, which also are splash-dispersed, are produced upon new infections, and these can rapidly spread the disease through multiple repeating cycles of new infection and additional spore production. Hence, outbreaks occur most frequently in years with multiple rain events throughout the season.

Fungal inoculum to start the disease cycle comes primarily from infected canes. Diseased canes should be pruned during the dormant season and removed from the vineyard or destroyed. If numerous infected berries remain on the vineyard floor, the spores originating from them can be largely negated by covering the berries with soil through cultivation or, if practical, covering them with mulch. A "delayed dormant" application of lime sulfur can be useful in organic vineyards to limit production of infectious spores from overwintered cankers in susceptible varieties or where the disease has become established.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.7.1 Pesticides Labeled for Management of Anthracnose

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Carb-o-nator (potassium bicarbonate)	2.5-5 lb/100 gal water	0	4	?	
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	?	
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Curative	-	Until Dry	?	See label for specific, curative or preventative, use directions.
PERpose Plus (hydrogen peroxide)	0.25-0.33 fl oz/gal Preventative	-	Until Dry	?	See label for specific, curative or preventative, use directions.
ProBlad Verde (Banda de Lupinus albus doce (BLAD))	18.1-45.7 fl oz/acre	1	4	?	Requires 2-4 hours drying time on plant foliage for the active ingredient to be fixed into the plant tissue before rain or irrigation occurs.
Stargus (Bacillus amyloliquefaciens str. F727)	1-4 qt/100 gal water	0	4	?	
Trilogy (neem oil)	0.5-1% solution.	UDH	4	?	Do not use after bloom on table grapes or following bunch closure on wine grapes. The maximum labeled rate is 2 gal/acre /application.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI – pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.7.2 ANGULAR LEAF SCORCH *Pseudopezicula tetraspora*

Angular leaf scorch was first described in 1985. Symptoms of this fungal disease are similar to those of rotbrenner, a disease of grapevines found in the cool grape-growing regions of Europe, which is caused by a very closely related fungus. Angular leaf scorch occurs sporadically and is seldom destructive, but is most likely to become a problem in years when high rainfall occurs during early shoot growth.

Disease symptoms occur mainly on the leaves and first appear as faint chlorotic spots. As these lesions grow larger, they change from yellow to reddish-brown and the margin often becomes pronounced (depending on the variety, the margin may be yellow, red, or absent). Lesions are confined by major veins, becoming "angular" or wedge-shaped. They eventually kill the tissue, often causing infected leaves to fall prematurely.

The fungus survives winter in infected leaves on the vineyard floor. Mature spores are ready for discharge in spring when grape buds begin to grow. During rainfall, spores are released into the air from fruiting structures, and susceptible tissue is infected.

Cultural practices that increase air circulation through the canopy can shorten the periods of leaf wetness that favor disease development. Destruction of leaf litter by cultivation, before bud break, can also reduce disease pressure. Conventional fungicides applied before rainfall, beginning about the 3-inch stage and continuing through fruit set have provided good control, but there are no data on the efficacy of organically approved products. See Table 7.5.1 for varietal susceptibility to this disease. Varieties with the least susceptibility include Catawba, Delaware, Dutchess, Foch, Fredonia, Gewürztraminer, Himrod, Ives, Niagara, and Vidal blanc.

IPM fact sheet Angular Leaf Scorch of Grape.

7.7.3 CROWN GALL *Agrobacterium vitis*

Crown gall is a bacterial disease whose characteristic symptom is fleshy galls produced mostly on the lower trunk, but which may form anywhere on the trunks where injuries occur. Large galls may develop rapidly and completely girdle young vines in one season. Galled vines frequently produce inferior shoot growth, and portions of the vine above the galls may die. Current-season galls are first apparent in early summer as white, fleshy, callus growth. Galls turn brown by late summer, and in the fall, become dry and corky.

The crown gall bacterium is systemically present in the vast majority of grape vines, but seldom causes disease unless the vine is injured. Budding and grafting cause injuries that occasionally elicit disease development at those wounding sites, as does "tractor blight", but cold injury is by far the most important factor in the Northeast. Therefore, management practices that minimize the risk of cold injury are currently the only practical technique for managing the disease. These include careful site selection for cold-sensitive varieties and cultural practices that promote winter hardiness. Hilling above the union of grafted vines protects buds from freezing and ensures the development of new scion shoots that may be needed for trunk renewal. The use of multiple-trunk vines and regular replacement of diseased or dead trunks with renewals helps to manage the disease at a tolerable level. See Table 7.5.1 for varietal susceptibility to this disease. Varieties with the least susceptibility include Cascade, Catawba, Concord, Corot noir, Delaware, Elvira, Einset Seedless, Foch, Fredonia, Frontenac, Frontenac gris, Frontenac Blanc, Geneva Red, Itasca, Ives, La Crescent, Marquette, Melody, Steuben, Traminette, Valvin Muscat, Vanessa, and Ventura.

IPM fact sheet Grape Crown Gall.

7.7.4 EUTYPA DIEBACK *Eutypa lata*

Eutypa dieback is a fungal disease appearing as cankers on trunks and arms of infected grapevines. New shoots above cankers often appear stunted, with shortened internodes and small, cupped, greenish-yellow leaves in the spring. (Such symptoms on new shoots superficially resemble those caused by Roundup and similar herbicides.) Healthy shoots usually overgrow and obscure affected shoots by early- to midsummer. Shoot and leaf symptoms become progressively worse each season until, eventually, the entire portion of the trunk or arm above the canker dies.

In winter or early spring, during rainfall or snowmelt, fungal spores are released from fruiting structures on the dead, infected wood of the cankers. Spores are dispersed by the wind and infection occurs when they enter fresh pruning wounds. Cankers and foliage symptoms are not evident until 2 to 4 years after infection; then, vine deterioration continues until the trunk or arm is finally killed.

Infected arms or trunks should be removed in late spring when foliar symptoms are noticeable and the resultant wounds remain susceptible for a more limited period of time than if made earlier. Pruning should be at least 6 inches below any dead or discolored wood associated with the canker. Any infected wood or stumps should, at the very least, be removed from the vineyard, and burned or buried if practical. See Table 7.5.1 for varietal susceptibility to this disease. Varieties with the least susceptibility include Catawba, Cayuga White, Delaware, Dutchess, Elvira, Geneva Red, Niagara, Rougeon, Seyval, and Vidal blanc.

IPM fact sheet Eutypa Dieback.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.7.4 Pesticides Labeled for Management of Eutypa Dieback

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Double Nickel 55 (Bacillus amyloliquefaciens str. D747)	See comments	0	4	?	Mix 1 fl oz Double Nickel 55 per gallon of water and apply to pruning wounds. Major pruning wounds are susceptible to infection during rains that occur soon after pruning.
Double Nickel LC (Bacillus amyloliquefaciens str. D747)	See comments	0	4	?	Major pruning wounds are susceptible to infection during rains that occur soon after pruning. Mix 2 fl oz Double Nickel LC per gallon of water and apply to pruning wounds.
Serenade ASO (Bacillus subtilis str QST 713)	2-4 qt/acre	0	4	?	
Serenade MAX (Bacillus subtilis str QST 713)	See comments	0	4	?	Major pruning wounds are susceptible to infection during rains that occur soon after pruning. 2 to 5% v/v solution applied to pruning wounds.
Serifel (Bacillus amyloliquefaciens str. MBI 600)	4-16 oz/acre	0	4	?	
Timorex Act (tea tree oil)	13-35 fl oz/acre	2	4	?	
Triathlon BA (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	?	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI – pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.7.5 SOUR ROT

Sour rot develops on injured berries at around 15° Brix when prolonged wet weather and relatively warm (above 60°F, optimum 68-77°F) conditions occur. Wild yeasts producing ethanol from the sugars in the injured berries and acetic acid bacteria utilizing the ethanol, generate the characteristic vinegar smell from which the disease gets its name. Numerous *Drosophila* spp. Fruit flies (commonly called vinegar flies), including *D. melanogaster* and *D. suzukii* (spotted wing drosophila), are attracted to the sour rot odors from infected fruit clusters and may lay eggs within them, enhancing disease expression.

Diseased berries drip juice laden with sour rot microbes onto nearby healthy berries, which in turn become infected through any wounds that might be available (rain cracks, bird or insect damage, Botrytis or powdery mildew infections, etc). The Drosophila insects play a central role in the full development of the disease and furthermore contribute to spread of the sour rot microbes throughout the vineyard.

Although it is almost impossible to stop sour rot once it has become established under wet and warm conditions, controlling other causes of berry injury beforehand will greatly reduce the probability of disease getting started in the first place. Mechanical injuries caused as swelling berries pull away from their stems in tightly compacted bunches are among the many injury sites in which sour rot can become established. Open canopies and leaf removal around clusters will promote faster drying after rains have stopped and can lower disease severity significantly.

Recent research suggests that disease development can be reduced through a combination of insecticide sprays to reduce Drosophila populations (see section 7.10.17) and a broad-spectrum sterilant (e.g., Oxidate) to limit microbial populations on the berries. This program is most effective if started around 15° Brix, when berries become susceptible and before symptoms develop, but it also can reduce further spread if initiated immediately after the disease is noticed through scouting activities.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.7.5 Pesticides Labeled for Management of Sour Rot

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Double Nickel 55 (Bacillus amyloliquefaciens str. D747)	0.25-3 lb/acre	0	4	?	
Double Nickel LC (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	?	
Falgro 4L (gibberillic acid)	0.4-16 grams AI/acre	0	4	?	Growth regulator. Affects stretching, thinning and sizing of clusters which may help reduce sour rot. Rate varies depending on goals and grape varieties.
GibGro 4LS (gibberillic acid)	0.4-16 grams AI/acre	-	4	?	Growth regulator. Affects stretching, thinning and sizing of clusters which may help reduce sour rot. Rate varies depending on goals and grape varieties.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	128 fl oz/100 gal water curative	0	Until Dry	?	Apply at first sign of disease. Continue with consecutive applications until control is achieved or use when conditions favor rapid disease development.
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	32-64 fl oz/100 gal water preventative	0	Until Dry	?	Start preventative sprays early when conditions favor disease development. Spray on a 5-10 day schedule with thorough coverage.
Oxidate 5.0 (hydrogen peroxide, peroxyacetic acid)	1:256 dilution	0	Until Dry	2	Apply at first sign/symptom of disease. Maintain a 3-10 day spray schedule until control is achieved.
ProGibb LV PLUS (gibberillic acid)	See comments	0	4	?	Growth regulator. Affects stretching, thinning and sizing of clusters which may help reduce Botrytis bunch rot. Rate varies depending on goals and grape varieties. See label for details.
Regalia (Reynoutria sachalinensis)	1-4 qt/acre	0	4	?	
Regalia CG (Reynoutria sachalinensis)	1-4 qt/acre foliar spray	0	4	?	
Romeo (Saccharomyces cerevisiae)	0.23 lb/acre	0	4	?	
Serenade ASO (Bacillus subtilis str QST 713)	2-4 qt/acre	0	4	2	
Serenade MAX (Bacillus subtilis str QST 713)	1-3 lb/acre	0	4	?	
Serenade Opti (Bacillus subtilis str QST 713)	14-20 oz/acre	0	4	2	Apply in sufficient water to provide full coverage.
TerraNeem EC (cold pressed neem oil)	1-1.5% solution	0	4	2	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.
Timorex Act (tea tree oil)	13-35 fl oz/acre	2	4	?	
Triathlon BA (Bacillus amyloliquefaciens str. D747)	0.5-6 qt/acre	0	4	?	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.7.6 SUMMER ROTS

Summer Rots is a name sometimes used for two similar diseases (ripe rot and bitter rot) common in more southern, humid production regions, although they occasionally occur in NY and PA (especially southeast PA). Bitter rot is the more regular threat in the mid-Atlantic region, but appears to occur only sporadically in NY, presumably due to the somewhat cooler temperatures farther north.

Bitter rot, *Melanconium fuligineum*, symptoms usually first occur after veraison, as the bitter rot fungus moves into the berry from the pedicel and turns the diseased portion brown (on white varieties) or a dull purple. Once the berry is completely rotted, it becomes covered with numerous raised black pustules (the fungal fruiting bodies, called acervuli). Within a few days, diseased berries soften and may drop; others shrivel into firmly attached mummies that resemble those caused by black rot and Phomopsis.

Bitter rot and black rot can be distinguished by (i) fungal fruiting bodies of bitter rot are irregular and variable in size, often larger and more pronounced, whereas those on black-rot-infected fruit are relatively small, round and uniform in size; (ii) the tendency of fruit infected with bitter rot to leave hands sooty black if handled when wet (whereas those infected with black rot will leaves hands clean); and (iii) bitter rot infections develop after veraison, those of black rot before veraison.

Berries infected with Phomopsis also tend to appear during the pre-harvest period rather than after veraison. And, compared to bitter rot, significant Phomopsis fruit rot typically occurs in association with significant infections of the rachis, and of the shoots and petioles (leaf stems) near the bottom three to five leaf positions on the shoots bearing the diseased berries. An absence of these other symptoms suggests that Phomopsis is not the cause of multiple berry infections.

The bitter rot fungus colonizes dead tissues of the grapevine (fallen leaves and berries, damaged shoots, necrotic bark), where it overwinters and produces spores the following spring. After flowering, some spores are moved by splashing raindrops onto the pedicels (stems) of the developing berries, where they germinate and cause latent (dormant) infections. When the berries mature, the fungus grows into them, causing the fruit to rot. The acervuli that cover the diseased berries contain abundant, black spores, which are spread to and infect healthy berries during subsequent rains. Infection occurs through any type of injury, including rain cracking, insect damage, or bird injury. Temperatures of approximately 82-86°F are optimal for infection.

Ripe rot, *Colletotrichum* spp., tends to predominate further south, although it has been documented as far north as New England. Symptoms do not develop until after veraison and become increasingly prevalent by harvest. Infected fruit initially develop circular, reddish brown lesions on their skin, which eventually expand to affect the entire berry. Under humid conditions, small "dots" of slimy, salmon-colored spores may develop across the rotten berry, and serve to spread the disease to healthy fruit if rains continue. Infected fruit shrivel and mummify, and may either remain attached or fall to the ground. No foliar symptoms are produced.

The ripe rot fungus overwinters in mummified fruit, infected pedicels, and dead bark and cankers. Spores are produced from these sites in the spring and are distributed by splashing and blowing rain. Fruit may be infected at any stage of their development, but infections remain latent until the berries begin to ripen. During warm rainy periods (77-86°F is optimum), the salmon-colored spores produced upon diseased fruit can spread the disease to healthy berries, which become increasingly susceptible to infection as they ripen. Frequent rains during the pre-harvest period can result in severe crop loss once the disease becomes active, especially if it is not managed.

Summer rots are favored by abundant, warm rains between veraison and harvest, although initial infections can occur much earlier and remain latent until this time. Cultural practices, such as pruning out dead spurs, removing overwintered mummies, and removing weak or dead cordons, are important to help reduce the inoculum in the vineyard. Sanitation through removal of mummies from the vine during dormant pruning, as for black rot, helps in their management. Susceptibility to both diseases increases with fruit maturity, so fruit become especially vulnerable when harvest is delayed. Timely harvest of ripe fruit is an essential component of disease management. Hybrids are generally more resistant to bitter rot than are varieties of Vinifera. There is little information on the relative susceptibility of specific varieties of Vinifera, Labrusca, or hybrids to ripe rot.

Both diseases are frequently controlled in the early- to mid-summer by fungicide sprays targeted against other diseases, such as downy mildew. Sprays targeted against bitter rot and/or ripe rot may be needed in the late season if the weather is warm and wet, especially if the diseases are observed in the vineyard or have occurred there in the past. In southerly regions where the diseases are consistent problems, it is typically necessary to apply protectant fungicides on a 2-week schedule from bloom until harvest, except during periods of drought. Because fruit are especially vulnerable in their final stages of ripening, pre-harvest sprays are particularly important where these diseases are active.

7.8 Insect and Mite Management

Many insects found in the vineyards of New York, while having the capacity to cause economic damage, do not occur on a yearly basis at damaging levels and therefore are considered minor pests. The several species that are considered major pests also vary both from year to year and from vineyard site to vineyard site. For these reasons it is important to be familiar with the life cycle of the pest to assist in developing a scouting program that will ensure a pest problem can be discovered and dealt with before it becomes an outbreak. Alternatively, it's important to know when a potential pest is not causing significant economic damage so that unnecessary controls can be avoided. Applying an organically approved broad-spectrum insecticide such as PyGanic EC (a pyrethrum) when not necessary, for example, is not only a waste of

money but also has the potential to disrupt biological control by beneficial organisms. This illustrates the need to take potential biological control agents (predators, parasitoids, parasites, microbes) into account when making management decisions. Following are descriptions of the most commonly found insect pests in vineyards.

7.9 Insects and Mites of Primary Concern

7.9.1 GRAPE BERRY MOTH

Grape berry moth is one of the most serious insect pests affecting grapes in New York and Pennsylvania as well as other grape growing areas in the Eastern USA. There are two to four generations of moths per season. Overwintered pupae emerge as adult moths in late May and lay eggs among the grape clusters. The larvae are small (up to 4/10-inch long) and feed internally in grape berries. External signs of moth feeding are the silk webs that tie several berries together. The larvae pupate inside pieces of leaf material generally under the vine, emerging as adult moths (wingspan is 1/2 inch). Bulletin 138 covers the risk assessment protocol in detail.

IPM fact sheet: Grape Berry Moth.
Grape Berry Moth Scouting Form.

Grape Berry Moth Management Options	
Scouting/thresholds	Follow guidelines in Bulletin 138 *Risk Assessment of Grape Berry Moth and Guidelines for Management of Eastern Grape Leafhopper*. Grape berry moth Scouting form.
Resistant varieties	None, but damage from grape berry moth can promote bunch rot and other diseases and this can be more severe in tight-clustered varieties.
Cultural management	***Mating disruption***. May prove effective in low-pressure situations. See Bulletin 135 *Pheromonal control of the grape berry moth: an effective alternative to conventional insecticides.* ***Vineyard management***. Avoid sites prone to heavy snowfall or those surrounded by wooded areas. Where possible, plant rows parallel to wooded edges to allow for spot treatment of outside 6 rows.
Chemical treatment	Bt and some other organic insecticides typically have relatively short residual activity and hence, may work better if applied twice per generation, space about 7 days apart.

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Table 7.9.1 Pesticides Labeled for Management of Grape Berry Moth

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	0	12	?	See container label for specific rates used.
Biobit HP (Bacillus thuringiensis, var. kurstaki)	1/2-1 lb/acre	0	4	?	
Bioprotec Plus (Bacillus thuringinensis subsp. Kurstaki)	1-2 pts/acre	0	4	1	Start applications before egg hatch and after seeing adult flight.
BT NOW (Bacillus thuringinensis subsp. Kurstaki)	1-3 pts/acre	0	4	?	Start applications before egg hatch and after seeing adult flight.
Cinnerate (cinnamon oil)	13-35 fl oz/100 gal water	0	-	?	25(b) pesticide. Conduct phytotoxicity test prior to application. See label for specific application volumes.

Table 7.9.1 Pesticides Labeled for Management of Grape Berry Moth

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Deliver (Bacillus thuringiensis, var. kurstaki)	0.5-1.5 lb/acre	0	4	1	
Dipel DF (Bacillus thuringinensis subsp. Kurstaki)	0.5-2 lb/acre	0	4	1	
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide. Target small caterpillars.
Ecotrol Plus (rosemary oil, peppermint oil, geraniol)	1-4 pts/acre	0	-	?	25(b) pesticide. Target small caterpillars.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Entrust (spinosad)	1.25-2.5 oz/acre	7	4	1	Target eggs at hatch or small larvae.
Entrust SC (spinosad)	4-8 fl oz/acre	3	4	1	
Grandevo CG (Chromobacterium subtsugae str. PRAA4-1)	1.5-4.25 Tbsp/1000 sq ft	0	4	?	
Grandevo WDG (Chromobacterium subtsugae str. PRAA4-1)	1-3 lb/ac	0	4	?	
Javelin WG (Bacillus thuringiensis, var. kurstaki)	0.5-1.25 lb/acre	0	4	1	
Molt-X (azadirachtin)	8 oz/acre	0	4	?	
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	
TerraNeem EC (cold pressed neem oil)	0.5-1.5% solution	0	4	?	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.
Venerate XC (Burkholderia spp. str A396)	1-2 qt/acre	0	4	1	In New York State, application is prohibited within 100 feet of any surface water.
XenTari (Bacillus thuringiensis, var. aizawai)	0.5-2 lb/acre	0	4	?	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.9.2 GRAPE LEAFHOPPERS

Grape leafhoppers 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 degree-day accumulations, one to two generations occur. Rapid population increases are most likely in hot, dry years. 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. A moderate infestation of grape leafhopper does not affect yield and quality significantly.

The species of leafhopper found on Labrusca-type varieties differs from those found on hybrids and Vinifera grapes. The Eastern grape leafhopper, *Erythroneura comes*, is found on Labrusca varieties such as Concord, Niagara, Catawba, Delaware, and other Labrusca varieties. Hybrids and Vinifera grapes are infested by other Erythroneura leafhopper species, principally *E. bistrata*.

IPM fact sheet: Grape Leafhopper.
Leafhopper Scouting Form.

Grape Leafhopper Management Options	
Scouting/thresholds	Follow guidelines in Bulletin 138 *Risk Assessment in Grape Berry Moth and Guidelines for Management of Eastern Grape Leafhopper*. Leafhopper Scouting Form.
Resistant varieties	None.
Cultural management	None.
Chemical treatment	No research data available.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.9.2 Pesticides Labeled for Management of Grape Leafhoppers

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Acti-Min FE Crop Protectant (kaolin)	12.5-37.5 lb/acre	up to harvest	4	1	Suppression only. Wine grapes only.
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	1	
AzaGuard (azadirachtin)	10-16 fl oz/acre	0	4	1	Apply with OMRI approved spray oil.
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	0	12	1	See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
BioRepel (garlic oil)	1 part BioRepel/100 parts water	-	-	?	25(b) pesticide.
Cinnerate (cinnamon oil)	13-35 fl oz/100 gal water	0	-	?	25(b) pesticide. Conduct phytotoxicity test prior to application. See label for specific application volumes.
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide.
Ecotrol Plus (rosemary oil, peppermint oil, geraniol)	1-4 pts/acre	0	-	?	25(b) pesticide.
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	1	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.

Table 7.9.2 Pesticides Labeled for Management of Grape Leafhoppers					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Glacial Spray Fluid (mineral oil)	1-2 gal/100 gal water	UDH	4	?	
Grandevo CG (Chromobacterium subtsugae str. PRAA4-1)	3-4.25 Tbsp/1000 sq ft	0	4	?	
Grandevo WDG (Chromobacterium subtsugae str. PRAA4-1)	2-3 lb/ac	0	4	?	
JMS Stylet-Oil (mineral oil)	1-2 gal/100 gal water	see comment	4	3	Do not apply sulfur within 10 days of an oil application. Although all oil products have not been tested, each works in the same general way. Pre harvest interval is 14 days for table grapes; 0 for others.
Molt-X (azadirachtin)	10 oz/acre	0	4	1	
M-Pede (insecticidal soap)	1-2% vol/vol solution	0	12	1	
Mycotrol ESO (Beauvaria bassiana)	0.25-1 qt/acre	0	4	?	
Neemix 4.5 (azadirachtin)	7-16 oz/acre	0	4	1	
PureSpray Green (white mineral oil)	0.5-2 gal/acre	see comment	4	?	Pre harvest interval is 14 days for table grapes; up to day of harvest for others. Do not apply within 10 days of a sulfur application. Do not use copper and oil together with fruit present. Do not tank-mix oil and copper more than once/season.
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	1	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	1	
Safer Brand #567 II (potassium laurate, pyrethrins)	6.4 oz/gal water applied at 1 gal mix/ 700 sq ft	Until Dry	12	1	
SuffOil-X (mineral oil)	1-2 gal/100 gal water	UDH	4	?	Do not mix with sulfur products.
Surround WP (kaolin clay)	12.5-50 lb/acre	UDH	4	1	Table grapes cannot be sprayed from first bloom until harvest. Reapplication is necessary after rain events.
TerraNeem EC (cold pressed neem oil)	0.5-1.5% solution	0	4	?	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.
TriTek (mineral oil)	1-2 gal/100 gal water	UDH	4	?	
Ultra-Pure Oil (mineral oil)	0.5-2 gal/acre	see comment	4	2	Do not apply sulfur within 10 days of an oil application. Pre-harvest interval is 60 days for table grapes; up to day of harvest for others.

Table 7.9.2 Pesticides Labeled for Management of Grape Leafhoppers					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Venerate XC (Burkholderia spp. str A396)	1-2 qt/acre	0	4	?	In New York State, application is prohibited within 100 feet of any surface water.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.9.3 JAPANESE BEETLES

Japanese beetles are distinguished by a metallic green abdomen and copper outer wings. Tufts of white hairs are arranged along the side of the 1/2-inch body and behind the wing tips. Adults cause damage by feeding on the foliage and occasionally the berries. There is one generation per year, with the peak of adult activity occurring in midsummer. Vines with smooth, thin leaves are most susceptible to Japanese beetle attack, as are vineyards adjacent to pasture or sod fields. Young vines, especially those in grow tubes, should be monitored closely to prevent excessive damage.

Japanese Beetles Management Options	
Scouting/thresholds	Young vines, especially those in grow tubes, should be monitored closely to prevent excessive damage.
Resistant varieties	Varieties with smooth, thin leaves are most susceptible to Japanese beetle attack.
Cultural management	***Vineyard management***. Avoid sites adjacent to pasture or sod fields.
Chemical treatment	No research data available.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.9.3 Pesticides Labeled for Management of Japanese Beetles					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Acti-Min FE Crop Protectant (kaolin)	12.5-37.5 lb/acre	up to harvest	4	?	Suppression only. Wine grapes only.
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	2	
AzaGuard (azadirachtin)	8-16 fl oz/acre	0	4	2	Apply with OMRI approved spray oil.
*AzaSol (azadirachtin)	6 oz/acre	0	4	2	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	0	12	2	See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
DEsect CROP (silicon dioxide)	1 lb/1000 sq ft	-	12	?	
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide.
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (See comment)	4	2	For applications the day of harvest, crop can be harvested as soon as spray has dried.

Table 7.9.3 Pesticides Labeled for Management of Japanese Beetles					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Grandevo CG (Chromobacterium subtsugae str. PRAA4-1)	3-4.25 Tbsp/1000 sq ft	0	4	?	Suppression only.
Grandevo WDG (Chromobacterium subtsugae str. PRAA4-1)	2-3 lb/ac	0	4	?	Suppression only.
Molt-X (azadirachtin)	8 oz/acre	0	4	2	
Neemix 4.5 (azadirachtin)	7-16 oz/acre	0	4	?	
PFR-97 20% WDG (Isaria fumosorosea Apopka str. 97)	1-2 lb/acre soil treatment	-	4	?	
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	2	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	2	
Safer Brand #567 II (potassium laurate, pyrethrins)	6.4 oz/gal water applied at 1 gal mix/ 700 sq ft	Until Dry	12	3	
Surround WP (kaolin clay)	12.5-50 lb/acre	UDH	4	?	Suppression only. Table grapes cannot be sprayed from first bloom until harvest. Infestations can be sprayed up to first bloom and again after harvest.
TerraNeem EC (cold pressed neem oil)	0.5-1.5% solution	0	4	?	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.9.4 POTATO LEAFHOPPER

Potato leafhopper are a sporadic but sometimes locally serious pest of grapes. Unlike grape leafhoppers, potato leafhoppers cannot overwinter in northern latitudes due to the cold winters. Each spring, however, large numbers of adults migrate north and colonize a number of different plant species, including grapes. Adult potato leafhoppers are wedge-shaped and iridescent green, while the nymphs are usually bright green. The nymphs, generally found on the undersides of leaves, walk in a sideways manner that helps distinguish them from other leafhopper species.

Both adults and nymphs feed by sucking sap from the vascular system of grape leaves. They also inject a salivary toxin that produces characteristic symptoms including leaves with yellow margins that are cupped downwards. A low infestation of potato leafhopper does not affect fruit quality or yield.

Potato Leafhopper Management Options	
Scouting/thresholds	None.
Resistant varieties	Observations indicate thin-leafed varieties including Cayuga White and Vinifera varieties develop obvious symptoms and may be more susceptible.

Cultural management	Vines adjacent to alfalfa more prone to problems, especially after alfalfa is cut.
Chemical treatment	No research data available.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.9.4 Pesticides Labeled for Management of Potato Leafhoppers

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Acti-Min FE Crop Protectant (kaolin)	12.5-37.5 lb/acre	up to harvest	4	?	Suppression only. Wine grapes only.
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
AzaGuard (azadirachtin)	10-16 fl oz/acre	0	4	?	Apply with OMRI approved spray oil.
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	0	12	?	See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
BioRepel (garlic oil)	1 part BioRepel/100 parts water	-	-	?	25(b) pesticide.
Captiva Prime (garlic oil, capsicum oleoresin extract, canola oil)	1-2 pt/acre	0	4	?	
Cinnerate (cinnamon oil)	13-35 fl oz/100 gal water	0	-	?	25(b) pesticide. Conduct phytotoxicity test prior to application. See label for specific application volumes.
Damoil (mineral oil)	1-3 gal/acre	-	4	?	Dormant and summer use. Do not apply this product within 2 days of harvest of grapes intended for fresh market for suppression of leafhopper or mites
DES-X (insecticidal soap)	2% solution sprayed at 75-200 gallons/acre	1/2	12	?	
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide.
Ecotrol Plus (rosemary oil, peppermint oil, geraniol)	1-4 pts/acre	0	-	?	25(b) pesticide.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Glacial Spray Fluid (mineral oil)	1-2 gal/100 gal water	UDH	4	?	See label for specific application volumes.

Table 7.9.4 Pesticides Labeled for Management of Potato Leafhoppers

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
JMS Stylet-Oil (mineral oil)	1-2 gal/100 gal water	see comment	4	2	Do not apply sulfur within 10 days of an oil application. Pre harvest interval is 14 days for table grapes; 0 for others.
KOPA Insecticidal Soap (potassium salts of fatty acids)	2 gal/100 gal water	1/2	12	2	See label for specific application volumes.
Molt-X (azadirachtin)	10 oz/acre	0	4	?	
M-Pede (insecticidal soap)	1-2% vol/vol solution	0	12	2	
Mycotrol ESO (Beauvaria bassiana)	0.25-1 qt/acre	0	4	?	
Neemix 4.5 (azadirachtin)	7-16 oz/acre	0	4	?	
PureSpray Green (white mineral oil)	0.5-2 gal/acre	see comment	4	?	Pre harvest interval is 14 days for table grapes; up to day of harvest for others. Do not apply within 10 days of a sulfur application. Do not use copper and oil together with fruit present. Do not tank-mix oil and copper more than once/season.
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	2	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	2	
Safer Brand #567 II (potassium laurate, pyrethrins)	6.4 oz/gal water applied at 1 gal mix/ 700 sq ft	Until Dry	12	2	
SuffOil-X (mineral oil)	1-2 gal/100 gal water	UDH	4	?	Do not mix with sulfur products.
Surround WP (kaolin clay)	12.5-50 lb/acre	UDH	4	2	Table grapes cannot be sprayed from first bloom until harvest. Infestations can be sprayed up to first bloom and again after harvest.
TerraNeem EC (cold pressed neem oil)	0.5-1.5% solution	0	4	?	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.
TriTek (mineral oil)	1-2 gal/100 gal water	UDH	4	?	
Ultra-Pure Oil (mineral oil)	0.5-2 gal/acre	see comment	4	?	Do not apply sulfur within 10 days of an oil application. Pre-harvest interval is 60 days for table grapes; up to day of harvest for others.
Venerate XC (Burkholderia spp. str A396)	1-2 qt/acre	0	4	?	In New York State, application is prohibited within 100 feet of any surface water.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.9.5 SPIDER MITES

Spider mites are small, eight-legged, plant-feeding arthropods related to spiders. Two species of spider mites can be encountered in New York vineyards. The European red mite is the more common species. Adult mites are dark red in color. When viewed with a hand lens, the mites appear hairy because they have white spines called "setae." Nymphs range in color from pale to dark orange. Both adults and nymphs pierce the leaf cells and extract plant juices. This leads to the characteristic bronze coloration, which impairs the photosynthetic capacity of the leaf. The European red mite overwinters in the egg stage, generally located in crevices in bark on two-year old and older wood. Two-spotted spider mites are often found in mixed populations with European red mites. Two-spotted spider mites are light in color with two black spots on their backs. They overwinter as adult females off of the grapevine and therefore must colonize vines each year.

Vinifera and hybrid varieties appear to be the most susceptible to infestations, although American varieties can also develop large densities under some conditions. European red mites may be found on the upper or lower leaf surface while two-spotted spider mites are normally found on the underside of the leaf. Four to nine generations occur in a season. Susceptible vineyards in production areas prone to damaging infestations should be monitored, starting at the bud break stage, for presence of this pest. Although problems can develop at any time after bud break, pay particular attention to the 1- to 4-inch growth stage and the postbloom period, especially after early July. Given a head start, the vine can tolerate a fair amount of feeding damage on lower leaves. Heavy mite infestations 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. Infestations can be severe on Long Island and in southeastern Pennsylvania vineyards. 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. Predatory mites, when present in the vineyard at sufficient densities, can provide excellent biological control of spider mites.

Spider Mite Management Options	
Scouting/thresholds	At bud break, start monitoring vineyards prone to infestations for presence of mites, especially European red mite. Monitoring is especially important at the 1- to 4-inch growth stage and the post-bloom period. Note presence or absence of predatory mites.
Resistant varieties	None.
Cultural management	Encourage the development of predatory mite populations in the vineyard.
Chemical treatment	Research has shown that early-season use of oils can suppress mite populations.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.9.5 Pesticides Labeled for Management of Spider Mites

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Auron DF (sulfur)	2-10 lb/acre	-	24	2	Labeled only for red mites. Not recommended within 2 weeks of an oil application nor if temperatures are expected to exceed 90 degrees during or within 3 days following the application.
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
AzaGuard (azadirachtin)	10-16 fl oz/acre	0	4	?	Apply with OMRI approved spray oil.
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	0	12	?	See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
Captiva Prime (garlic oil, capsicum oleoresin extract, canola oil)	1-2 pt/acre	0	4	?	

Table 7.9.5 Pesticides Labeled for Management of Spider Mites					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Cinnerate (cinnamon oil)	13-35 fl oz/100 gal water	0	-	?	25(b) pesticide. Conduct phytotoxicity test prior to application. See label for specific application volumes.
Damoil (mineral oil)	1-3 gal/acre	-	4	?	Dormant and summer use. Do not apply this product within 2 days of harvest of grapes intended for fresh market for suppression of leafhopper or mites
Drexel Suffa (sulfur)	0.25 to 1.6 gal/acre	UDH	24	2	Labeled only for red mites. Do not apply when temperatures exceed or are likely to exceed 90°F. Do not use sulfur with oil or within 14 days of an oil spray. Concord and other Labrusca type Grapes may be injured.
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide.
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
GC-Mite (garlic oil, clove oil, cottonseed oil)	1 gal / 100 gal spray water	-	-	1	25(b) pesticide. Conduct phytotoxicity test prior to application.
Glacial Spray Fluid (mineral oil)	1-2 gal/100 gal water	UDH	4	1	
Grandevo CG (Chromobacterium subtsugae str. PRAA4-1)	3-4.25 Tbsp/1000 sq ft	0	4	?	
Grandevo WDG (Chromobacterium subtsugae str. PRAA4-1)	2-3 lb/ac	0	4	?	
JMS Stylet-Oil (mineral oil)	1-2 gal/100 gal water	see comment	4	1	Do not apply sulfur within 10 days of an oil application. Pre harvest interval is 14 days for table grapes; 0 for others.
KOPA Insecticidal Soap (potassium salts of fatty acids)	2 gal/100 gal water	1/2	12	?	See label for specific application volumes.
Mantis EC (rosemary oil, soybean oil, peppermint oil)	1-8 pt/100 gal water	0	-	?	25(b) pesticide.
Microthiol Disperss (sulfur)	3-10 lb/acre	-	24	2	Sulfur can suppress mites, but efficacy is not high, and it can reduce populations of some beneficial mites. May cause injury on sensitive varieties, see Table 7.5.1. Do not use within 2 weeks of oil applications nor at temperatures over 90 degrees.
M-Pede (insecticidal soap)	1-2% vol/vol solution	0	12	1	

Table 7.9.5 Pesticides Labeled for Management of Spider Mites

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Nuke Em (citric acid)	Normal: 1 fl oz/32 fl oz water. Strong: 2 fl oz/32 fl oz water	0	-	?	25(b) pesticide. Use the normal strength mix first. If needed, use the next stronger strength.
Oleotrol-I Bio-Insecticide Concentrate (soybean oil)	43-45 fl oz/100 gal water	-	-	?	25(b) pesticide.
Omni Supreme Spray (mineral oil)	0.25-1 gal/acre	-	12	1	Summer application. Do not exceed 1 gallon of oil per acre during summer applications. Do not spray near the time of sulfur application.
Omni Supreme Spray (mineral oil)	1-2 gal/acre	-	12	1	Dormant application. Provides suppression. Should not apply to grapes for fresh market.
PFR-97 20% WDG (Isaria fumosorosea Apopka str. 97)	1-2 lb/acre	-	4	?	
PureSpray Green (white mineral oil)	0.5-2 gal/acre	see comment	4	1	Pre harvest interval is 14 days for table grapes; up to day of harvest for others. Do not apply within 10 days of a sulfur application. Do not tank-mix oil and copper more than once/season. Do not use copper and oil together with fruit present.
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	
Sil-Matrix (potassium silicate)	0.5-1% solution	0	4	?	Mix 2-4 qts in 100 gallons of water and apply at 20 gallons finished spray/acre.
Sil-Matrix LC (potassium silicate)	1-4 qt/100 gal water	UDH	4	?	Mix 1-4 qts in 100 gallons of water and apply at 50-250 gallons finished spray/ac.
SuffOil-X (mineral oil)	1-2 gal/100 gal water	UDH	4	1	Do not mix with sulfur products.
TetraCURB Max (rosemary oil, clove oil, peppermint oil, castor oil)	32 fl oz/100 gal water preventative	0	-	?	25(b) pesticide
TetraCURB Max (rosemary oil, clove oil, peppermint oil, castor oil)	64-128 fl oz/100 gal water moderate/heavy infestation	0	=	?	25(b) pesticide
Thiolux (sulfur)	3-10 lb/acre	-	24	2	Sulfur can suppress mites, but efficacy is not high, and it can reduce populations of some beneficial mites. Labeled only for red mites.
Trilogy (neem oil)	0.5-2% solution.	UDH	4	?	Do not use after bloom on table grapes or following bunch closure on

Table 7.9.5 Pesticides Labeled for Management of Spider Mites

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
					wine grapes. The maximum labeled rate is 2 gal/acre /application.
TriTek (mineral oil)	1-2 gal/100 gal water	UDH	4	1	
Ultra-Pure Oil (mineral oil)	0.5-2 gal/acre	see comment	4	1	Do not apply sulfur within 10 days of an oil application. Pre-harvest interval is 60 days for table grapes; up to day of harvest for others.
Venerate XC (Burkholderia spp. str A396)	2-4 qt/acre	0	4	?	Suppression only. Not labeled for European red miteIn New York State, application is prohibited within 100 feet of any surface water.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found. PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10 Minor and Sporadic Insect Pests

7.10.1 BANDED GRAPE BUG and *LYGOCORIS INCONSPICUOUS* These two insects are true bugs in the family Miridae. **Banded Grape Bug** is a sporadic pest of grapes in the Finger Lakes and Lake Erie regions and does not require treatment in most years. Nymphs of this insect emerge in the spring and feed on flowers and young berries, using their sucking and piercing mouth parts. The nymphs range in size from 1/8- to 1/2-inch in length, depending on the stage. 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 fewer clusters. Adults, which appear at about bloom, are predaceous and do not cause damage. Economic injury can occur when more than 1 nymph per 10 shoots are present. This injury only occurs prior to bloom (between 5- and 10-inch shoot growth). Look for nymphs on grape clusters and shoot tips prior to the bloom period. They can be recognized by their long, banded antennae.

Lygocoris inconspicuous has a similar life cycle as the banded grape bug. Nymphs emerge from overwintering eggs shortly after bud break and begin feeding on shoot tips, flower buds, pedicels, and the cluster rachis. This feeding activity results in floret drop, reduced berry set, and reduced cluster number. The nymphs are light green in color with threadlike antennae that are not banded. They pass through five growth stages and become adults shortly before bloom. For a given growth stage, they are considerably smaller than the banded grape bug. Scout for these insects on clusters and shoot tips. Because of their small size, green color, and habit of hiding when disturbed, they can be very difficult to see on the cluster. This pest is sporadic and does not require treatment in most years. When present, however, it can cause considerable economic damage.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.1 Pesticides Labeled for Management of True Bugs

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	2	
AzaGuard (azadirachtin)	10-16 fl oz/acre	0	4	2	Apply with OMRI approved spray oil. Labeled for Lygus bugs only,
*AzaSol (azadirachtin)	6 oz/acre	0	4	2	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	2	See container label for specific rates used. Labeled for Lygus bugs only,
BioCeres WP (Beauveria bassiana strain ANT-03)	1-2 lb/acre	0	4	?	

Table 7.10.1 Pesticides Labeled for Management of True Bugs

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
DES-X (insecticidal soap)	2% solution sprayed at 75-200 gallons/acre	1/2	12	?	
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	2	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
KOPA Insecticidal Soap (potassium salts of fatty acids)	2 gal/100 gal water	1/2	12	?	See label for specific application volumes.
Molt-X (azadirachtin)	10 oz/acre	0	4	2	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found. PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.2 CLIMBING CUTWORMS

Climbing cutworms are known to feed on grapes. Larvae hide in the soil litter below the grape trellis and climb onto vines on warm nights to feed on developing primary buds. Only during bud swell are cutworms able to inflict serious damage to a vineyard. To examine vines for cutworms, search under the bark and in the soil litter beneath a vine with damaged buds, or search the vine with a flashlight after dark. Weeds under vines may provide shelter for cutworms.

IPM fact sheet Climbing Cutworms.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.2 Pesticides Labeled for Management of Climbing Cutworms

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
AzaGuard (azadirachtin)	8-16 fl oz/acre	0	4	?	Apply with OMRI approved spray oil.
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	?	See container label for specific rates used.
Bug-N-Sluggo (spinosad, iron phosphate)	0.15 oz/sq yard	7	4	?	Apply in a 6 inch circular band around the base of plants to be protected.
Cinnerate (cinnamon oil)	13-35 fl oz/100 gal water	0	-	?	25(b) pesticide. Conduct phytotoxicity test prior to application. See label for specific application volumes.
Deliver (Bacillus thuringiensis, var. kurstaki)	0.5-1.5 lb/acre	0	4	?	
Dipel DF (Bacillus thuringinensis subsp. Kurstaki)	0.5-2 lb/acre	0	4	?	

Table 7.10.2 Pesticides Labeled for Management of Climbing Cutworms

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Ecotrol Plus (rosemary oil, peppermint oil, geraniol)	1-4 pts/acre	0	-	?	25(b) pesticide. Target small caterpillars.
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Entrust (spinosad)	1.25-2.5 oz/acre	7	4	1	Target eggs at hatch or small larvae.
Entrust SC (spinosad)	4-8 fl oz/acre	3	4	1	
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Javelin WG (Bacillus thuringiensis, var. kurstaki)	0.5-1.25 lb/acre	0	4	1	
Mantis EC (rosemary oil, soybean oil, peppermint oil)	1-8 pt/100 gal water	0	-	?	25(b) pesticide. Target small caterpillars.
Molt-X (azadirachtin)	8 oz/acre	0	4	?	
Neemix 4.5 (azadirachtin)	4-10 oz/acre	0	4	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	
Seduce Insect Bait (spinosad)	20-44 lb/acre	7	4	?	Broadcast granules.
TerraNeem EC (cold pressed neem oil)	0.5-1.5% solution	0	4	?	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.
XenTari (Bacillus thuringiensis, var. aizawai)	0.5-1.5 lb/acre	0	4	?	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.3 EUROPEAN CORN BORER

European corn borer is an important lepidopteran pest of corn, but it is also known to feed on over 200 other plant species, including grapes. 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. The larvae vary in color, ranging from creamy to light gray to faint pink, with very small, round, dark brown spots on each segment and a dark-colored head capsule. 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. Adult moths are a creamy yellowish-brown and approximately one inch long. Eggs are white and laid in masses resembling overlapping fish scales on the underside of leaves. Egg laying can occur in late May, late June to early July, or early August, depending on the genetic race of corn borer present.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.3 Pesticides Labeled for Management of European Corn Borer

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	?	See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
Cinnerate (cinnamon oil)	13-35 fl oz/100 gal water	0	-	?	25(b) pesticide. Conduct phytotoxicity test prior to application. See label for specific application volumes.
Deliver (Bacillus thuringiensis, var. kurstaki)	0.5-1.5 lb/acre	0	4	2	
Dipel DF (Bacillus thuringinensis subsp. Kurstaki)	0.5-2 lb/acre	0	4	2	
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide. Target small caterpillars.
Ecotrol Plus (rosemary oil, peppermint oil, geraniol)	1-4 pts/acre	0	-	?	25(b) pesticide. Target small caterpillars.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Javelin WG (Bacillus thuringiensis, var. kurstaki)	0.5-1.25 lb/acre	0	4	2	
Mantis EC (rosemary oil, soybean oil, peppermint oil)	1-8 pt/100 gal water	0	-	?	25(b) pesticide. Target small caterpillars.
Molt-X (azadirachtin)	10 oz/acre	0	4	?	
Mycotrol ESO (Beauvaria bassiana)	0.25-1 qt/acre	0	4	2	
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.4 GRAPE CANE BORER

Grape cane borer is a small (3/8-inch), cylindrical brown beetle that bores into canes, leaving round entrance holes that are about 1/8-inch in diameter. Immature cane borers feed only on dead or dying wood, but adults can enter vigorous, live canes starting in late August. Tunneling can weaken canes causing them to break or die back. It can be particularly problematic when training young vines. Damage has been reported

primarily in vineyards surrounding Keuka and Seneca Lakes in the Finger Lakes region of New York. Research in New York and Europe indicates that problems with grape cane borer are reduced if wood from pruning is removed and destroyed each year. Destruction of burn piles before late summer is recommended.

IPM fact sheet Grape Cane Borer.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.4 Pesticides Labeled for Management of Grape Cane Borer

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	?	See container label for specific rates used.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	Spray soon after egg hatch. Use in combination with non-phytotoxic crop oil in sufficient water to cover undersides of leaves.
Molt-X (azadirachtin)	8 oz/acre	0	4	?	Use in combination with non-phytotoxic crop oil in sufficient water to cover undersides of leaves.
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.5 GRAPE PHYLLOXERA

Grape phylloxera are small, aphid-like insects with a complex life cycle. Two forms of grape phylloxera occur within the same species, and several generations of each may occur in any given year. The root gall form feeds on the outside of galls or on swellings on the roots of some grape species and varieties. Loss due to this form can be substantially reduced by grafting to a phylloxera-resistant rootstock (see Table 6.8). This grafting will not affect injury caused by the leaf gall form of the phylloxera. The leaf gall form lives inside galls on the underside of grape leaves of some grape species and varieties. There is a wide range in the susceptibility of grape varieties to both forms of phylloxera. Although Vinifera roots are especially vulnerable to phylloxera, research indicates phylloxera can also feed on Labrusca roots and reduce vine vigor. Vinifera and Labrusca leaves rarely develop leaf galls but some hybrids like Aurore, Baco noir, and Seyval blanc as well as the newer cold hardy varieties Frontenac, Frontenac gris and La Crescent seem particularly prone to leaf galls. Examine foliage on a weekly basis before and after bloom. Many varieties can withstand extensive galling.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.5 Pesticides Labeled for Management of Phylloxera

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
AzaGuard (azadirachtin)	8-16 fl oz/acre	0	4	?	Apply with OMRI approved spray oil.
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	?	See container label for specific rates used.

Table 7.10.5 Pesticides Labeled for Management of Phylloxera

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Molt-X (azadirachtin)	8 oz/acre	0	4	?	Use in combination with non-phytotoxic crop oil in sufficient water to cover undersides of leaves.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restrited entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.6 GRAPE ROOTWORM

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 if left untreated, can cause serious damage and vineyard decline over a period of years. Grape rootworm adults begin appearing in vineyards in mid- to late May. They lay eggs on the vine trunk. After the eggs hatch, the larvae crawl into the soil and attach themselves to grape roots. They remain there for 1–2 years while completing their development. An insecticide application made when chain-like feeding symptoms appear throughout a vineyard will control adults before they lay eggs. This pest appears sporadically and does not require treatment every year.

IPM fact sheet Grape Rootworm.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.6 Pesticides Labeled for Management of Grape Rootworm

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	?	See container label for specific rates used.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Molt-X (azadirachtin)	8 oz/acre	0	4	?	
PFR-97 20% WDG (Isaria fumosorosea Apopka str. 97)	1-2 lb/acre soil treatment	-	4	?	
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.7 GRAPE ROOT BORERS

Grape root borers are clear-wing moths that strongly resemble paper wasps. At present, in this region they occur only in southern and eastern Pennsylvania. Larvae feed on grape roots for a 2-year period. Mature larvae burrow to just below the soil surface, spin a dirty brown silk cocoon, and pupate. Adults emerge in mid- to late summer, mate, and lay eggs beneath vines. The eggs hatch and reenter the root system. Careful monitoring for pupal cases on the soil surface beneath vines will reveal when pupation is occurring. Good under row weed control is important in limiting the number of sites available for ovipositioning (egg-laying). Mounding soil beneath vines after borers have pupated, and then leveling the ridges in the fall or spring creates an environment where adults are unable to dig to the surface after leaving their cocoons. Timing is important because if mounding is done too early the larvae merely tunnel up into the ridge before pupating.

7.10.8 GRAPE FLEA BEETLES or STEELY BEETLES

These beetles are small (3/16-inch) bluish-black beetles that damage vines by feeding on small grape buds. Larvae feed on the upper surface of the leaves. If adult beetles are present in damaging numbers in the early season, they should be controlled with an insecticide application at bud swell. They tend to be more abundant on the vineyard edge near woods.

IPM fact sheet Grape Flea Beetle.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.8 Pesticides Labeled for Management of Grape Flea Beetles or Steely Beetles

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	3	
AzaGuard (azadirachtin)	8-16 fl oz/acre	0	4	3	Apply with OMRI approved spray oil.
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	3	See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	3	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Grandevo WDG (Chromobacterium subtsugae str. PRAA4-1)	2-3 lb/ac	0	4	?	Suppression only.
Mantis EC (rosemary oil, soybean oil, peppermint oil)	1-8 pt/100 gal water	0	-	?	25(b) pesticide.
Molt-X (azadirachtin)	8 oz/acre	0	4	3	
Mycotrol ESO (Beauvaria bassiana)	0.25-1 qt/acre	0	4	?	Labeled for flea beetles only.
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	

Table 7.10.8 Pesticides Labeled for Management of Grape Flea Beetles or Steely Beetles					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Safer Brand #567 II (potassium laurate, pyrethrins)	6.4 oz/gal water applied at 1 gal mix/ 700 sq ft	Until Dry	12	?	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found. PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.9 GRAPE CANE GALLMAKERS

Grape cane gallmakers are small (1/8-inch) brown weevils that form scars in shoots, typically beyond the last grape cluster. The 3/4-inch reddish swelling is quite noticeable on green shoots. Berry size and percentage of sugar are not affected, and the scars are easily found and removed during winter pruning.

IPM fact sheet Grape Cane Gallmaker.

7.10.10 GRAPE CANE GIRDLERS

Grape cane girdlers are small (1/8-inch) black weevils that girdle grape canes by chewing 2 series of holes several inches apart. The girdles are generally beyond the last grape cluster, so there is usually no loss of fruit. Cultural control of grape cane girdler involves cutting off and burning the infested part of the canes. This must be done before adults emerge from the canes in late summer.

IPM fact sheet Grape Cane Girdler.

7.10.11 MEALYBUGS and SOFT SCALES

These insects have received attention recently due to their ability to vector leafroll virus in grapes. There are several species of soft scales present in our area and at least one species of mealybug, the grape mealybug. In survey work in the Finger Lakes from 2006-2008 we found low levels of both mealybugs and soft scale. Some of these individuals have tested positive for two viruses that cause leafroll disease. At this point we do not know whether they are playing a role in spreading the virus in eastern vineyards but because of their low numbers, we believe it is minimal. Research is ongoing to clarify this situation. In the event that moderate to high populations develop, dormant oils can be applied prior to budbreak and may provide some control. Insecticides applied during the season should be timed to coincide with production of crawlers. These pests rarely reach population levels which require treatment and treatment will not stop virus transmission.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.11 Pesticides Labeled for Management of Mealybugs and Soft Scale					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
AzaGuard (azadirachtin)	10-16 fl oz/acre	0	4	?	Apply with OMRI approved spray oil. Labeled for scales only; see label for specific species.
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	?	See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
*Brandt Lime Sulfur (calcium polysulfide)	4-10 gal/acre	-	48	?	Dormant application only for mealybugs.
Cinnerate (cinnamon oil)	35-40 fl oz/100 gal water	0	-	?	25(b) pesticide. Conduct phytotoxicity test prior to application. See label for specific application volumes.

Table 7.10.11 Pesticides Labeled for Management of Mealybugs and Soft Scale					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
	mealybug; 13-35 fl oz/100 gal water scales				
Damoil (mineral oil)	4-6 gal/acre	-	4	1	Dormant application only for mealybugs.
DES-X (insecticidal soap)	2% solution sprayed at 75-200 gallons/acre	1/2	12	?	
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide.
Ecotrol Plus (rosemary oil, peppermint oil, geraniol)	1-4 pts/acre	0	-	?	25(b) pesticide. Labeled for mealybugs only.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Glacial Spray Fluid (mineral oil)	1-2 gal/100 gal water	UDH	4	1	Labeled for mealybugs only.
Golden Pest Spray Oil (soybean oil)	2 gal/acre (concentrate)	-	4	1	Labeled for mealybugs only. Dormant application.
Grandevo WDG (Chromobacterium subtsugae str. PRAA4-1)	2-3 lb/ac	0	4	?	Labeled for mealybugs only.
JMS Stylet-Oil (mineral oil)	1-2 gal/100 gal water	see comment	4	1	Mealybugs only. Do not apply sulfur within 10 days of an oil application. Pre harvest interval is 14 days for table grapes; 0 for others. Thorough coverage is essential.
KOPA Insecticidal Soap (potassium salts of fatty acids)	2 gal/100 gal water	1/2	12	?	See label for specific application volumes.
Mantis EC (rosemary oil, soybean oil, peppermint oil)	1-8 pt/100 gal water	0	-	?	25(b) pesticide. Target crawler stage
Molt-X (azadirachtin)	10 oz/acre	0	4	?	
M-Pede (insecticidal soap)	1-2% vol/vol solution	0	12	?	Target scale crawler stage.
Mycotrol ESO (Beauvaria bassiana)	0.25-1 qt/acre	0	4	?	Labeled for mealybugs only.
Neemix 4.5 (azadirachtin)	7-16 oz/acre	0	4	?	

Table 7.10.11 Pesticides Labeled for Management of Mealybugs and Soft Scale

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Oleotrol-I Bio-Insecticide Concentrate (soybean oil)	43-45 fl oz/100 gal water	-	-	?	25(b) pesticide.
PureSpray Green (white mineral oil)	0.5-2 gal/acre	see comment	4	1	Mealybugs only. Pre harvest interval is 14 days for table grapes; up to day of harvest for others. Do not apply within 10 days of a sulfur application. Do not tank-mix oil and copper more than once/season. Do not use copper and oil together with fruit present. Do not use copper and oil together when fruit present.
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	
SuffOil-X (mineral oil)	1-2 gal/100 gal water	UDH	4	1	Do not mix with sulfur products.
TerraNeem EC (cold pressed neem oil)	0.5-1.5% solution	0	4	?	See label for specific application volumes. Do not apply sulfur or sulfur-containing products within 14 days of treatment.
TetraCURB Max (rosemary oil, clove oil, peppermint oil, castor oil)	64-128 fl oz/100 gal water moderate/heavy infestation	0	-	?	25(b) pesticide
TetraCURB Max (rosemary oil, clove oil, peppermint oil, castor oil)	32 fl oz/100 gal water preventative	0	-	?	25(b) pesticide
Trilogy (neem oil)	0.5-1% solution. Use 25 gal water/acre.	UDH	4	?	Do not use after bloom on table grapes or following bunch closure on wine grapes. The maximum labeled rate is 2 gal/acre /application. Use sufficient water per acre to ensure thorough coverage.
TriTek (mineral oil)	1-2 gal/100 gal water	UDH	4	2	
Ultra-Pure Oil (mineral oil)	0.5-2 gal/acre	see comment	4	2	Mealybugs only. Do not apply sulfur within 10 days of an oil application. Labeled for mealybugs only. Pre-harvest interval is 60 days for table grapes; up to day of harvest for others.
Venerate XC (Burkholderia spp. str A396)	2-4 qt/acre	0	4	?	Suppression only. Labeled for mealybugs only. In New York State, application is prohibited within 100 feet of any surface water.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.12 MULTICOLORED ASIAN LADY BEETLE (MALB)

MALB is an important predator of aphid pests on a number of different crops. However, near harvest it can become a problem for grape growers (both for wine and sweet juice). After a sufficient cold period in the fall the adult beetles begin searching for overwintering sites and this can bring them into vineyards where they may feed on ripe or damaged grapes. Injury to fruit, however, is not the real concern. When disturbed, by harvesting of grapes, for example, the beetles produce a noxious smelling liquid from their joints that contaminates the fruit and causes a severe off-flavor in juice or wine. This problem has been most severe on the Niagara Peninsula and the southeastern shore of Lake Erie, but has also been reported in the Finger Lakes. We currently do not have a good estimate of economic threshold, but it may be as little as 15 beetles per grape lug. During the summer MALB feed on a number of different aphid species, including the introduced soybean aphid. When soybean aphids are abundant, this probably leads to an abundance of MALB and potentially to greater problems in vineyards.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.12 Pesticides Labeled for Management of Multicolored Asian Lady Beetle (MALB)

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	1	See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Molt-X (azadirachtin)	8 oz/acre	0	4	?	
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	1	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	1	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.13 PLUME MOTH

Plume moth larvae can cause injury to young shoots and grape clusters early in the growing season. In most years, this injury is not significant. The light green larvae hatch at, or near, bud break. They fold young, terminal leaves together to form a shelter in which they feed on leaf tissue (the leaves are held together with webbing). This, in itself, is generally not a serious problem because the shoot can recover after the larvae complete development (in early June). When present in very high densities, the larvae sometimes accidentally enclose young flower clusters within their leaf shelters; if this happens, they will feed on the florets. Infestations are often limited to vineyard edges. This pest does not require treatment in most years.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.13 Pesticides Labeled for Management of Plume Moth

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide. Target small caterpillars.
Ecotrol Plus (rosemary oil, peppermint oil, geraniol)	1-4 pts/acre	0	0	?	25(b) pesticide. Target small caterpillars.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Molt-X (azadirachtin)	8 oz/acre	0	4	?	
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restrcited entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.14 ROSE CHAFER

Rose chafers are clumsy, light-brown beetles about 5/8-inch long. They damage leaves and flower clusters around the bloom period. Populations are usually highest on light, sandy soil.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.14 Pesticides Labeled for Management of Rose Chafer

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
AzaGuard (azadirachtin)	10-16 fl oz/acre	0	4	?	Apply with OMRI approved spray oil.
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	?	See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.

Table 7.10.14 Pesticides Labeled for Management of Rose Chafer					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
Molt-X (azadirachtin)	8 oz/acre	0	4	?	
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	
Surround WP (kaolin clay)	12.5-50 lb/acre	UDH	4	?	Suppression only. Table grapes cannot be sprayed from first bloom until harvest. Infestations can be sprayed up to first bloom and again after harvest.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.15 THRIPS

Thrips are small (1/25-inch) yellowish or brownish insects that rarely cause significant injury to grapes in our area. The adults are winged and more brownish, while immature thrips are more yellowish and have a worm-like appearance. They use their sucking mouth parts to feed on leaf tissue. When populations are high, during the early part of the season, their feeding activity can result in small, deformed leaves and stunted shoots. Later in the season, the vines are much better able to tolerate thrips feeding. It is rarely necessary to treat for this pest. Aurore and DeChaunac varieties appear to be most susceptible to shoot stunting. Concord and other Labrusca varieties tolerate feeding with no apparent injury.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.15 Pesticides Labeled for Management of Thrips					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	
*AzaSol (azadirachtin)	6 oz/acre	0	4	?	
Azera (azadirachtin, pyrethrins)	32 fl oz/acre	0	12	?	See label for specific thrips species. See container label for specific rates used.
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	1/2	-	?	25(b) pesticide.
BioRepel (garlic oil)	1 part BioRepel/100 parts water	-	-	3	25(b) pesticide.
Captiva Prime (garlic oil, capsicum oleoresin extract, canola oil)	1-2 pt/acre	0	4	?	
Cinnerate (cinnamon oil)	13-35 fl oz/100 gal water	0	-	?	25(b) pesticide. Conduct phytotoxicity test prior to application. See label for specific application volumes.

Table 7.10.15 Pesticides Labeled for Management of Thrips					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide.
Ecotrol Plus (rosemary oil, peppermint oil, geraniol)	1-4 pts/acre	0	0	?	25(b) pesticide.
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0 (see comment)	4	?	For applications the day of harvest, crop can be harvested as soon as spray has dried.
Entrust (spinosad)	1.25-2.5 oz/acre	7	4	1	Target eggs at hatch or small larvae.
Entrust SC (spinosad)	4-8 fl oz/acre	3	4	1	
Garlic Barrier AG+ (garlic juice)	1-2%	-	-	?	25(b) pesticide. Use sufficient water per acre to ensure foliage is thoroughly wetted. Repellent.
GC-Mite (garlic oil, clove oil, cottonseed oil)	1 gal / 100 gal spray water	-	-	?	25(b) pesticide. Conduct phytotoxicity test prior to application.
Grandevo CG (Chromobacterium subtsugae str. PRAA4-1)	3-4.25 Tbsp/1000 sq ft	0	4	?	
Grandevo WDG (Chromobacterium subtsugae str. PRAA4-1)	2-3 lb/ac	0	4	?	
Mantis EC (rosemary oil, soybean oil, peppermint oil)	1-8 pt/100 gal water	0	-	?	25(b) pesticide.
Molt-X (azadirachtin)	10 oz/acre	0	4	?	
Oleotrol-I Bio-Insecticide Concentrate (soybean oil)	43-45 fl oz/100 gal water	-	-	?	25(b) pesticide.
PFR-97 20% WDG (Isaria fumosorosea Apopka str. 97)	1-2 lb/acre soil treatment	-	4	?	Aimed at pupae in the soil.
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	?	
PyGanic EC 5.0 II (pyrethrins)	4.5-15.6 fl oz/acre	0	12	?	
Surround WP (kaolin clay)	25-50 lb/acre	UDH	4	1	Table grapes cannot be sprayed from first bloom until harvest. Infestations can be sprayed up to first bloom and again after harvest.
TetraCURB Max (rosemary oil, clove oil, peppermint oil, castor oil)	32 fl oz/100 gal water preventative	0	-	?	25(b) pesticide

Table 7.10.15 Pesticides Labeled for Management of Thrips

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
TetraCURB Max (rosemary oil, clove oil, peppermint oil, castor oil)	64-128 fl oz/100 gal water moderate/heavy infestation	0	=	?	25(b) pesticide
Trilogy (neem oil)	0.5-1% solution. Use 25 gal water/acre.	UDH	4	?	Do not use after bloom on table grapes or following bunch closure on wine grapes. The maximum labeled rate is 2 gal/acre /application. Use sufficient water per acre to ensure thorough coverage.
Venerate XC (Burkholderia spp. str A396)	2-4 qt/acre	0	4	?	Suppression only. In New York State, application is prohibited within 100 feet of any surface water.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.16 TUMID GALLMAKER

Tumid gallmaker is a small (1/10-inch) brown to reddish fly with plume-like antennae. From early May to mid-September, it lays its eggs in masses between developing tissues at the bud or shoot tips. After hatching, the larvae cause injury by boring into vine tissue and causing a round, reddish gall to form. These galls can develop on leaf tissue or petioles, where they probably do little actual damage to the vine, or in grape clusters, where there is more concern about economic injury. Hence, the greatest concern for this pest is in the early part of the season. Tumid gallmaker is generally not as prevalent in the western and central grape-growing regions as in the southeastern areas. Aurore and Rougeon appear to be particularly susceptible.

IPM fact sheet Grape Tumid Gallmaker.

7.10.17 DROSOPHILA SPP. VINEGAR FLIES, INCLUDING SPOTTED WING DROSOPHILA

Spotted wing drosophila (SWD) is an invasive fruit fly (often referred to as vinegar flies) originally from Asia that became widely distributed in the Northeast in 2011. In overall appearance, it is similar to other fruit flies that can be found in wineries and in overripe, damaged berries. One major difference is that the female has a very large ovipositor (egg-laying structure) that she uses to insert eggs into intact, soft-skinned ripe and ripening fruit. Berry crops appear to be particularly vulnerable while tougher skinned grapes not as much, although some spotted wing drosophila have been reared from very ripe, intact grapes. Also, thin-skinned varieties such as 'Pinot noir' may be more susceptible than others to direct damage. Overall risk to juice grapes and other thick-skinned cultivars appears relatively low.

Our most recent research does indicate that fruit flies, including SWD, can facilitate sour rot in susceptible grape varieties in years where the environmental conditions are supportive of disease development (see setion 7.7.5). Damage to fruit from birds or yellow jackets likely exacerbates the situation by increasing opportunities for fruit flies to spread sour rot microorganisms. Insecticides targeting fruit flies at around 15° Brix have been shown to reduce incidence and severity of sour rot.

Fruit flies become active in the vineyard near and during harvest when ripe fruit are present. Several species of Drosophila fruit flies can be found, including the invasive SWD. The main threat from these fruit flies at this time is the potential to spread fruit rot organisms, especially sour rot.

IPM Invasive Species and Exotic Pests fact sheet Spotted Wing Drosophila.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.17 Pesticides Labeled for Management of Drosophila spp. Vinegar Flies, including Spotted Wing Drosophila					
Class of Compounds Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Azera (azadirachtin, pyrethrins)	16-32 fl oz/acre	0	12	2	See container label for specific rates used.
BioCeres WP (Beauveria bassiana strain ANT-03)	1-2 lb/acre	0	4	?	
Ecotec Plus (rosemary oil, peppermint oil, geraniol)	1-4 pt/100 gal water	0	-	?	25(b) pesticide. Target maggot stage.
Ecoworks EC (cold pressed neem oil)	1-4 pts/acre	0	4	?	
Entrust (spinosad)	1.25-2.5 oz/acre	7	4	1	2(ee) recommendation. User must have a copy of the recommendation in their possession at the time of application. Do not make more than 5 applications per calendar year. Do not make applications less than 5 days apart. Do not apply more than a total of 0.36 lb ai per acre of spinosad per season. Do not make more than 2 consecutive applications of Group 5 insecticides (spinetoram and spinosad). If additional treatments are required after 2 consecutive applications of Group 5 insecticides rotate to another class of effective insecticides for at least one application.
Entrust SC (spinosad)	4-8 fl oz/acre	3	4	1	2(ee) recommendation. User must have a copy of the recommendation in their possession at the time of application. Do not make more than 5 applications per calendar year. Do not make applications less than 5 days apart. Do not make more than 2 consecutive applications of Group 5 insecticides (spinetoram and spinosad). If additional treatments are required after 2 consecutive applications of Group 5 insecticides rotate to another class of effective insecticides for at least one application.
Grandevo CG (Chromobacterium subtsugae str. PRAA4-1)	3-4.25 Tbsp/1000 sq ft	0	4	?	
Grandevo WDG (Chromobacterium subtsugae str. PRAA4-1)	2-3 lb/acre	0	4	2	Begin applications as soon as adult flies are active and continue until adult activity is no longer present. Use in rotation with other products labeled for SWD.
Mantis EC (rosemary oil, soybean oil, peppermint oil)	1-8 pt/100 gal water	0	-	?	25(b) pesticide. Target maggot stage.
PyGanic EC 1.4 II (pyrethrins)	16 fl oz/acre	Until Dry	12	3	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.

Table 7.10.17 Pesticides Labeled for Management of Drosophila spp. Vinegar Flies, including Spotted Wing Drosophila

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
PyGanic EC 5.0 II (pyrethrins)	4.5-15.61 fl oz/acre	0	12	3	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.10.18 SPOTTED LANTERNFLY

Spotted lanternfly (SLF) is a new invasive insect pest of grapevines in the U.S. It was first detected in 2014 in Southeastern Pennsylvania where the largest known population now occurs. As of early 2021, populations are established in Connecticut, Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, and West Virginia. Continued spread of this pest is expected.

As an adult, this planthopper is large (1-inch-long) and colorful (brown and black spotted forewings, red hindwings, and a black and yellow abdomen). SLF use their sucking mouthparts to feed on the plant phloem – they do not feed on the fruit. There is only one generation per year with the egg stage overwintering. Nymphs emerge in the spring and will feed on grapevines, but SLF does not typically become problematic in vineyards until the late summer and early fall, with up to thousands of adult SLF invading vineyards in a short period of time in areas where the populations have had time to build. They are strong jumpers in both the nymph and adult life stage, but only adults can fly. Adults are relatively weak fliers.

They have a broad host range (>70 plant species), but grapevines appear to be among their preferred hosts. SLF may be found in the surrounding wood edge in high numbers before invading the vineyard. There is no economic threshold currently available for this pest. High levels of feeding (approx. >20 per vine) may result in weak vines and increased susceptibility to winter injury. In some cases, complete vine death has been observed. Feeding injury is typically not apparent within the growing season, though the presence of honeydew and/or sooty mold on the leaves, trunk, or fruit may be a sign of SLF presence. Note that this may also indicate the presence of other sap-feeding pests (e.g. scale, mealybugs).

Research is ongoing. If you find SLF outside of the current quarantine zone, it should be immediately killed and reported to your state department of agriculture. In New York, report it to the NYS Dept. of Agriculture and Markets, using the Spotted Lanternfly Public Report.

NYS IPM Program Spotted Lanternfly Website.
IPM Invasive Species and Exotic Pests fact sheet Spotted Lanternfly.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.10.18 Pesticides Labeled for Management of Spotted Lanternfly

Class of Compounds Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Mycotrol ESO (Beauvaria bassiana)	0.25-1 -qt/acre	0	4	?	
BoteGHA ES (Beauveria bassiana GHA)	0.25-1 -qt/acre	0	4	?	
Aza-Direct 2(ee) (azadirachtin)	1-3.5 pts/ac	0	4	?	2(ee) recommendation. User must have a copy of the recommendation in their possession at the time of application.
M-Pede 2(ee) (insecticidal soap)	1-2 gals/acre (1-2% v/v solution)	0	12	?	2(ee) recommendation. User must have a copy of the recommendation in their possession at the time of application.

*Restricted-use pesticide. [1]Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.11 Weed Management

Weeds are part of the vineyard ecosystem where they can interfere with planting operations; provide alternate hosts for pests; compete for water and nutrients; and contaminate mechanically harvested fruit. Excessive weed growth within the grape canopy can also alter the microclimate around plants by interfering with sunlight penetration and air movement, leading to higher disease pressure and increasing the risk of spring frost. Managing weeds requires that the positive aspects of weed growth and any ecosystem services they provide are balanced with their negative effects in the planting. Minimizing weed competition during vineyard establishment is critical to achieve optimal vine growth and yields. In-row weed management may be one of the most difficult tasks in the production of organic grapes. Between the rows, the row middles, weed management or cover crop growth can be a powerful tool for managing overly vigorous vines, minimizing soil erosion, and improving equipment access in wet seasons. For more information on cover crops, refer to Section 3.

Good preplant preparation, plant establishment, and use of permanent cover crops in the alleyways/row middles help reduce weed pressure, considerably. Perennial weeds should be eliminated from the site before planting. This can be achieved with repeated cultivation or using "green manure" cover crops that are plowed under prior to planting. Without herbicides, eliminating perennial weeds can take several years. Refer to Sections 3 and 4 for more information.

Cultivation is sometimes used as a row middle weed management tool. Low vine size restricts productivity of own-rooted Labrusca varieties such as Concord that generally have shallow root systems and cultivation has been used to minimize weed competition is such vineyards. However, there are negative aspects to continuous cultivation. Excessive cultivation can lead to undesirable consequences such as soil erosion, reduced soil organic matter, and breakdown in soil structure resulting in compaction and reduced permeability, so use it sparingly and not when soils are wet. If cultivation is used for row middle management, it is suggested that negative effects be limited by not cultivating more often than necessary to suppress weed growth, cultivating to shallow (1-2") depths only, and cultivating with the goal of reducing, rather than completely eliminating, weed or cover crop growth. Fall planting of ryegrass or other cover crops can be used in conjunction with cultivation to provide winter cover. See section 3 for more information on cover crops.

Grasses (ryegrass, fescue) can be planted in the row middles and managed with regular mowing. Sod minimizes weeds within the planting, provides winter cover for row middles, and is a good surface for equipment and foot traffic. Fescues are excellent plants for the row middles because they do not tiller and will not invade the plant row. See section 3 for more information on appropriate ground covers for vineyards. In addition to mowing row middles, it is important to keep areas around the vineyard mowed to prevent weed seeds from blowing into the planting.

In mature vineyards, weed management may be influenced by variety, rootstock, plant growth stage, designated market, etc. Productivity of shallow-rooted vines such as Concord can be severely limited by weed competition, whereas Concord vines grafted to rootstock 3309 can achieve optimal vine size without row middle cultivation. The critical period of weed competition is from bloom until veraison, when days are long, grapevine leaf area is maximized, and when soil moisture may be limiting. On the other hand, growth of overly vigorous vines can be reduced with weed competition and the effect of weed competition on limiting soil moisture post-bloom may reduce berry size and lead to concentrated flavors and higher wine quality.

The yearly hilling up and taking down of a soil ridge to protect the graft union of cold tender varieties grown on a rootstock can be useful in managing weeds and pests if timed correctly. Pulling the soil ridge down in the spring covers newly emerged weed seedlings as well as over-wintering inoculum of black rot and downy mildew and pupae of grape berry moth. However, a single "take down" in the spring, followed by hilling up in the fall, should not be counted on as the sole means of weed control in most vineyards, as annual and perennial weeds will proliferate during the summer months.

Another potential approach to under-row weed management is use of an under trellis mower, using commercially available equipment. This was investigated at the Long Island Horticultural Research and Extension Lab. Results indicated no difference between under-row mowing and conventional herbicide treatments in terms of yield or fruit quality, but mowing is more labor intensive and expensive. Mowing shifted the spectrum of weeds strongly toward summer annual grasses.

Organic mulches can also be used as tools for in-row and row middle management. Organic mulches are generally discouraged for under-row weed control in vineyards due to concerns about harboring rodents that may feed on the vines. Possible materials include straw, hay, sawdust, and wood chips. They are most effective where soil moisture and fertility are low and where low vine size restricts vineyard productivity. Use of organic mulches can lead to excessive vine vigor by increasing the soil water content and through release of nutrients. In one study in Western New York, application of 5 tons of straw mulch for two consecutive years increased petiole potassium levels which led to foliar symptoms of magnesium deficiency. As a reminder, straw mulch may serve as a major source of weed seed; be sure to inspect straw before purchase. According to USDA NOP standards in sections 205.601 and 205.206, the following mulches can be used as weed barriers in organic production:

- Fully biodegradable materials such as wood chips, leaves, or straw
- Newspaper or other recycled paper, without glossy or colored inks

- Plastic mulch and covers provided they are pulled up at the end of the growing/harvest season and that they are petroleum-based but not polyvinyl chloride (PVC)
- Biodegradable biobased mulch film as defined in USDA NOP section 205.2 and produced without organisms or feedstock derived from excluded methods. Mulch film meeting these requirements is not currently commercially available.

Although agricultural plastic should be recycled if recycling is available, most agricultural plastics in New York State, especially difficult to clean plastic films used as weed barriers, are currently going to the landfill. China's market demand for the plastic ended in 2018, and alternative disposal solutions are not yet widely available. See the *Agricultural Plastics Recycling in New York State Case Study* pdf document for a summary of agricultural plastic recycling successes and challenges, with a 2019 update at the end. Burning or on-farm burying of agricultural plastic is prohibited according to the *USDA National Organic Program Regulations & NOFA-NY Certified Organic, LLC Guidance and Policy Manuals* pdf document. For a discussion about the reasoning behind the NOP rules that allow organic growers to use plastic but not biodegradable mulch at this time, see the *Allowed Mulches on Organic Farms and the Future of Biodegradable Mulch* pdf document.

There are a number of mechanical, thermal and animal measures that can be used to limit the effects of weeds under the plant row. Mechanical and thermal options include fixed hoes, rotary cultivators, flamers, steamers, and hot water applicators. A good list of available options is found in the *Grapes: Organic Production* guide. Animal weeders have also been used with some success in organic plantings across the United States. The use of weeder geese, guinea fowl, and sheep have some effectiveness, but due to food safety concerns regarding microbial contamination of food crops from manure, they should only be used after harvest in fall or during the planting (non-bearing) year. These animals do not like to eat all weed species so some clean-up of weeds is required after their use.

Organic Herbicide Considerations:
An organic herbicide strategy can be a useful part of a robust and diversified weed management program. If relied on alone, organic herbicides may require frequent re-applications for sustained weed control. Organic herbicides do not prevent weed seeds from germinating, rather they burn back to the ground small, established weeds. If these weeds have perennial roots, they will regrow. Best results are obtained in situations where small, annual weeds have germinated around the crop, rather than situations where perennial weeds are established. Because organic herbicides are non-selective, post emergent, contact herbicides, they also have the potential to damage the crop plants (leaves, green stems, flowers, fruit, etc.) if the spray contacts the crop. Therefore, using a hooded sprayer may help to prevent crop contact and associated injury. Herbicides are sprayed in a 4 foot strip under the plant. High spray volumes are required to get sufficient spray coverage for good weed control. Note that you may need to use up to 100 gallons of solution per sprayed acre to ensure sufficient herbicide coverage. Consult the pesticide label for specifics on how to apply the product, paying particular attention to the weeds controlled, the product's solubility in water, the need for agitation to ensure thorough mixing, and the need for spray adjuvants.

For more information on weed management consult: *Grapes: Organic Production*

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation NYS(DEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.11.1 Organic Herbicides Labeled for Management of Vineyard Weeds

Product Name (Active Ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
AVENGER AG OPTIMA BURNDOWN (d-limonene)	7-10% v/v dilution. See label for details.	7	4	?	
Axxe (ammonium nonanoate)	6-15% v/v dilution. See label for details.	-	4	?	
Ecoblend Weed and Grass Burndown (soybean oil)	32-64 oz/gal water	-	-	?	
Ecoblend Weed Control Pro (soybean oil, citric acid)	5-32 oz/gal water	-	-	?	
Finalsan Herbicidal Soap (ammoniated soap of fatty acids.)	5.0-16.7% v/v. See label for details.	-	24	?	
Fireworxx Herbicide (capric acid, caprylic acid)	3-9% v/v. See label for details.	-	24	?	

Table 7.11.1 Organic Herbicides Labeled for Management of Vineyard Weeds					
Product Name (Active Ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Green Gobbler 20% Vinegar Weed Killer (acetic acid)	15-30 gal/acre	2	48	?	
Harris 20% Vinegar Weed Killer (acetic acid)	44-88 fl oz/1000 sq ft	2	48	?	
HomePlate Non-Selective Herbicide (capric acid, caprylic acid)	3-9% v/v. See label for details.	-	24	?	
Suppress Herbicide EC (capric acid, caprylic acid)	3-9% v/v. See label for details.	-	24	?	

Efficacy: 1-effective in some research studies, 2-inconsistent efficacy results, 3-not effective, ?-efficacy unknown or no data found.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label, UDH = up to day of harvest.

7.12 Wildlife Management

Deer and birds have the potential to be economically destructive in a short period of time. Deer browse on young shoot growth early in the year and can destroy a training system if not caught early. Fencing and dogs are the two most reliable options of keeping deer out of the vineyard. Repellents can be used but they must be put in place prior to the deer discovering the presence of "food" as deer are much harder to deter once they have enjoyed a meal. Because much of the deer damage to vines occurs during the dormant season, repellent applications may be limited by cold temperatures or snow cover. Deer Damage Permits (DDPs; for taking deer outside of hunting season), or Deer Management Assistance Program Permits (DMAPs; taking deer during open hunting seasons) permits for shooting of deer causing substantial damage may be available to reduce the population in some areas. Contact your regional Department of Environmental Conservation wildlife office for technical advice and a permit application.

Flocking birds can destroy a crop in a matter of days. Netting is the best option to exclude birds from feeding on ripening grapes but is a costly option for all but the more valuable grape varieties. Several types of netting, such as plastic, nylon, cotton, and polyethylene, are marketed for protecting fruits. A lightweight acrylic netting that can be draped directly over plants is available. It does not require support and it does not interfere with sunlight, pollination, or growth. Most netting is expensive, but it can be reused for many years. For more information see: *Bird Damage Prevention for Northern New England Fruit Growers* by Alan Eaton, UNH Cooperative Extension. Repellent and scare tactics such as mylar tape, scare eyes, distress calls, cannons and human activity in the vineyard have provided short-term success against birds. Birds quickly adapt to the noises and scare tactics as they learn they will not be hurt. Frequently moving noisemakers to different locations in the vineyard can increase the time frame of effectiveness from days to weeks. In more recent field trials, air dancers or inflatable tube men, have shown success for reducing bird damage to some grape plantings.

There are no chemicals registered for vertebrate control in New York State vineyards. Specific practices for vertebrate management are listed in Table 7.12.1.

Table 7.12.1. Vertebrate Damage Mitigation Practices	
Animal Pest	**Management Practices[1]**
Birds	Netting; visual scare devices (air dancers, eye-spot balloons, silhouettes, reflective tape); auditory frightening device (recorded alarm calls, pyrotechnics, propane cannon). Population reduction through shooting by licensed hunter of game species in appropriate season (crows, turkeys); or unprotected species (European starlings, English sparrows, pigeons). All state and local firearms laws or regulations must be followed[1].
Mice and voles	Wire trunk guards; close mowing of vineyard middles; vegetation reductions (<40% ground cover) under vines; removal of dropped fruit and prunings; habitat manipulations including elimination of unmowable areas within vineyards; monitor to determine the need for management. Population control through trapping by landowner.
Raccoons	Electrified exclusion fencing. Population reduction through shooting by licensed hunters or landowners in appropriate seasons; through trapping by landowner, by licensed trapper, or by licensed nuisance wildlife control agent.
Red and gray foxes	Manipulation including elimination of protective cover within vineyards. Population reduction through shooting by licensed hunters or landowners in appropriate seasons; through trapping by landowner, by licensed trapper, or by licensed nuisance wildlife control agent.

Table 7.12.1. Vertebrate Damage Mitigation Practices	
Animal Pest	**Management Practices[1]**
White-tailed deer	Exclusion fencing (8 ft. (244 cm) high-tensile woven wire or 5 to 6 ft. (152 to 183 cm) electric exclusion fencing; peanut-butter baited electric fences; invisible fencing with dogs); habitat manipulation including elimination of protective cover within vineyards. Population reduction through shooting by licensed hunters, landowners or their agents with Deer Damage Permits (DDP), or Deer Management Assistance Program (DMAP) permits. Unlike with other vertebrate pests, landowners cannot kill nuisance deer without a permit.
Woodchucks	Exclusion fencing (electrified exclusion fencing); habitat manipulation including removal of brush piles within vineyards. Population reduction through shooting by licensed hunters or landowners; through trapping by landowner or by licensed nuisance wildlife control agent.

[1] Conduct shooting and trapping only as defined by New York State Department of Environmental Conservation regulations. Shooting for nuisance wildlife control is allowed only when neighboring occupied buildings are >500 ft. distant; shooting when neighboring buildings are less than 500 ft. distant requires neighbor permission. Also check local ordinances, as shooting and trapping are prohibited in some areas. Note: It is illegal to trap a nuisance animal and release it onto public lands or someone else's property. It must be released on the landowner's property or killed.

7.13 Harvest & Nuisance Pests

During harvest operations some pests can contaminate the grapes, reducing their quality, e.g. the striped snail, wasps and yellow jackets, multicolored Asian lady beetles (MALB), and mice. Wasp and yellow jacket nests can be destroyed during the growing season as they are found in the vineyard. Snails can be managed with Sluggo bait (follow label directions) or with copper band barriers (100% effective) placed around trunks. See the 2000 NYS IPM Project Report, *Demonstration and Evaluation of Pest Management Alternatives in Finger Lakes Grapes* by T. Martinson and T. Weigle for more information on managing the striped snail. To manage MALB, refer to section 7.10 Minor and Sporadic Insect Pests. In years with high mouse populations, trap mice prior to harvest.

At the time this guide was produced, the following materials were available in New York State for managing this pest and were allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.13.1 Pesticides Labeled for Management of Nuisance Pests					
Trade Name (*active ingredient*)	**Product Rate**	**PHI (days)**	**REI (hours)**	**Efficacy[1]**	**Comments**
Bug-N-Sluggo *(iron phosphate and spinosad)*	0.15 oz/square yard	7	4	1	For snails and slugs. Apply in a 6 inch circular band around the base of the plant.
Garlic Barrier AG+ *(garlic juice)*	1-2%	-	-	?	25(b) pesticide. For slugs.
PyGanic EC 1.4 II *(pyrethrins)*	16-64 fl oz	When spray has dried	12	?	Wasps & yellow jackets.
Sluggo Slug and Snail Bait *(iron phosphate)*	0.15 oz/sq yd	0	0	1	For snails and slugs. Apply in a 6-inch circular band around the base of the plant.

[1]Efficacy: 1- effective in some research studies, 2 - inconsistent efficacy results, 3 - not effective, ? - not reviewed or no research available.
PHI - pre-harvest interval, REI – restricted entry interval, - = pre-harvest interval isn't specified on label.

8. FOOD SAFETY

Implementing practices that reduce microbial risks to produce crops that are eaten raw is important to consumer safety and farm economic viability. Produce-associated foodborne illness outbreaks have caused consumer illnesses and deaths resulting in increased buyer food safety requirements and the first ever produce safety regulations as part of the Food Safety Modernization Act (FSMA). Pathogens can contaminate fruits and vegetables during all phases of production, harvesting, and packing. Wild and domesticated animals, soil amendments, agricultural water, improperly trained workers, unclean picking and packing containers, and ineffective sanitation programs can all result in fresh produce contamination. The FSMA Produce Safety Rule (i.e., 21 CFR Parts 11, 16, and 112 Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption) requires at least one supervisor or responsible party from each covered farm to have successfully completed food safety training recognized as adequate by the Food and Drug Administration and to be in compliance with relevant food safety practices. The Produce Safety Alliance provides training that meets the training requirement and has created many educational materials to help growers understand and implement required practices. In addition, the National Good Agricultural Practices (GAPs) Program website provides educational materials and offers trainings for growers who are new to food safety and may need help

beginning the process of developing a farm food safety plan. Regardless of whether a farm is subject to the FSMA Produce Safety Rule, GAPs can be used to identify and reduce microbial risks. This is critically important because many valuable markets and buyers require that growers have a farm food safety plan in order to buy their commodities.

The Food Safety Modernization Act (FSMA) Produce Safety Rule (PSR) applies to farms that grow, harvest, pack or hold covered fruits and vegetables when those fruits and vegetables are in an unprocessed state (i.e., Raw Agricultural Commodities (RACs)) and that meet income thresholds. FSMA PSR practices are focused on preventing microbial contamination of fresh produce and include requirements for managing agricultural water, worker training, soil amendments, wild and domesticated animals, and sanitation of equipment, tools and buildings. The final FSMA PSR was released on November 27, 2015 but several subparts and guidance are still evolving. Updates and information are available at the United States Food and Drug Administration's FSMA Final Rule on Produce Safety website.

Implementing a few simple practices can reduce food safety risks significantly. Assessing risk on the farm to identify areas where microbial contamination occurs is the first step. For crops that are harvested by hand and eaten fresh, such as table grapes, implementing an effective worker-training program and providing clean, well-stocked toilet and handwashing facilities will always be important to food safety. Train all workers to scrub their hands with soap for 20 seconds, rinsing with water that has no detectable *E.coli*, and drying with single-use towels before beginning work, after using the toilet, taking breaks, smoking and any other time they are unclean. Do not allow workers who are ill to handle produce. Train workers to never harvest produce that is contaminated with animal feces and prevent wild and domesticated animals from entering production fields. Assess the quality of any agricultural water that contacts the edible portion of the crop by testing it for quantified generic *E.coli*. Assess all soil amendments to determine if they contain biological soil amendments of animal origin (BSAAOs) such as manure. BSAAOs should only be applied before planting so it can be incorporated into the soil. For fall-fruiting berries, using composted BSAAOs will reduce microbial risks if there is a need to apply soil amendments in the spring. The key is to maximize the time from application of BSAAOs to harvest of the crop. Ensure that picking containers are clean and free from any animal fecal contamination. Following these steps can dramatically reduce risks of human pathogen contamination.

NOTE: Application of postharvest agricultural water is not recommended for soft fruits such as berries, because they can greatly promote mold growth by wetting the fruit.

At the time this guide was produced, the following materials were available in New York State as sanitizers allowable for organic production. Listing a pest on a pesticide label does not assure the pesticide's effectiveness. The registration status of pesticides can and does change. Pesticides must be currently registered with the New York State Department of Environmental Conservation (NYSDEC) to be used legally in NY. However, pesticides meeting the federal requirements for minimum-risk (25(b)) pesticides do not require registration. Current NY pesticide registrations can be checked on the NYSDEC Bureau of Pesticides Management – Information Portal. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 8.1.1 Rates for Sanitizers Labeled for Postharvest Facilities

Product name *active ingredient*	**Food contact surfaces[1]**	**Hard surface, non-food contact[1]**
CDG Solution 3000 *chlorine dioxide*	25-50 ppm solution	110-500 ppm dilution
Oxine[2] *chlorine dioxide*	100 ppm solution	500 ppm solution
Pro Oxine[2] *chlorine dioxide*	50-200 ppm solution	500 ppm solution
Enviroguard Sanitizer *hydrogen peroxide/peroxyacetic acid*	-	2.5-20 fl oz/5 gal water
Jet Oxide 15 *hydrogen peroxide/peroxyacetic acid*	0.33-1.87 fl oz/5 gal water	-
Oxonia Active *hydrogen peroxide/peroxyacetic acid*	1.0-1.4 oz/4 gal water	1.0 -2.5 oz/8 gal water
Peraclean 5 *hydrogen peroxide/peroxyacetic acid*	1.0-1.5 fl oz/5 gal water	-

Table 8.1.1 Rates for Sanitizers Labeled for Postharvest Facilities		
Product name *active ingredient*	**Food contact surfaces[1]**	**Hard surface, non-food contact[1]**
Peraclean 15 *hydrogen peroxide/peroxyacetic acid*	0.33-1.87 fl oz/5 gal water	-
Perasan 'A' *hydrogen peroxide/peroxyacetic acid*	1.0-6.1 fl oz/6 gal water	-
Per-Ox *hydrogen peroxide/peroxyacetic acid*	1-5.6 fl oz/5 gal water	1-17 fl oz/15 gal water
SaniDate 5.0 *hydrogen peroxide/peroxyacetic acid*	1.6-5.4 fl oz/ 5 gal water	1.6-5.4 fl oz/ 5 gal water
San-I-King No. 451 *sodium hypochlorite*	6 oz/10 gal water followed by 2 oz/10 gal water rinse – porous surfaces 1 oz/10 gal water or 2 oz/10 gal (see label) – non-porous surfaces	6 oz/10 gal water – porous surfaces 2 oz/10 gal water – non-porous surfaces
Shield-Brite PAA 15.0 *hydrogen peroxide/peroxyacetic acid*	0.7-3.8 fl oz/10 gal water	-
StorOx 2.0 *hydrogen peroxide/- acid*	0.5 fl oz/1 gal water	0.5 fl oz/1 gal water
VigorOx 15 F & V *hydrogen peroxide/peroxyacetic acid*	0.31-0.45 fl oz/5 gal water-	1.1-9.5 fl oz/5 gal water
VigorOx LS-15 *hydrogen peroxide/peroxyacetic acid*	0.31-0.45 fl oz/5 gal water	1.1-9.5 fl oz/5 gal water

[1] Thoroughly clean all surfaces and rinse with potable water prior to treatment.
[2] Requires acid activator.

9. SPRAYER TECHNOLOGY

9.1 Spraying Small, Organic Vineyards:

On small-scale organic vineyards spraying often requires special attention to calibrating sprayers, calculating amounts of pesticide to use, and measuring pesticide products.

To ensure even distribution throughout the canopy, a systematic approach to spraying the whole canopy is essential. Take particular care to cover the top of the canopy as well as ensuring adequate penetration into the inside and middle of the canopy and the fruiting zone. Spray from both sides of the row. Water sensitive cards (Syngenta) or Surround, kaolin clay, (Engelhard) may be used as tracers to monitor spray distribution.

PRIOR TO SPRAYING—CALIBRATING SPRAYERS

- ***Calibration of backpack sprayers—for canopy spraying***

1. Fill the spray tank with a known quantity of clean water (e.g. 2 gallons).
2. Determine the number of plants that you can spray on both sides with the water in the spray tank (e.g. 48 plants covered with the 2 gallons of water).
3. Determine the total number of plants per acre (e.g. 968 plants per acre).
4. Calculate the spray volume required per acre using this formula and the above numbers:
   Spray volume/acre **=** (plants per acre **÷** plants covered per spray tank) **x** volume applied in spray tank
   Spray volume/acre **=** (968 ÷ 48) **x** 2 **=** 40 gallons per acre

- ***Calibration of backpack sprayers—in general***

Use clean water.

DYNAMIC CALIBRATION

1. Select correct nozzle and pressure.
2. Measure and mark off an area 10 feet x 10 feet (100 sq ft) on concrete or other hard surface.
3. Fill sprayer to a known level and mark the fill level.
4. Spray the marked-off, 100 sq ft area.
5. Refill sprayer with water to the fill level mark, noting how much water was added.

6. The amount of water added to the spray tank is the amount of spray applied per 100 sq ft. Compare this to the desired amount.

STATIC CALIBRATION

1. Select correct nozzle and pressure.
2. Fill the sprayer with clean water.
3. Measure and mark off an area 10 feet x 10 feet (100 sq ft) on concrete or other hard surface.
4. Spray the marked-off, 100 sq ft area, while recording the time taken to spray the area.
5. Carry out a static run of the same time it took to spray the 100 sq ft area, operating the spraying without moving and collecting the liquid into a graduated measuring jug.
6. Compare the quantity collected in the jug with nozzle chart and desired amount.

CALCULATING THE AMOUNT OF PESTICIDE TO USE

Some pesticides give application rates on a per acre basis but may need to be used on smaller areas. When converting a known quantity per acre to spray a smaller area, the first step is to measure the area to be sprayed with a tape measure or other measuring device. Divide the number of square feet measured by 43,560 (the number of square feet in an acre) to obtain the acreage you plan to treat (in decimal form).

Example:

1. If you are going to spray 20,000 sq. ft,
   20,000 divided by 43,560 = 0.459 acre
2. The label states 3 pints of product per acre
   Multiply the label rate per acre by the decimal for your area
   3 pints multiplied by 0.459 = 1.38 pints
3. Remember there are 16 fl oz in 1 pint.

MEASURING SMALL AMOUNTS OF PESTICIDE

The following tables and examples provide information on converting pesticide rate amounts for smaller areas.

Powders and granules

Example: The label says to use 3 lbs of powdered product per 100 gallons but you will use a backpack sprayer with a 5-gallon tank. Using Table 9.1.1, locate the amount of powdered product the label requires per 100 gallons and read across the 3 lb row to the 5 gallons column to find you need to use $2^{3}/_{8}$ oz of powder. Use clean weighing scales to provide the correct amount of powder. NEVER use a volumetric measure (e.g. measuring cup) because the bulk density of dry formulations varies between products affecting the amount of pesticide added to the tank.

Table 9.1.1 Amount of powder or granules to use

Volume of liquid			
100 gallons	***25 gallons***	***5 gallons***	***1 gallon***
4 oz	1 oz	$^{3}/_{16}$ oz	½ tsp
8 oz	2 oz	$^{3}/_{8}$ oz	1 tsp
1 lb	4 oz	$^{7}/_{8}$ oz	2 tsp
2 lb	8 oz	1 ¾ oz	4 tsp
3 lb	12 oz	2 $^{3}/_{8}$ oz	2 Tbsp
4 lb	1 lb	3 ¼ oz	2 Tbsp + 2 tsp

Liquids

Example: The label says to use 4 pts of liquid product per 100 gallons of spray but you will use a backpack sprayer with a 5-gallon tank. Using Table 9.1.2, locate the amount of liquid product the label requires per 100 gallons and read across the 4 pts row to the 5 gallons column to find you need to mix 3¼ fl oz of liquid product. Use a clean measuring cylinder, cup or spoon to provide the correct amount of liquid.

Table 9.1.2. Amount of liquid to use			
Volume of liquid			
100 gallons	***25 gallons***	***5 gallons***	***1 gallon***
1 gal	2 pt	6 ½ oz	1 ¼ oz
4 pt	1 pt	3 ¼ oz	5/8 oz
2 pt	½ pt	1 9/16 oz	5/16 oz
1 ½ pt	6 oz	1 ¼ oz	¼ oz
1 pt	4 oz	7/8 oz	3/16 oz
8 oz	2 oz	7/16 oz	½ tsp
4 oz	1 oz	¼ oz	¼ tsp

Dilutions
Some labels call for a dilution rate of the applied product. Use Table 9.1.3 for dilution rates for smaller total volumes. For example, a dilution rate of 1 gallon in 100 gallons would be the same as ¾ cup + 5 tsp in 5 gallons for a backpack sprayer with a 5-gallon tank.

Table 9.1.3 Dilution of liquid products to various concentrations			
Dilution rate	***1 gallon***	***3 gallon***	***5 gallon***
1 in 100	2 Tbsp + 2 tsp	½ cup	¾ cup + 5 tsp
1 in 200	4 tsp	¼ cup	6 ½ Tbsp
1 in 800	1 tsp	1 Tbsp	1 Tbsp + 2 tsp
1 in 1000	¾ tsp	2 ½ tsp	1 Tbsp + 1 tsp

Measuring equipment.
Always use measuring equipment that is dedicated only for pesticide use. For very small quantities of liquids, a syringe can be useful. For powder or granular products use weighing scales; do not rely on a measuring cup as product bulk density varies between products.

Safety.
When measuring, mixing or applying pesticides, be sure to use the protective clothing and equipment listed on the pesticide label. Also, be careful to avoid contaminating water when measuring and mixing pesticides.

9.2 Selecting a Small Sprayer for the Small, Organic Vineyard

There are many important points to consider before purchasing a sprayer, including the area to spray, proximity to the local supplier, and the size of the sprayer, amongst others. Sprayers for small plantings range from backpack sprayers to small truck- or ATV-mounted machines.

CANOPY SPRAYERS

Backpack sprayers

Small capacity (4-5 gallon) sprayers will produce up to approximately 100 psi pressure. Weight is an important consideration and growers should select a sprayer with good, wide, padded straps to ease the load on your shoulders. Correct nozzle selection according to the target is very important to ensure even coverage. A good-sized fill hole at the top is also important.

There are three factors affecting application rate - forward speed, pressure, and nozzle tip size. Normally output increases or decreases according to the pressure in the system, (which is dependent upon how vigorous you pump the handle up and down). Unfortunately most inexpensive backpack sprayers have no pressure gauge to monitor this. It's suggested that you purchase a backpack sprayer that includes a pressure gauge. Another option is to purchase a spray pressure valve to install on the spray wand, such as a CF valve. These pressure valves will ensure a constant output irrespective of hand pump action.

An alternative to the hand-operated backpack sprayer is a battery-powered backpack sprayer. Maximum pressure is relatively low and it is easier than using a traditional hand pump sprayer when spraying many rows of plants.

Portable mist and air blower backpacks

These are ideal where canopy penetration is required, such as for denser, vigorous plantings. These sprayers have a small gas engine that drives a fan blower creating an airstream through a hand-held tube (similar to a leaf blower). The tube has a nozzle mounted at the end that adds spray to the airstream. The operator directs the spray towards the canopy by pointing the hand-held tube at the plants to be treated. To protect

the applicator from the spray mist, it is advised to point the tube backwards to avoid walking into the spray. Engine speed can be reduced, slowing airspeed to match smaller, early-season canopies. Airflow from these sprayers rustle the canopy, allowing for good penetration and deposition. Some drawbacks to these sprayers are that they are heavy and the engines are noisy, requiring ear protection. Also note that the airflow from the sprayer can increase pesticide drift off the target.

Portable engine-driven gas sprayers
A number of manufacturers offer sprayers with a small gas engine and a 10 to 12 gallon tank. Larger capacity tanks (14 to 100 gallons) are also available. These sprayers can be pulled by a lawn tractor, ATV/UTV, or small tractor.

Small, mounted sprayers
Small, 15 to 25 gallon sprayers, are available that can be mounted to the carrier rack of an ATV. These sprayers use a small electric pump to provide pressures of up to 70 psi. When equipped with a hand wand and a hose, they can be used to spray short rows and for spot spraying. The same system is ideal for weed control.

Large, skid mounted sprayers
These are larger sprayers that fit in the back of a pick-up truck. Skid mounted sprayers have a tank capacity of 35 to 200 gallons and use a gas engine as a power source.

Small, trailered airblast sprayers
Very small airblast sprayers, with tank capacities up to 110 gallons and a 5.5 to 20 hp gas engine, can be towed by an ATV or a small tractor. Larger tank capacities up to 300 gallons are also available but require larger tractors with weights and brakes for safe operation. Remember, the larger the gas engine, the more important it is to buy an electric start option. Small airblast sprayers are ideal in blueberry plantings with tall plants but suffer from a lack of air direction, therefore purchase sprayers with deflectors or towers to direct the air into the canopy.

Small, mounted airblast sprayers
Three-point hitch, PTO-driven models with a 22- or 24-inch fan, for fitting onto 25 plus hp tractors are available. Beware of drift, again consider models which direct the air via deflectors or towers.

HERBICIDE OR GROUND APPLICATION SPRAYERS
Backpack, small ATV-mounted tank, and hand-lance sprayers

These sprayers can be used for herbicide application. However, be very careful that if these sprayers are used for herbicides in addition to other pesticides, there is no herbicide residue in the sprayer. Therefore, clean these sprayer out thoroughly before using them to apply pesticides other than herbicides. Alternatively, have a dedicated herbicide-only sprayer to avoid cross-contamination.

Controlled Droplet Applicators (CDA)
The use of CDA's will considerably reduce the need to carry vast amounts of water. Controlled Droplet Applicators use a battery-powered spinning disc that produces 95% of the same-size droplets, thus reducing herbicide volumes by at least 50% and water amounts by 75%. Herbi and Mantis are two examples of hand-held CDA's. ATV- or tractor-mounted shielded CDA's are also available that reduce spray rates while shielding the plants from the spray.

Wick wipers
Where occasional weeds and driving over wet land are a problem, a hand-held wick wiper is an easy-to use, effective option. Wick wipers consist of a small tank to hold the liquid (usually part of the handle) that soaks a rope wick or a sponge. The rope or sponge is wiped against the weeds.

For further information on pesticide application technology visit the Pesticide Environmental Stewardship website. Also, consult Chapter 7, Sprayer Application Technology, in the New York and Pennsylvania Pest Management Guidelines for Grapes https://cropandpestguides.cce.cornell.edu/

10. PESTICIDES MENTIONED IN THIS PUBLICATION

Table 10.1 Fungicides

Product Name	Active Ingredient	EPA Reg. No.
Acoidal	sulfur	62562-4
Actinovate AG	Streptomyces Lydicus WYEC 108	73314-20
Auron DF	sulfur	62562-4-94100
Badge X2	copper hydroxide, copper oxychloride	80289-12
Basic Copper 53	basic copper sulfate	45002-8
BotryStop	Ulocladium oudemansii (U3 Strain)	75747-2-68539
*Brandt Lime Sulfur	calcium polysulfide	61842-30-48813
Carb-o-nator	potassium bicarbonate	70051-117

Table 10.1 Fungicides

Product Name	Active Ingredient	EPA Reg. No.
Champ WG	copper hydroxide	55146-1
ChampION++	copper hydroxide	55146-115
Cinnerate	cinnamon oil	25(b) pesticide
Companion Biological Fungicide	Bacillus amyloliquefaciens	87645-4-94485
*Copper Sulfate Crystals	copper sulfate pentahydrate	56576-1
CS 2005	copper sulfate pentahydrate	66675-3
Cueva Fungicide Concentrate	copper octanoate	67702-2-70051
Damoil	mineral oil	19713-123
Dart Fungicide EC	capric acid, caprylic acid	51517-11
Defend DF	sulfur	62562-8
DES-X	insecticidal soap	67702-22-70051
Double Nickel 55	Bacillus amyloliquefaciens str. D747	70051-108
Double Nickel LC	Bacillus amyloliquefaciens str. D747	70051-107
Drexel Suffa	sulfur	19713-39
EcoSwing Botanical Fungicide	extract of Swinglea glutinosa	10163-357
Ecoworks EC	cold pressed neem oil	89152-4
ET-F Algicide/ Bactericide/ Fungicide	copper sulfate pentahydrate	64962-5
Fungout	citric acid	25(b) pesticide
Glacial Spray Fluid	mineral oil	34704-849
Howler	Pseudomonas chloroaphis strain AFS009	91197-3-92488
JMS Stylet-Oil	mineral oil	65564-1
Kaligreen	potassium bicarbonate	11581-2
Kalmor	copper hydroxide	91411-11-59807
Kentan DF	copper hydroxide	80289-2
Kocide 2000-O	copper hydroxide	91411-10-70051
Kocide 3000-O	copper hydroxide	91411-11-70051
KOPA Insecticidal Soap	potassium salts of fatty acids	67702-11-59807
LALSTOP G46 WG	Gliocladium catenulatum str J1446	64137-13
LifeGard LC	Bacillus mycoides isolate J	70051-126
LifeGard WG	Bacillus mycoides isolate J*	70051-119
Mastercop	copper sulfate pentahydrate	55272-18-66222
Microthiol Disperss	Sulfur	70506-187
Mildew Cure	garlic oil, cottonseed oil, corn oil	25(b) pesticide
Milstop	potassium bicarbonate	70870-1-68539
M-Pede	insecticidal soap	10163-324
Nordox 75 WG	cuprous oxide	48142-4
Nu-Cop 50 WP	copper hydroxide	45002-7
Nu-Cop 50DF	copper hydroxide	45002-4
Nu-Cop HB	copper hydroxide	42750-132
Nuke Em	citric acid	25(b) pesticide
Omni Supreme Spray	mineral oil	5905-368
OSO 5% SC Fungicide	polyoxin D zinc salt	68173-4-70051
Oxidate 2.0	hydrogen dioxide, peroxyacetic acid	70299-12
Oxidate 5.0	hydrogen peroxide, peroxyacetic acid	70299-28
PerCarb	sodium carbonate peroxyhydrate	70299-15
PERpose Plus	hydrogen peroxide	68539-15
Prestop WG	Gliocladium catenulatum str J1446	64137-13
ProBlad Verde	Banda de Lupinus albus doce (BLAD)	84876-2
PureSpray Green	white mineral oil	69526-9
Quimag Quimicos Aguila Copper Sulfate Crystal	copper sulfate pentahydrate	73385-1
Regalia	Reynoutria sachalinensis	84059-3
Regalia CG	Reynoutria sachalinensis	84059-3
Romeo	Saccharomyces cerevisiae	91810-2
Serenade ASO	Bacillus subtilis str QST 713	264-1152
Serenade MAX	Bacillus subtilis str QST 713	264-1151
Serenade Opti	Bacillus subtilis str QST 713	264-1160
Serifel	Bacillus amyloliquefaciens str. MBI 600	71840-18

Table 10.1 Fungicides

Product Name	Active Ingredient	EPA Reg. No.
Sil-Matrix	potassium silicate	82100-1
Sil-Matrix LC	potassium silicate	70051-127
Solawit 80DF	sulfur	93745-1
Sporan EC2	rosemary oil, clove oil, peppermint oil, thyme oil	25(b) pesticide
Stargus	Bacillus amyloliquefaciens str. F727	84059-28
SuffOil-X	mineral oil	48813-1-68539
Sulfur 80 WDG	sulfur	19713-674
Taegro 2	Bacillus subtilis var. amyloliquefaciens str. FZB2	70127-12
TerraNeem EC	cold pressed neem oil	88760-5
Thiolux	sulfur	34704-1079
Timorex Act	tea tree oil	86182-3-88783
Triathlon BA	Bacillus amyloliquefaciens str. D747	70051-107-59807
Trilogy	neem oil	70051-2
TriTek	mineral oil	48813-1
Ultra-Pure Oil	mineral oil	69526-5-499

*Restricted-use pesticide; may be purchased and used only by certified applicators or used by someone under the direct supervision of a certified applicator.

Table 10.2 Insecticides and Miticides

Product Name	Active Ingredient	EPA Reg. No.
Acti-Min FE Crop Protectant	kaolin	92942-1
Aza-Direct	azadirachtin	71908-1-10163
AzaGuard	azadirachtin	70299-17
*AzaSol	azadirachtin	81899-4-74578
Azera	azadirachtin, pyrethrins	1021-1872
Biobit HP	Bacillus thuringiensis, var. kurstaki	73049-54
BioCeres WP	Beauveria bassiana strain ANT-03	89600-2
BioLink Insect & Bird Repellant	garlic juice	25(b) pesticide
Bioprotec Plus	Bacillus thuringinensis subsp. Kurstaki	89046-12
BioRepel	garlic oil	25(b) pesticide
BoteGHA ES	Beauveria bassiana GHA	82074-1
*Brandt Lime Sulfur	calcium polysulfide	61842-30-48813
BT NOW	Bacillus thuringinensis subsp. Kurstaki	89046-12-70299
Bug-N-Sluggo	spinosad, iron phosphate	67702-24-70051
Captiva Prime	garlic oil, capsicum oleoresin extract, canola oil	10163-336
Cinnerate	cinnamon oil	25(b) pesticide
Damoil	mineral oil	19713-123
Deliver	Bacillus thuringiensis, var. kurstaki	70051-69
DEsect CROP	silicon dioxide	7655-1
DES-X	insecticidal soap	67702-22-70051
Dipel DF	Bacillus thuringinensis subsp. Kurstaki	73049-39
Ecotec Plus	rosemary oil, peppermint oil, geraniol	25(b) pesticide
Ecotrol Plus	rosemary oil, peppermint oil, geraniol	25(b) pesticide
Ecoworks EC	cold pressed neem oil	89152-4
Ecozin Plus 1.2% ME	azadirachtin	5481-559
Entrust	spinosad	62719-282
Entrust SC	spinosad	62719-621
Garlic Barrier AG+	garlic juice	25(b) pesticide
GC-Mite	garlic oil, clove oil, cottonseed oil	25(b) pesticide
Glacial Spray Fluid	mineral oil	34704-849
Golden Pest Spray Oil	soybean oil	57538-11
Grandevo CG	Chromobacterium subtsugae str. PRAA4-1	84059-27
Grandevo WDG	Chromobacterium subtsugae str. PRAA4-1	84059-27
Javelin WG	Bacillus thuringiensis, var. kurstaki	70051-66
JMS Stylet-Oil	mineral oil	65564-1
KOPA Insecticidal Soap	potassium salts of fatty acids	67702-11-59807

Table 10.2 Insecticides and Miticides		
Mantis EC	rosemary oil, soybean oil, peppermint oil	25(b) pesticide
Molt-X	azadirachtin	68539-11
M-Pede	insecticidal soap	10163-324
Mycotrol ESO	Beauvaria bassiana	82074-1
Neemix 4.5	azadirachtin	70051-9
Oleotrol-I Bio-Insecticide Concentrate	soybean oil	25(b) pesticide
PFR-97 20% WDG	Isaria fumosorosea Apopka str. 97	70051-19
PureSpray Green	white mineral oil	69526-9
PyGanic EC 1.4 II	pyrethrins	1021-1771
PyGanic EC 5.0 II	pyrethrins	1021-1772
Safer Brand #567 II	potassium laurate, pyrethrins	59913-9
Seduce Insect Bait	spinosad	67702-25-70051
Sil-Matrix LC	potassium silicate	70051-127
SuffOil-X	mineral oil	48813-1-68539
Surround WP	kaolin clay	61842-18
TerraNeem EC	cold pressed neem oil	88760-5
TetraCURB Max	rosemary oil, clove oil, peppermint oil, castor oil	25(b) pesticide
Trilogy	neem oil	70051-2
TriTek	mineral oil	48813-1
Ultra-Pure Oil	mineral oil	69526-5-499
Venerate XC	Burkholderia spp. str A396	84059-14
XenTari	Bacillus thuringiensis, var. aizawai	73049-40
*Restricted-use pesticide; may be purchased and used only by certified applicators or used by someone under the direct supervision of a certified applicator.		

Table 10.3 Herbicides		
Product Name	**Active Ingredient**	**EPA Reg. No.**
AVENGER AG OPTIMA BURNDOWN	d-limonene	92967-4
Axxe	ammonium nonanoate	70299-23
Ecoblend Weed and Grass Burndown	soybean oil	25(b) pesticide
Ecoblend Weed Control Pro	soybean oil, citric acid	25(b) pesticide
Finalsan Herbicidal Soap	ammoniated soap of fatty acids.	67702-8
Fireworxx Herbicide	capric acid, caprylic acid	67702-54-59807
Green Gobbler 20% Vinegar Weed Killer	acetic acid	85208-1-93489
Harris 20% Vinegar Weed Killer	acetic acid	85208-1-3
HomePlate Non-Selective Herbicide	capric acid, caprylic acid	67702-54-70051
Suppress Herbicide EC	capric acid, caprylic acid	51517-9

Table 10.4. Mollusk Control Chemicals		
Trade Name	**Active Ingredient**	**EPA Reg. No.**
Bug-N-Sluggo	iron phosphate and spinosad	67702-24-70051
Garlic Barrier AG+	garlic juice	25(b) pesticide
Sluggo Slug and Snail Bait	iron phosphate	67702-3-70051

Table 10.5. Growth Regulators		
Trade Name	**Active Ingredient**	**EPA Reg. No.**
FalGro 4L	gibberellic acid	62097-2-82917
GibGro 4LS	gibberellic acid	55146-62
ProGibb LV PLUS	gibberillic acid	73049-498

Table 10.6 Sanitizers		
Trade Name	**Active Ingredient**	**EPA Reg. No.**
CDG Solution 3000	chlorine dioxide	75757-2
Enviroguard Sanitizer	hydrogen peroxide/peroxyacetic acid	63838-1-527
Jet Oxide 15	hydrogen peroxide/peroxyacetic acid	54289-4-81803

Table 10.6 Sanitizers		
Trade Name	**Active Ingredient**	**EPA Reg. No.**
Oxine	chlorine dioxide	9804-1
Oxonia Active	hydrogen peroxide/peroxyacetic acid	1677-129
Peraclean 5	hydrogen peroxide/peroxyacetic acid	54289-3
Peraclean 15	hydrogen peroxide/peroxyacetic acid	54289-4
Perasan 'A'	hydrogen peroxide/peroxyacetic acid	63838-1
Per-Ox	hydrogen peroxide/peroxyacetic acid	833-4
Pro Oxine	chlorine dioxide	9804-9
SaniDate 5.0	hydrogen peroxide/peroxyacetic acid	70299-19
San-I-King No. 451	sodium hypochlorite	2686-20001
Shield-Brite PAA 15.0	hydrogen peroxide/peroxyacetic acid	63838-2-64864
StorOx 2.0	hydrogen peroxide/peroxyacetic acid	70299-7
VigorOx 15 F & V	hydrogen peroxide/peroxyacetic acid	65402-3
VigorOx LS-15	hydrogen peroxide/peroxyacetic acid	65402-3

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