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Organic Production and IPM Guide for Raspberries and Blackberries

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2016 Production and IPM Guide for Organic Raspberries and Blackberries

Coordinating Editors

Leigh Archer (Cornell University, Horticulture Section, School of Integrative Plant Science)

Juliet Carroll* (Cornell University, New York State IPM Program)

Catherine Heidenreich* (Cornell University, Horticulture Section, School of Integrative Plant Science)

Marvin Pritts* (Cornell University, Horticulture Section, School of Integrative Plant Science)

Contributors and Resources

Kerik Cox* (Cornell University, Plant Pathology and Plant Microbe-Biology Section, School of Integrative Plant Science)

Greg Loeb* (Cornell University, Department of Entomology)

Michael Helms* (Cornell University, Pesticide Management Education Program)

Andrew Landers (Cornell University, Department of Entomology)

Paul Curtis (Cornell University, Department of Natural Resources)

Courtney Weber (Cornell University, Horticulture Section, School of Integrative Plant Science)

Laura McDermott (Cornell Cooperative Extension, Capital District Vegetable and Small Fruit Program)

**Pesticide Information and Regulatory Compliance*

Staff Writers

Mary Kirkwyland, Elizabeth Graeper Thomas, Marion Zuefle, Theodora Bucien (Cornell University, New York State IPM Program)

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Dedication

This publication is dedicated to Cathy Heidenreich who was tragically killed in an automobile accident in December, 2014. Cathy put her heart and soul into her work, which included many hours on this guide.

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Updates and additional information for this guide are available at www.nysipm.cornell.edu/organic_guide. Please submit comments or suggested changes for these guides to organicguides@gmail.com.

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Contents

INTRODUCTION

This guide for organic raspberry and blackberry production is focused on nutrient 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.

Raspberries and blackberries are moderately amenable to organic production. One of the greatest challenges to organic growers is weed management. Sustained weed pressure during the planting year can negatively affect yield for several subsequent years. There are also a few pests that can be impossible to control organically if the weather does not cooperate (e.g. gray mold on fruit). But, with sufficient attention to weed control and proper site and nutrient management, raspberries and blackberries can be successfully grown with organic production methods.

For a more comprehensive understanding of raspberry and blackberry production we suggest the following resources: Raspberry & Blackberry Production Guide for the Northeast, Midwest, and Eastern Canada, NRAES-35 available for purchase from: http://palspublishing.cals.cornell.edu/, and Organic Culture of Bramble Fruits. For those interested in greenhouse or high-tunnel production we suggest: Greenhouse Raspberry Production Guide, and High Tunnel Raspberries and Blackberries.

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 some 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 the use of cultural practices to minimize pest outbreaks. With the limited pest control products available in many organic production systems, IPM techniques such as keeping accurate pest history records, selecting the proper site, and preventing pest outbreaks through use of sanitation, variety selection and biological controls are essential to producing a high quality crop.

All website addresses and links are listed in Section 11: References. A glossary of terms used in this guide is included at the end in section 12.

1. GENERAL ORGANIC MANAGEMENT PRACTICES

1.1 Organic Certification

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 National Organic Program (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 Farming Resource Center web page. See more certification details in this guide under Section 3.1: 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. More information can be found at the National Organic Program USDA Agricultural Marketing Service website.

1.2 Organic System Plan

An organic system plan (OSP) is central to the certification process and is a good management tool, regardless of whether or not certification is being sought. 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 can be very valuable in terms of anticipating 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. Certifying organizations may be able to provide a template for the farm plan. The following description of the organic system plan is from the

National Organic Program Handbook:

> A plan of management of an organic production or handling operation that has been agreed to by the producer or handler and the certifying agent and that includes written plans concerning all aspects of agricultural production or handling described in the Organic Food Production Act of 1990 and the regulations in Subpart C, Organic Production and Handling Requirements."

The National Sustainable Agriculture Information Service, (formerly ATTRA), has produced a Guide for Organic Crop Producers that includes a chapter on writing the organic system plan. The Rodale Institute has also developed resources for transitioning to organic and developing an organic system plan.

It is important to note that the USDA National Organic Program 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 to authorized representatives of USDA, including the certifying agent.

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. The minimum acceptable days to harvest interval for raw manure is 120 days (see National Organic Standards); buyers may require a period longer than 120 days between application and harvest however. Always maximize the time between the application of raw manure and harvest. It is important to never side dress with raw manure or use straw that has been used as animal bedding. 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. The practice of crop rotation to promote a healthy soil should be initiated in the one or two years prior to planting establishment or is limited to row middle in a perennial crop such as raspberries and blackberries. Organic growers must attend to the connection between soil, nutrients, pests, and weeds to succeed. Berry Soil and Nutrient Management: A Guide for Educators and Growers is available for free at: http://fruit.cornell.edu/berry/production/soilnutrientmgmt/. It is an excellent resource for information on managing soils for health, and includes an extensive discussion of the role of organic matter. This website also links to 12 webinars on soil and nutrient management in berry crops. Another excellent resource is Building Soils for Better Crops, 3rd edition, by Fred Magdoff and Harold Van Es, 2010, available from www.sare.org/publications/soils.htm, SARE, Sustainable Agriculture Research and Education. For more information, refer to the Cornell Comprehensive Assessment of Soil Health, along with Berry Soil and Nutrient Management - A Guide for Educators and Growers.

3. SITE SELECTION

For organic raspberry and blackberry production, the importance of proper site selection and preparation cannot be over-emphasized. Raspberry and blackberry plantings typically reach full productivity in the fourth year and can last for 10 to 15 years in organic production systems. This approach maximizes yields while soil nitrogen content and soil pathogens remain at acceptable levels for production. Consider that an ideal site should be close to your markets, be of sufficient acreage to allow for crop rotation, have available water of acceptable quality for irrigation and frost protection, have well-drained soil, and have good air drainage (slopes of 3-4% preferably facing north and away from prevailing winter winds). Sites should not have recently been cropped to plants susceptible to Verticillium wilt.

Conduct needed site improvements prior to planting. Once raspberries and blackberries are planted it is very difficult to make major changes to improve soil and air drainage, or to modify soil tilth, pH, or nutrient status. Improving soil structure or eliminating soil compaction layers in a planting becomes less feasible once the plants have become established.

Weather plays a critical role in site selection, as well. The macroclimate, mesoclimate and microclimate of a raspberry and blackberry site play important roles in variety selection and potential profitability. Of particular importance are the potential for spring frosts, winter minimum temperatures, length of the growing season, and growing season heat accumulation. More detailed information on the site selection information presented here also can be found in Raspberry and Blackberry Production Guide for the Northeast, Midwest and Eastern Canada, NRAES-35.

A web-based, interactive site selection tool, the New York Vineyard Site Evaluation System, www.nyvineyardsite.org, uses specific climate information with a 3 kilometer resolution, based on 30 years of weather data, to determine the suitability of your site for different grape varieties. Although the tool was developed for vineyards, the map-based system integrates information on climate,

topography, soils, and winter low temperatures much of which may be applicable to site selection for raspberry and blackberry varieties across the state.

3.1 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. Mandated one-year crop rotation out of raspberries and blackberries must be observed, though a 3-5 year rotation may prove more beneficial to break disease and insect life cycles and reduce pest pressure. Adequate buffer zones must exist between certified organic and conventionally grown crops to prevent drift of prohibited materials onto certified organic crops. The buffer zones must be either a barrier (diversion ditch or dense hedgerow) or an area of sufficient size. 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 National Organic Farmers Association of New York (NOFA NY) organic certification guidance manual states, "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.

3.2 Soil and Air Drainage and Soil Depth

Preparations for raspberry and blackberry production must begin at least one year in advance of planting. Selecting a site with good air and water drainage is essential for successful organic production. A nutritionally healthy planting in a well-drained soil with exposure to air movement is least susceptible to damage from pests and frosts.

Raspberries and blackberries need good internal soil drainage to grow and do best on a well-drained sandy loam. Wet soils restrict root growth and respiration, resulting in weak growth and reduced yields. Coarse-textured 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 planting 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. Perennial crops often require more intensive drainage than annual row crops so planting on raised beds or on berms can be useful to improve soil drainage in the rooting zone. Raised beds may be more prone to drying out, so the ability to provide an adequate water supply is also critical.

Air drainage is an important consideration in choosing a raspberry or blackberry field site. Cold air, like water, runs down hill, 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 frost damage. Selecting a site with a gentle slope (3-4%) and good air drainage will reduce the risk of cold or frost injury. Overhead irrigation, where available is also a frost protection option. Good air drainage will also promote faster drying of foliage, flowers and fruit which will reduce the duration and frequency of disease infection periods. Good air drainage is essential to an organic disease management strategy.

Although raspberries and blackberries can be grown on a variety of soils, shallow soils have less water holding capacity and will limit root development, resulting in smaller plants with smaller crops. Rooting depth of 18 inches or more is considered important for adequate plant 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.

3.3 Soil Testing

Knowing all you can about the soil of a potential raspberry and blackberry 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 6.0 to 6.5 is suggested for most raspberry and blackberry varieties. See Table 6.1 for soil and tissue testing laboratories and refer to section 6, Nutrient Management, for more information.

A nematode analysis performed on representative soil samples is a wise step in the year or two prior to planting since it will allow time for using a cover crop to reduce plant parasitic nematode populations, see section 4, Cover Crops, for more information. Samples may be submitted for nematode testing to the Plant Disease Diagnostic Clinic, College of Agriculture and Life Sciences, Ithaca, NY. For more information and fee schedules visit their website at www.plantdiinic.cornell.edu. The best time for collecting samples for nematode testing is during summer, when soils are moist, not dry. A minimum of 6 soil subsamples, approx. 1″ diameter and 4″ deep should be collected randomly from an area approx. ½ acre in size. Gently mix samples together, transfer about 1 pint of mixed soil to a plastic bag, and ship as soon as possible to the diagnostic lab. Refrigerate sample if it can not be shipped immediately.

3.4 Irrigation Water Source

Another important criterion to consider when selecting a raspberry and blackberry site is irrigation water quantity and quality. The irrigation water source should provide sufficient volume of water to irrigate as needed during the growing season. The irrigation system should be in place prior to planting to insure availability of water to new rootstock. Sprinkler irrigation may be used to provide frost protection of flowers and fruit on primocane-fruiting varieities in the early fall. Trickle irrigation uses water more efficiently than overhead irrigation and keeps plant foliage and fruit drier, which can help discourage the development of fungal and bacterial diseases. Trickle irrigation, however, cannot be used for frost protection purposes. Typical floricane-fruiting plants require 1 to 2 inches of rainfall per week, or 25 to 30 inches per season. The critical period when raspberries and blackberries require sufficient water to optimize growth and yield is during fruiting. Be sure to have a water test done on irrigation water sources prior to site selection to determine its physical, chemical, and biological constituents. Irrigation water pH should be 7.0 or below, and should also have a low salt content (<2.0 ds/m; preferably <1.0 ds/m) as raspberries and blackberries are salt-sensitive fruit crops. Always check with your certifier on the products used for lowering irrigation water pH. Water contaminated with sewage or manure should not be used for crop irrigation. Use only potable water to irrigate raspberries and blackberries during bloom and harvest. For more information on irrigation see: Raspberry and Blackberry Production Guide, NRAES-35.

4. COVER CROPS

Cover crops are grown for their valuable effect on soil properties, such as organic matter, and, in raspberries and blackberries, on their preplant ability to eliminate or suppress weeds, provide nutrients to the plants, and reduce nematode populations. They can also improve water infiltration into the soil, maintain populations of beneficial fungi, and may help control insects and diseases. To be effective, cover crops should be treated as any other valuable crop on the farm, with their cultural requirements carefully considered and met, including nutrient requirements; susceptibility, tolerance, or antagonism to root pathogens and other pests; life cycle; and mowing/incorporation methods. See Table 4.1 for more information on specific 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.

4.1 Goals and Timing for Preplant Cover Crops

Cover crops play an important role in a raspberry or blackberry planting, especially during the years prior to planting through improvement of soil organic matter, breaking up of compaction layers, erosion control, and suppression or elimination of weeds. Goals should be established for choosing a cover crop; for example, the crop can add nitrogen, smother weeds, or reduce nematode populations. The cover crop might best achieve some of these goals if it is in place for an entire growing season and incorporated into the soil prior to plant establishment.

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 early spring before planting. Certain cover crops (marigold, brassicas) will either suppress or resist nematode populations. These should be considered where reduction of nematode populations is needed. 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 before seed head formation.

Some growers may plant raspberries and blackberries into a mowed or killed sod of annual rye, rather than planting into bare soil. A sod residue suppresses weeds for several weeks while the raspberry or blackberry row becomes established, and minimal soil disturbance results in reduced weed seed germination. To use this system, seed grain rye in autumn, and mow it (at 18 inches) in spring when the rye plants start to flower. Wait a couple of days then plant into the rye residue. With this system, creating bare soil suitable for weed growth is minimized. Weeds may be controlled for 6 to 8 weeks after planting.

See Cornell's online 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.

Table 4.1. Cover Crops for Raspberries and Blackberries: Cultural Requirements and Crop Benefits

SPECIES	USE TIMING	PLANTING DATES	LIFE CYCLE	SOIL TYPE PREFERENCE	SEEDING (LB/A)	COMMENTS
Alfalfa [1]	Preplant	early April-late May	Perennial	Well-drained, high pH (6.0-7.0)	14	+May be difficult to incorporate if allowed to overwinter +Inoculate seed with nitrogen-fixing bacteria, if seeded in a field for the first time
Brassicas e.g. mustards, rapeseed	Preplant	April OR late Aug.-early Sept.	Annual /biennial	Loam to clay	5-12	+Good dual purpose cover & forage +Establishes quickly in cool weather +Mow or incorporate before seed formation +Biofumigant properties
Buckwheat	Preplant	Late spring-early summer	Summer annual	Most	45-55	+Rapid grower (warm season) +Good catch or smother crop +Good short-term soil improver for poor soils +Mow or incorporate before seed formation +Will winter kill
Cereal Rye	Preplant	August-early October	Winter annual	Sandy to clay loams	55-115	+Most cold-tolerant cover crop +Excellent allelopathic weed control +Good catch crop, rapid germination & growth +Mow or incorporate before seed formation +Temporary nitrogen (N) tie-up when turned under
Fescues fine (red, hard) tall	Row middles	April-May OR late Aug.-Sept.	Long-lived perennial	Most	70-100	+Very good low-maintenance permanent cover, especially in infertile, acid, droughty &/or shady sites +Can be incorporated preplant +Tall fescue has high vigor, requires more frequent mowing, and has moderately high water use +Fine fescues have low vigor, require less frequent mowing, and have moderate water use
Marigold	Preplant	Late May-June	Annual	Most	5	+Will winter kill +Biofumigant properties
Ryegrass	Row middles	August-early Sept.	Winter annual OR short-lived perennial	Most	9-16	+Temporary N tie-up when turned under +Rapid growth +Good catch crop +Heavy N & moisture users
Sorghum-Sudangrass	Preplant	June-August	Summer annual	NI	10-35	+Tremendous biomass producers in hot weather +Good catch or smother crop +Biofumigant properties
Spring Cereals (oats, barley)	Preplant	Mid-August to September	Summer annual	Silt and clay loams	90-115	+Incorporate in late June when planted in the spring +Rapid growth +Ideal quick cover crop
Vetch [1]	Preplant	August	Annual /biennial	Most	30-40	+Does not need added nitrogen +Mow or incorporate before seed formation
Wheat	Preplant	September-October	Winter annual	Most	75-120	+Mow or incorporate before seed formation

Adapted from M. Sarrantonio. 1994. Northeast Cover Crop Handbook; the Mid-Atlantic Berry Guide for Commercial Growers. 2008. Penn State Univ; the Pest Management Guidelines for Berry Crops. 2009. Cornell Univ.; and L. Bushway, M. Pritts and D. Handley, eds. 2008. Raspberry and Blackberry Production Guide, NRAES-35.

[1] Legumes may benefit from inoculation of seed with nitrogen-fixing bacteria when planted in a field for the first time. Check with your certifier for allowable sources of inoculum.

Allowing cover crop residue to remain on the soil surface might make it easier to fit into a crop rotation and will help to conserve soil water. Keep in mind that some of the nitrogen contained in the residue will be lost to the atmosphere, and total organic matter added to the soil will be reduced. Turning under the cover crop will speed up decomposition and nitrogen release from the crop residue. Cover crops such as grasses with low nitrogen content should be plowed under in the fall to allow time for decomposition prior to planting. Legumes, which contain more nitrogen and decompose more quickly, can be plowed under within a month of planting.

4.2 Cover Crops for Row Middles

Use of cover crops in the row middles (the area between the plant-rows) in raspberry and blackberry plantings can have both beneficial and detrimental impacts, but most growers consider the benefits to outweigh the disadvantages. The main disadvantages are the cost of establishment and competition that can occur. In some areas prone to spring frost, bare soil middles provide greater protection because the dark soil holds more heat. However, even without planting a specific cover crop between rows, the middle vegetation will need to be managed, either by regular mowing or cultivating. Permanent row-middle alleyways require regular mowing as well, but the advantages are improved traction for equipment, reduced soil rutting and compaction, little dust, mud, and erosion, biodiversity for the planting agroecosystem, and increased soil organic matter. Growers like the ability to work in the fields shortly after a rain, which may not be possible with bare or weedy alleyways.

The types of sods suggested for permanent row middles are several species of fescues, or perennial ryegrass (Table 4.1). These species are relatively tolerant of low fertility, drought, and disease, compete with weeds effectively, and do not spread into planting rows. These sods are often sold in companion mixes to ensure rapid establishment and sustained competitive ability.

Although perennial grasses are preferred, it is possible to plant different species, such as legumes, in the row middles. These species should be able to outcompete most weeds and have low water use requirements. Bear in mind that both cover crops and weed species may become infected with and serve as reservoirs of the soilborne ringspot viruses (Tomato ringspot virus and Tobacco ringspot virus) which, in the presence of the nematode vector, can infect raspberries and blackberries, leading to a slow decline in vigor or plant death.

5. VARIETY SELECTION

Raspberries and blackberries are classified as floricane (summer) or primocane (fall) bearing varieties depending on the age of the canes that fruiting bodies will appear. These two types of production can further be classified into early, mid-season, and late season varieties depending on when fruit ripens. Consider the needs of your market when selecting raspberry and blackberry varieties and maximize your returns by choosing varieties that bloom and mature at staggered times during the season, according to your market's preferences and availability of labor to harvest the crop. By planting multiple cultivars it is now possible to have fruit from mid to late June until frost in much of NY, with only a short decrease in production during the late summer.

In organic raspberry and blackberry production, the variety's relative resistance or susceptibility to fungal diseases can be an important decision factor because of the limited number of organic fungicides that are available for disease management. Resistant varieties, where known, are listed in the disease management tables in section 7. If susceptible varieties are considered, the importance of site, canopy management, sanitation and the selection of proper fungicides and application procedures will increase. Overall, for successful organic production, raspberry and blackberry varieties should be vigorous enough to tolerate marginal conditions, weed competition, and be less prone to fruit rots.

Varieties which have the best potential for organic production in New York State include:

Floricane (summer) bearing:

- Early season: Prelude, Killarney
- Mid-season: Nova, Double Gold (golden fruit)
- Late season: K81-6, Royalty (purple fruit), Brandywine (purple fruit)
- Black raspberries: Bristol, Jewel, MacBlack
- Blackberries: Chester, Triple Crown

Primocane (fall) bearing:

- Early season: Autumn Bliss
- Mid-season: Caroline, Joan J
- Late season: Heritage, Josephine, Crimson Giant, Double Gold (golden fruit)

Varieties vary widely in their susceptibility to fungal diseases and some may be less susceptible to insects. A variety of fruit colors are widely available for production in the Northeast. These include cultivars of black, purple, red and golden raspberries. Different colored cultivars may be more susceptible to disease or winter damage. Black raspberries, for example, may winter kill if temperatures drop to -5°F in combination with dry winds and have a shorter harvest season than red raspberries. They are also quite susceptible to viral infections, Verticillium wilt, and rusts. If susceptible varieties are planted, the importance of site, sanitation and cultural practices will increase in accordance to the variety's susceptibility.

Growers must also consider where they obtain their planting stock. According to language in the USDA-NOP regulation §205.202, "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." With the limited availability of organically certified planting material, raspberry and blackberry growers will likely be able justify the use of non-organic sources to their certifying agency.

6. 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. In raspberry and blackberry plantings, the key considerations when managing nutrition organically include preplant soil pH and nutrient adjustments; nutrition in established plantings; and understanding carbon to nitrogen ratios to deliver appropriate amounts of nitrogen to the crop.

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 partides 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.

One goal of the grower is to heighten resource use efficiency (land, water, nutrients) to optimize plant growth and fruit yield. Plant size and yield can be influenced by water and nutrient supply (i.e. adequate water is needed for adequate nutrient uptake). Weak plants with few, small leaves will intercept insufficient sunlight to produce adequate yields in the current season or to develop flower buds for the next season. Conversely, over-stimulated plants with abundant large, dark green leaves have low water use efficiency, are more prone to winter injury, diseases and insect feeding, and produce fewer fruit. Organic raspberry and blackberry plantings should strive to balance soil nutrient availability—via irrigation, organic matter content, soil pH, and microbial activity—with plant growth and production goals.

Nutrient demand is greatest during leaf and fruit development in spring when reserve nutrients carried over from the previous year have been used up and the plant is actively growing. Plant age, vegetative growth, and fruit yield are the deciding factors in determining the need for nutrients during the growing season.

A webinar series specifically about soil and nutrient management in berries is archived at: http://www.fruit.cornell.edu/berry/production/soilnutrientmgmt/ along with Berry Soil and Nutrient Management - A Guide for Educators and Growers, http://www.fruit.cornell.edu/berry/production/soilnutrientmgmt/pdfs/BerrySoilandNutrientManagementGuide.pdf .

6.1 Soil and Leaf Analysis

Regular soil and leaf analysis helps monitor nutrient levels. Choose a reputable nutrient testing lab (see Table 6.1) and use it consistently to avoid discrepancies caused by different extraction methods. It is recommended that leaf testing be incorporated into a fertility management program with soil testing to assist in determining the plants' nutrient status and to make sure that what is in the soil is making it into the plants in the proper amounts. It is recommended that soil and leaf tests be completed in each block. Leaf testing is especially crucial in getting the information needed to make management decisions in problem areas of the planting and should be used on a more frequent basis, if needed.

Table 6.1. Nutrient Testing Laboratories					
Testing Laboratory	Web URL	Soil	Leaf	Compost/ Manure	Forage
Agro-One (Cornell Recommendations)	dairyone.com/analytical-services/agronomy-services/about-agro-one/	x	x	x	x
Agri Analysis, Inc.	www.agrianalysis.com/		x	x	
A&L Eastern Agricultural Laboratories, Inc.	www.al-labs-eastern.com/	x	x	x	
Penn State Agricultural Analytical Services Lab.	www.aasl.psu.edu/	x	x	x	
University of Massachusetts	www.umass.edu/soiltest/	x	x	x	
University of Maine	anlab.umesci.maine.edu/	x	x	x	x

Table 6.2 gives the target values for raspberry and blackberry leaf nutrients sampled in late July or early August 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. 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. Deficient, sufficient, and excessive nutrient concentrations in leaves.				
		Target values (ppm, unless otherwise noted)		
Nutrient	Symbol	Deficient Below	Sufficient	Excess Above
Nitrogen	N	1.90%	2.00-3.00%	4.00%
Phosphorus	P	0.20%	0.25-0.40%	0.50%
Potassium	K	1.30%	1.50-2.50%	3.50%
Calcium	Ca	0.50%	0.60-2.00%	2.50%
Magnesium	Mg	0.25%	0.60-0.90%	1.00%
Sulfur	S	0.35%	0.40-0.60%	0.80%
Boron	B	23	30-70	90
Iron	Fe	40	60-250	350
Manganese	Mn	35	50-200	350
Copper	Cu	3	6-20	30
Zinc	Zn	10	20-50	80

Adapted from: Pritts (2008) Soil and Nutrient Management. Chpt 7 In: Raspberry and Blackberry Production Guide. L. Bushway, M. Pritts and D. Handley (eds.). NRAES-35. Ithaca, NY.

Note: ppm is parts per million.

% by dry weight of leaf

6.2 Soil pH

Maintaining a soil pH range of 6.0 to 6.5 is recommended for raspberries and blackberries. Use the soil test results to determine the appropriate amount of lime (raise pH) or sulfur (lower pH) to apply. The lime or sulfur requirement will depend on soil texture, current pH, and organic matter content. Follow the recommendations of the soil test and apply and incorporate sufficient lime or sulfur prior to planting. It typically takes one year for the applied lime or sulfur to raise or lower the soil pH, respectively. The slightly acid soil pH of 6.0-6.5 is required to help avoid micronutrient deficiencies.

Prilled sulfur formulations are preferred for soil application because they are easier to work with, provide better coverage, and are cheaper than powdered sulfur. Prilled sulfur takes about one year or more to oxidize and reduce soil pH; powdered sulfur takes 6 to 9 months. Likewise, finely ground lime is more difficult to work with, but it will raise the soil pH faster than coarse particles.

6.3 Managing Nutrients

Follow the recommendations of the soil test when adding nutrients to prepare a site for planting. Pay particular attention to the soil test results for potassium, phosphorus, magnesium, calcium, and boron. If interpreting your own soil tests, it is important to know the phosphorus extraction method used by your analytical lab in order to get a proper recommendation. When preplant recommendations are followed, additional potassium and phosphorus likely will not be required unless the soil is very sandy.

However, potassium (K) demand by raspberry and blackberry plants is relatively high, so make certain there is sufficient available potassium in the soil before planting. Boron is frequently low in fruit plantings throughout the Northeast. Refer to CALCULATING THE AMOUNT OF PESTICIDE TO USE and Tables 9.1, 9.2, and 9.3 in Section 9.1 for converting amounts per acre to amounts needed for smaller areas and for measuring and mixing small amounts.

In established plantings, base fertilizer amounts on leaf analysis. In the event that potassium is required, a reasonable amount of potassium to apply, preferably in the fall, is up to 100 lb/acre. See table 6.3 for organic sources of potassium. Pay attention to the K/Mg ratio and if it is above 4, then additional magnesium should be applied with the potassium fertilizer to prevent inducing a magnesium deficiency: the K/Mg ratio should be less than 5.

Magnesium (Mg) deficiency in raspberries and blackberries is relatively common, especially on sandy or acidic soils. Factors that influence magnesium availability include soil pH and excess potassium. In established plantings that are low to deficient in magnesium, typical recommendations would be for 10-40 lb/acre actual magnesium, but follow recommendations of the leaf analysis.

Table 6.3. Available Potassium in Organic Fertilizers

Sources	Pounds of Fertilizer/Acre to Provide given Pounds of K_2O per acre:				
	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)**	8000	16000	24000	32000	40000
Potassium sulfate 50% K_2O	40	80	120	160	200

*Only non-GMO sources of alfalfa may be used. Check with your certifier.

**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. Available Phosphorous in Organic Fertilizers

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

* 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.

Boron is frequently low in fruit plantings throughout the Northeast. If boron is required, then apply no more than 2 lb/acre actual boron in any one year. The best time to apply boron is prior to fruiting in primocane-fruiting varieties and mid-summer for other types. Check with your certifier for information on allowable sources of magnesium and boron.

Phosphorus demand by raspberries and blackberries is relatively low, and phosphorus is usually not required in established plantings. In most cases excess P is more of a concern. Table 6.4 lists some organic fertilizer sources of P.

6.4 Preparing a Nitrogen Budget

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 material undergoing decomposition has an initially high C/N ratio (very little nitrogen), microbes will use whatever nitrogen is available for their own growth, leaving little for plants. This can result in temporary nitrogen deficiency. Once the decomposition process begins to slow and those microbes die off, they will release their nitrogen back into the soil where it will become available to plants. The rule of thumb is that if the C/N ratio is less than 20 or the material's nitrogen content is greater than 2.5%, then there will be enough nitrogen available for both decomposer microbes and plants. If the C/N ratio is above 20, then nitrogen will likely be immobilized until sufficient decomposition has taken place. One reason that additional nitrogen is recommended for plantings mulched with sawdust or wood chips (plantings with a high C/N ratio) is to help overcome the temporary nitrogen deficiency that occurs during the decomposition of wood.

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.

Management of N, and insuring adequate supply at the times of crop need, requires some planning. Prepare a nitrogen budget for organic production to estimate the amount of N released by various organic amendments as well as native soil organic matter. Examples of manures and their nutrient content are shown in Table 6.5. 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 6.1). Knowing these values will help evaluate if the budget plan is providing appropriate amounts of N during the season by comparing them to the nitrogen guidelines for raspberries and blackberries (Table 6.6)

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, 50 lbs. would be available the first year, 25 lbs. the second, and 12.5 lbs. the third. 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 raspberry and blackberry plantings.

Table 6.5. 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.

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 different types of organic matter to these organisms is essential to helping build this type of diverse biological community and ensuring long-term organic soil and crop productivity.

Table 6.6. Annual Nitrogen Guidelines for Raspberries and Blackberries.

Planting Age (years)	Amount Actual N (lbs/Acre)	Timing
Floricane (summer) bearing		
0	25-35	4 weeks after planting
1	35-55[a]	May or split between May and June
2+	40-80[a]	May or split between May and June
Primocane (Fall) bearing		
0	25	4 weeks after planting and in August
1	50-80[a]	Split between May and June
2+	70-100[ab]	Split between May and June

[a] Use higher amount on sandier soils or if irrigation is used

[b] Adjust amount based on leaf analysis.

The annual nitrogen guidelines for raspberries and blackberries are outlined in Table 6.6. Use leaf analysis for determination of nutrient status in established plantings, and adjust nitrogen fertilization accordingly (see section 6.1). 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 (see Tables 6.5 and 6.7). These products can be expensive, so are most efficiently used if applied in a 3 foot band over the plant row, splitting applications between May and early June. Be aware that spring applications of nitrogen can greatly increase the risk of gray mold fruit rot infections.

Table 6.7 lists some commonly available fertilizers, their nutrient content, and the amount needed to provide different amounts of available nitrogen, adapted by Vern Grubinger from the University of Maine soil testing lab.

Table 6.7. Available Nitrogen in Organic Fertilizers

	Pounds of Fertilizer/Acre to Provide given 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)*, 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)*	200	400	600	800	1000

* Application rates for some materials are multiplied to adjust for their slow to very slow release rates.

7. ORGANIC RASPBERRY AND BLACKBERRY IPM

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

7.1 Developing a Raspberry and Blackberry IPM Strategy

1. Examine your raspberry and blackberry operation closely. Break it down into specific plantings, or "blocks."
2. Produce a map of each planting (or block) to record weeds, pest outbreaks, nutrient deficiencies, drainage problems, missing plants, and any other abnormalities you find.
3. Develop a record-keeping system for each planting or block.
4. Develop a scouting plan for each 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, select appropriate nozzles, and reduce spray drift. Consult the Pesticide Application Technology website at Cornell University: http://web.entomology.cornell.edu/landers/pestapp/ or the Raspberry and Blackberry Production Guide for the Northeast, Midwest, and Eastern Canada, NRAES-35 available for purchase from: http://palspublishing.cals.cornell.edu/.
8. Develop a thorough knowledge of the raspberry and blackberry 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 planting (or 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 IPM website: nysipm.cornell.edu/fruits/
Cornell Fruit Resources: www.fruit.cornell.edu
New York State berry IPM insect and disease fact sheet index: nysipm.cornell.edu/factsheets/berries/
Cornell University Pesticide Management Education Program: pmep.cce.cornell.edu/
Pesticide Application Technology at Cornell University: http://web.entomology.cornell.edu/landers/pestapp/
Elements of IPM for Raspberries in New York State www.nysipm.cornell.edu/elements/raspb.asp
Network for Environment and Weather Applications (NEWA) newa.cornell.edu
Berry Diagnostic Tool www.hort.cornell.edu/diagnostic

7.2 Weed Management

Weeds are a fundamental part of the raspberry and blackberry planting ecosystem. Weeds can compete for water and nutrients; provide alternate hosts for pests; and interfere with planting operations. Weed growth can also alter the microdimate around plants, leading to higher spotted wing drosophila and disease pressure. Managing weed or cover crop growth in row middles can be a powerful tool for minimizing erosion, and improving equipment access in wet seasons. For more information on cover crops, refer to section 4.

Table 7.2.1 Weed management without herbicides in floricane-fruiting (summer fruiting) raspberries and blackberries.

Year	Month	Non-herbicidal options
Planting year*	April	Till to prepare for planting unless planting into killed sod.
	April - June	Hand weed in-row and apply mulch. Mow row middles and planting borders to keep weeds from producing seeds.
	After planting	Hand weed in-row. Mow row middles and borders.
Fruiting years	March - June	Hand weed in-row. Mow row middles and borders.
	June-August	Hand weed in-row. Mow row middles and borders.
	After harvest	Remove floricanes. Mow row middles and borders.

*Critical time for reducing weeds.

Table 7.2.2 Weed management without herbicides in primocane-fruiting (fall fruiting) raspberries.

Year	Month	Non-herbicidal options
Planting year*	April	Till to prepare for planting, unless planting into killed sod.
	April - May	Hand weed in-row and apply mulch. Mow row middles and planting borders.
	Mid-June - October	Hand weed in-row. Mow row middles and borders.
Fruiting years	March - June	Mow canes to ground before new canes emerge. Hand weed in-row. Mow row middles and borders.
	June -October	Mow between rows or hand weed only.
	After harvest	Mow rows to the ground in late fall or in early spring before new primocanes emerge.

*Critical time for reducing weeds.

Good preplant preparation, plant establishment, and use of cover crops in the alleyways or 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.

Minimizing weed competition during plant establishment is critical to achieve optimal plant growth and yields. One approach is to use synthetic mulch such as thick plastic on each side of the plant row in the year of establishment and then roll it off at the end of the season. In organic production in NY, plastic mulch must be removed from the ground each year at the end of the growing or harvest season. However, biodegradable starch-based mulch produced without organisms or feedstock derived from exduded methods may be able to remain (check with your organic certifier). In mature plantings, productivity of raspberry and blackberry bushes can be limited due to weed competition. Some level of weed control is usually necessary, as described in Tables 7.2.1 and 7.2.2, to limit weed growth into the plant canopy which can interfere with sunlight penetration and lead to higher spotted wing drosophila and disease pressure.

Cultivation is sometimes used as a row-middle weed management tool. However, continuous or 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. Cultivation should be minimized because the raspberry and blackberry root system is very shallow. If cultivation is used for row middle management, it is suggested that negative effects be limited by cultivating only (1) enough to suppress weed growth, (2) to shallow (1-2") depths, and (3) with the goal of reducing, rather than completely eliminating, weed or cover crop growth.

Grasses (ryegrass, fescue) can be planted between rows and managed with regular mowing to minimize weeds within the planting. Grasses provide winter cover for row middles and a good surface for equipment and foot traffic. Because fescues do not tiller they will not invade the plant row and, therefore, are excellent plants for the row middles. See section 4 for more information on appropriate ground covers for raspberry and blackberry plantings or consult the Raspberry and Blackberry Production Guide (NRAES-35).

Managing weeds within the row may be one of the most difficult tasks in the production of organic raspberries and blackberries. Yet it is essential because of the low competitive ability of the crop. Organic mulches used as tools for weed management are most effective in the planting year and in sites with low soil moisture and fertility. Potential organic mulches for use within the row include straw, hay, sawdust and wood chips. In raspberries and blackberries, mulches are only recommended for the first few months after planting because prolonged mulching can create conditions favorable for root diseases. Straw mulch may serve as a major source of weed seed; be sure to inspect straw before purchase. Use of straw or hay mulch between the rows for suppression of weed growth is not recommended.

There are a number of mechanical, thermal and animal measures that can be used to limit the effects of weeds in a raspberry or blackberry planting. Mechanical and thermal options include fixed hoes, rotary cultivators, flamers, steamers, and hot water applicators. 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, animals should be used during the planting (non-bearing) year only.

It is important to keep areas around the field mowed to prevent weed seeds from blowing into the planting. Also, cultivating, mulching, and pulling weeds by hand help maintain weed-free plantings, as outlined in Tables 7.2.1 and 7.2.2. An organic herbicide strategy alone cannot provide satisfactory weed control for organic growers.

Herbicides are applied in a dilute spray in a 4 foot strip under the plant. Consult the pesticide label for specifics on how to apply the pesticide. Note that you may need to use up to 100 gallons of solution per sprayed acre.

Note: An organic herbicide strategy alone cannot provide satisfactory weed control for organic raspberry & blackberry growers.

At the time this guide was produced, the following materials were labeled 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 (DEC) to be used legally in NY. Those pesticides meeting requirements in EPA Ruling 40 CFR Part 152.25(b) (also known as 25(b) pesticides) do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System (PIMS) **website** http://pims.psur.cornell.edu. **ALWAYS CHECK WITH YOUR CERTIFIER** before using a new product.

Table 7.2.3. Organic Herbicides Labeled for Management of Weeds in Raspberry & Blackberry

Trade Name (*active ingredient*)	Product Rate	PHI (days)	REI (hours)	Efficacy[1]	Comments
AXXE Broad Spectrum Herbicide *(ammonium nonanoate)*	6-15% solution	-	24	?	Apply spray until the undesirable plants are fully wetted with the herbicide solution.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.3 Principles of Insect and Disease Management

While raspberry and blackberry production may be severely limited by insect pests and plant diseases, an understanding of the factors involved in their development can ensure effective management. The development of disease and insect damage is highly dependent on characteristics and conditions of the crop (host), the pathogen/pest population, and the environment. These factors all must be conducive before disease development and/or considerable insect damage will occur.

Pruning and trellising practices can promote plant health in the raspberry or blackberry planting, some key considerations include:

- Prevent horizontal growth of canes
- Keep fruit off the ground
- Promote air drainage
- Keep plant row middles open to allow for mowing and air flow
- Allow for ease of harvest

Characteristics of the host that influence disease and pest susceptibility include the host's vigor, physiology, and variety (genetics). Aggressiveness or virulence, abundance, and physiology are characteristics of the pest or pathogen populations that influence their ability to cause disease or damage. At the same time, abiotic environmental conditions such as temperature, moisture, light, and soil chemistry can affect both the host and pest and may promote or prevent disease. Moreover, the presence, abundance and activity of natural enemies can play an important role in determining pest status. The most successful disease pathogens and insect pests have coevolved with their hosts over many years to incite disease and damage at the most opportune times. To successfully

minimize disease and pest damage, the relevant aspects of the host, pathogen/pest, and environment must all be managed within specific timeframes.

Although insect pests and plant disease pathogens are vastly different in their biology, they often have enough similarity in life history strategies to allow successful management under a single set of underlying principles. These principles include avoidance/exclusion, eradication, and protection. They are defined below.

Avoidance/exclusion:

This principle focuses on preventing pathogen introduction and minimizing factors that favor the establishment of pests and pathogens. Several practices that exclude or limit pathogen and pest presence include the following:

- Select sites with good soil drainage. Install tile in plantings with less than optimal drainage and/or incorporate raised beds or berms to further promote soil drainage.
- Choose sites with good air drainage. Promote air circulation by selecting an open site, removing dead or senescent plant material and reducing weeds; these practices allow fruit and leaves in berry plantings to dry more quickly.
- Plant only disease free and insect free planting stock.
- Practice weed management as weeds can be hosts for raspberry and blackberry pathogens and arthropod (insect and mite) pests.
- Avoid planting raspberries and blackberries in proximity to other crops or habitats that harbor large pathogen and/or pest populations.
- Plant raspberries and blackberries under covered production to avoid outside sources of disease inoculum.

Eradication:

This principle is concerned with the destruction of pathogen/pest populations. These practices include:

- Sanitation of plantings by removal of infected/infested plant material including overripe fruit, leaf litter, and plants to eradicate pathogen and pest populations. Destruction of this material is accomplished through burning, chipping, burying, and composting.
- Several biological control alternatives are available for insect suppression for raspberry and blackberry crops including products based on formulated *Bacillus thuringiensis* and insectary-reared predatory mites. Currently, there are consistently reliable biological control products that have been developed for managing raspberry diseases, although there are numerous biopesticides that are available and effective in low disease pressure situations.
- Chemical application of fungicides, insecticides, and miticides may reduce pathogen and pest populations below damage thresholds, but will rarely eradicate them.

Protection:

This principle is founded on protection of plants from pathogen infection and pest damage. Practices that protect plants by minimizing factors favoring infection and damage include the following:

- Plant raspberry and blackberry varieties that are disease resistant or less susceptible to diseases of concern.
- Avoid excessive nitrogen fertilization as many pathogens, insects and mites thrive on succulent tissues.
- Harvest fruit promptly and cool it to protect from fruit rots and insect infestations on overripe fruit.
- Applications of fungicides, insecticides, or miticides may protect susceptible tissues from disease and insect damage.
- Plant raspberries and blackberries under covered production to protect against rainfall, which is the primary factor driving infection and spread of disease.

7.4 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.

7.4.1 ANTHRACNOSE ***(Elsinoe veneta)***

Small, purple spots scattered over young canes appear in the spring. The spots enlarge to about one eighth inch in diameter, become sunken in the center, and turn gray with a purple border. Many spots can run together to form large sunken diseased areas on the cane. This disease is generally much more severe on black and purple raspberries than on red varieties. The disease can infect the canes, leaves, fruit, and stems of berry clusters. Infected canes become more susceptible to winter injury and other diseases than healthy canes.

Anthracnose Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No known resistant varieties. 'Boyne', 'Killarney', 'Qualicum', 'Bristol' (black), and Redwing are particularly susceptible varieties. 'Blackhawk' (black) and 'Jewel' (black) are varieties that may be less susceptible.
Cultural management	Remove and burn any diseased canes before new canes emerge in the spring. Prune bushes to maintain good air circulation. Further promote air circulation by controlling weeds and establishing narrowing fruiting rows. Single-cropping systems may reduce the disease prevalence compared to double-cropping.
Chemical Treatment	Apply a delayed dormant spray[1] of lime sulfur or copper.

[1] This "delayed dormant" application has always been the most important spray for the control of the major cane diseases. Thorough coverage is essential for control; therefore, this spray should be applied on a calm day and in a sufficient amount of water to soak the canes completely. Sprays applied after half inch green-tip may burn the leaves, particularly in warm weather.

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Table 7.4.1 Pesticides Labeled for Management of Anthracnose

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Agricure (potassium bicarbonate)	2-5 lbs/acre	0	1	?	
Badge X2 (copper hydroxide, copper oxychloride)	1-3.5 lb/acre	0	48	1	Use 1-2.25 lb/acre when leaf buds begin to open and then again when flower buds show white. Use 1.75-3.5 lb/acre in the fall after harvest.
Basic Copper 53 (basic copper sulfate)	2.0-3.7 lb/acre	up to day	48	1	
Champ WG (copper hydroxide)	2 or 4 lbs/acre	-	48	1	May cause crop injury under some conditions.Use 2 lb/A when leaf buds begin to open and again when flower buds show white. Use 4 lb/A for fall application after harvest. Use with 1 quart of superior-type oil per acre.
CS 2005 (copper sulfate pentahydrate)	19.2 or 32 oz/acre	0	48	1	Use 19.2 oz/A when leaf buds begin to open and again when flower buds show white. Use 32 oz/A for fall application after harvest.
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	?	Do not mix with other pesticides or fertilizers. Not compatible with alkaline solutions.
Nordox 75 WG (cuprous oxide)	1.25 to 6.5 lb/acre	-	12	1	See label for specific rates and application timing.
Nu-Cop 50DF (copper hydroxide)	2 or 4 lbs/A	1	48	1	See label for specific rates and application timing.
Nu-Cop HB (copper hydroxide)	1-4 lbs/A	-	48	1	See label for specific rates and application timing.Discontinue use if signs of

Table 7.4.1 Pesticides Labeled for Management of Anthracnose					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
					phytotoxicity appear.
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	?	See label for specific use directions.
Trilogy (neem oil)	1% solution	up to day	4	?	Maximum labeled use of 2 gal/acre/application.Do not apply while bees are actively visiting.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.4.2 SPUR BLIGHT *(Didymella applanata)*

Symptoms of spur blight include chocolate brown or purple blotches centered on individual buds that appear on canes in mid to late summer. Buds within the discolored areas either fail to grow or produce weak shoots the following year. Symptoms often become established during bud break to early prebloom, however wet conditions during the early spring favor disease development. Red raspberry varieties are much more susceptible than other varieties. Summer fruiting cultivars are also more susceptible to infection.

Spur Blight Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No known resistant varieties. Particularly susceptible varieties include 'Royalty', 'Titan', 'Canby', 'Williamette', 'Reveille', 'Festival' and 'Sentry'. Less susceptible varieties include 'Brandywine', 'Killarney', 'Latham', 'Newburgh', and 'Algonquin'.
Cultural management	Prune and burn or remove diseased canes before new canes emerge in the spring. Maintain good air circulation by controlling weeds and establishing narrow fruiting rows. Avoid application of excess nitrogen to decrease excessively vigorous plantings.
Chemical Treatment	Apply a delayed dormant spray[1] of lime sulfur or copper.

1 This "delayed dormant" application has always been the most important spray for the control of the major cane diseases. Thorough coverage is essential for control; therefore, this spray should be applied on a calm day and in a sufficient amount of water to soak the canes completely. Sprays applied after half inch green-tip may burn the leaves, particularly in warm weather.

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Table 7.4.2 Pesticides Labeled for Management of Spur Blight

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	?	See label for specific use directions.
Regalia *(Reynoutria sachalinensis)*	1-4 qts/acre	0	4	?	

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.4.3 CANE BLIGHT OR SPOT *(Leptosphaeria coniothyrium)*

The disease causes weak growth of some or all of the fruiting laterals, followed by wilting of the leaves above the blighted area. Dark brown or purple cankers appear on the main cane or on laterals below the wilt symptoms, often extending several inches along the cane. Cane tissue in the infected region is weak and bends easily. Infection sites are usually associated with pruning wounds or other injuries, but they are not always obvious. Compared to spur blight, cane blight is more likely to involve whole canes and is not strictly confined to the areas surrounding buds. It is most common in black and purple raspberries because of tipping practices, although red raspberries are reported to be equally susceptible. Infections most often occur from late April to early May making summer fruiting cultivars more susceptible.

Cane Blight or Spot Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No known resistant varieties.
Cultural management	Remove and burn diseased canes before new canes emerge in the spring. If the disease appears on red varieties, try to determine and eliminate the source of injury.
Chemical Treatment	Apply a delayed dormant spray[1] of lime sulfur or copper.

[1] This "delayed dormant" application has always been the most important spray for the control of the major cane diseases. Thorough coverage is essential for control; therefore, this spray should be applied on a calm day and in a sufficient amount of water to soak the canes completely. Sprays applied after half inch green-tip may burn the leaves, particularly in warm weather.

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Table 7.4.3 Pesticides Labeled for Management of Cane Blight or Spot

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	?	See label for specific use directions.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.4.4 POWDERY MILDEW *(Sphaerotheca macularis)*

Infected leaves are covered with a white powdery layer of mycelium and spores, and may curl upwards. Some cultivars simply develop chloroticblotches on the leaf surfaces. Severely infected developing shoots may become long and spindly with stunted leaves. Raspberries grown under tunnels or in greenhouses are particularly susceptible to infection. Black raspberry cultivars are generally more susceptible than red. Blackberries are not prone to powdery mildew.

Powdery Mildew Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Particularly susceptible varieties include 'Canby', 'Rosanna', 'Royalty', 'Reveille', and 'Latham'. Less susceptible varieties include 'Titan', 'Prelude', 'Encore', 'K81-6', 'Moutere', 'Killarney', 'Crimson Giant', 'Heritage', 'Autumn Britten', 'Autumn Bliss', 'Jaclyn', 'Joan J', 'Caroline', 'Polka', 'Himbo Top', 'Ruby' and 'Bristol' (black).
Cultural management	Prune to maintain good air circulation within the planting and remove late-developing primocanes that may be infected. The disease is best managed by avoiding susceptible varieties. This disease may be more problematic in covered production where air circulation is reduced.
Chemical Treatment	Generally chemical control for the pathogen is not warranted, however there are fungicides labeled for use. Chemical applications may also provide protection against gray mold, anthracnose, spur blight, and cane blight.

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Table 7.4.4 Pesticides Labeled for Management of Powdery Mildew

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Acoidal (sulfur)	6-15 lb/acre	-	24	1	Do not use on sulfur sensitive varieties.
Actinovate AG (*Streptomyces lydicus* WYEC 108)	3-12 oz/acre	0	until dry	?	For best results apply with a spreader/sticker prior to onset of disease. Re-apply at 7-14 day intervals depending on disease pressure and environmental conditions.
Agricure (potassium bicarbonate)	2-5 lbs/acre	0	1	?	
Cinnerate (cinnamon oil)	13-30 fl oz/100 gal water	-	-	?	25(b) pesticide
Defend DF (sulfur)	6-15 lb/acre	-	24	1	Do not use on sulfur sensitive varieties.
DES-X (insecticidal soap)	2% formulation sprayed at 75-200 gallons/acre	1/2	12	?	
Glacial Spray Fluid (mineral oil)	0.75-1.5 gal/100 gal water	up to day	4	1	See label for specific application volumes and equipment
GrasRoots (cinnamon oil)	1 part GrasRoots: 9 parts water	-	-	?	25(b) pesticide.
JMS Stylet-Oil (paraffinic oil)	3-6 qt/100 gal water	0	4	1	A high volume of water is needed for through coverage. Many common pesticides are phytotoxic when applied with or close to oil sprays (e.g., sulfur). Check label for restrictions.

Table 7.4.4 Pesticides Labeled for Management of Powdery Mildew					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Kaligreen (potassium bicarbonate)	2.5-3 lb/acre	1	4	1	Do not mix with highly acidic products or nutrients.
Micro Sulf (sulfur)	6-15 lb/acre	-	24	1	Some varieties may be sensitive to sulfur.
Microthiol Disperss (sulfur)	6-15 lb/acre	-	24	1	Not recommended within 2 weeks of an oil application nor if temperatures are expected to exceed 90 degrees within 3 days following the application.
Mildew Cure (garlic oil, cottonseed oil, corn oil)	1% solution	-	-	?	25(b) pesticide. Conduct phytotoxicity test prior application.
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	1	Do not mix with other pesticides or fertilizers. Not compatible with alkaline solutions.
Nuke Em (citric acid)	Normal: 1 fl oz/31 fl oz water	-	-	?	25(b) pesticide
Omni Supreme Spray (mineral oil)	0.75-1.5 gal/acre	-	12	?	See label for specific precautions.
Organocide (sesame oil)	1-2 gal/100 gal water	-	-	?	25(b) pesticide
Oxidate 2.0 (hydrogen dioxide, peroxyacetic acid)	128 fl oz/100 gal water curative 32 fl oz/100 gal water preventative	0	until dry	1	See label for specific use directions.
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	1	See label for specific use directions.
PureSpray Green (white mineral oil)	Dilute: 0.75-1.5 gal/100 gal water. Concentrate: 1.5-3 gals/A	up to day	4	1	
Regalia (*Reynoutria sachalinensis*)	1-4 qt/acre	0	4	?	
Sil-Matrix (potassium silicate)	0.5-1% solution	up to day	4	?	
SuffOil-X (aliphatic petroleum solvent)	1-2 gal/100 gal water	up to day	4	?	Do not use in combination with or immediately before or after spraying with fungicides containing sulfur.
Thiolux (sulfur)	6-12 lb/acre	-	24	1	
Trilogy (neem oil)	1% solution	up to day	4	?	Maximum labeled use of 2 gal/acre/application. Do not apply while bees are actively visiting.

Table 7.4.4 Pesticides Labeled for Management of Powdery Mildew					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
TriTek (mineral oil)	1-2 gal/100 gal water	up to day	4	1	See comment for SuffOil-X

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.4.5 BOTRYTIS FRUIT ROT/GRAY MOLD ***(Botrytis cinerea)***

Gray mold is the most common cause of fruit rot of brambles. Ripening fruit becomes rotten, and some or all of the individual fruitlets are covered with a gray fuzzy mass of fungal conidia (spores) and mycelium, hence the common name "gray mold". Gray mold can cause extensive crop losses in years when wet, warm, and humid weather prevails during harvest. Fruit may become infected at any time during development, but is most susceptible just before and after harvest. Black raspberries are generally more resistant than red raspberries. Cultivars with an open canopy tend to develop less mold.

IPM fact sheet on Gray Mold (Botrytis Fruit Rot) nysipm.cornell.edu/factsheets/berries/botrytis.pdf

Botrytis Fruit Rot/Gray Mold Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Susceptible varieties include 'Algonquin', 'Nova', 'Qualicum', and 'Anne' (golden).
Cultural management	Harvest and cool all ripe fruit promptly. Prune bushes to promote air circulation and minimize disease spread (e.g. pruning and weed management) within the canopy and the plantings. Plant in covered production to mimize gray mold infection and spread .
Chemical Treatment	Fungicide sprays should be applied as necessary and are most important just before rainy periods that occur during bloom and before harvest.

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Table 7.4.5 Pesticides Labeled for Management of Gray Mold (Botrytis Fruit Rot)					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Actinovate AG (*Streptomyces lydicus* WYEC 108)	3-12 oz/acre	0	until dry	?	For best results apply with a spreader/sticker prior to onset of disease.
Agricure (potassium bicarbonate)	2-5 lbs/acre	0	1	?	
Cueva Fungicide Concentrate (copper octanoate)	0.5-2 gal/acre	up to day	4	1	
Double Nickel 55 (*Bacillus amyloliquefaciens* str D747)	0.25-3 lb/acre	0	4	2	
Double Nickel LC (*Bacillus amyloliquefaciens* str D747)	0.5-6 qt/acre	0	4	2	
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	?	
Optiva (*Bacillus subtilis* str. QST 713)	14-24 oz/acre	0	4	2	Repeat on 7-10 day intervals

Table 7.4.5 Pesticides Labeled for Management of Gray Mold (Botrytis Fruit Rot)					
Trade 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 32 fl oz/100 gal water preventative	0	until dry	2	See label for specific use directions.
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	2	See label for specific use directions.
Regalia (*Reynoutria sachalinensis*)	1-4 qt/acre	0	4	?	Initiate at first sign of disease then reapply every 7-14 days
Serenade ASO (*Bacillus subtilis*)	2-6 qt/acre	0	4	2	Begin application prior to disease development and repeat on 2-10 day interval or as needed. Add a surfactant to improve spray coverage.
Serenade MAX (*Bacillus subtilis*)	1-3 lb/acre	0	4	?	See comment on Serenade ASO.
Serenade Opti (*Bacillus subtilis*)	14-20 oz/acre	0	4	?	See comment on Serenade ASO.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.4.6 MOSAIC VIRUS COMPLEX

Raspberry mosaic disease is caused by a complex of viruses. Spread is almost entirely caused by the large raspberry aphid. Signs of infection are variable, depending on which virus or mixture of viruses is involved. The leaves are mottled, with yellowish or light green blotches on a darker green background. The leaves are also usually smaller than normal and are frequently deformed or cupped. Leaf symptoms are most apparent in the spring, but higher summer temperatures can suppress virus activity and, in turn, suppress symptoms. Infected plants are gradually stunted and produce dry, poor-quality fruit. Young shoot tips may die, becoming black and bent. The disease is generally severe only on black raspberries and may be moderately severe on purple raspberries.

Mosaic Virus Complex Management Options	
Scouting/thresholds	None established.
Variety susceptibility	More resistant varieties include 'Titan', 'Festival', and 'Algonquin', 'Qualicum', 'Tulameen', and 'Royalty' (purple). Susceptible varieties include 'Newburgh', 'Taylor', 'Redwing', 'Summit', and 'Ruby'.
Cultural management	Plant only certified (virus-indexed) nursery stock. Plants propagated in the laboratory and greenhouse by tissue-culture techniques (i.e. those that have never been grown in the field) are most likely to be free of harmful viruses. Separate new plantings from old raspberries or wild brambles by at least 150 to 200 yards if practical. Remove and destroy obviously infected plants as they appear.
Chemical Treatment	Management of aphid vector with insecticides may slow disease spread within a field but is unlikely to prevent introduction.

7.4.7 CRUMBLY BERRY *(Tomato Ringspot Virus)*

"Crumbly berry" is a symptom associated with a variety of problems, though one of the most common causes is infection by Tomato Ringspot virus. This disease occurs only on red raspberries and is widely distributed throughout North America. Infected plants appear healthy but produce small, crumbly berries that fall apart when picked. The virus is spread by the American dagger nematode. These microscopic roundworms feed on plant roots and can pick up the virus from infected weeds or host crop plants. Infected plants occur in patches that enlarge over time as the disease is spread by the nematode.

Crumbly Berry Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known.
Cultural management	Plant only certified (virus-indexed) nursery stock. Do not replant sites from which crumbly berry plants have been removed. Analyze new planting site or suspected problem sites for the dagger nematode. If detected, select another site or rotate with a biofumigant cover crop (see Table 4.1).
Chemical Treatment	If nematode testing indicates high population levels of the vector, a biofumigant cover crop may be beneficial (see Table 4.1).

7.4.8 ORANGE RUST *(Arthuriomyces peckianus)*

This is a serious fungal disease that occurs only on black and purple raspberries, red raspberries are immune. The disease is most easily identified in the spring. New canes arising from infected plants in the spring are weak, spindly, and thornless and have misshapen, pale leaves. In contrast to new canes arising from a healthy plant, infected canes usually arise in bunches. The lower surfaces of new leaves are covered first with large orange pustules that erupt several weeks after the leaves unfold. Established planting should be examined for orange rust every year during the first weeks of the growing season when symptoms are easiest to observe.

Orange Rust Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Red raspberries are immune to the disease.
Cultural management	Do not establish new plantings next to wooded areas or fence rows unless wild brambles are first eradicated. Examine new plants about one month after planting or when canes are 12-18 inches tall. Also check them for rust each following year. Identify infected plants before spores have the opportunity to infect neighboring plants. Dig up and burn all infected plants immediately, taking care to remove the roots as well.
Chemical Treatment	Fungicides should not be applied to manage this disease. Hosts need to be eradicated.

7.4.9 RASPBERRY LEAF AND CANE SPOT ***(Septoria rubi)***

Circular brown spots, approximately less than one sixteenth of an inch in diameter, appear on the leaves in summer. The spots enlarge and coalesce during the season. Defoliation can occur during severe infections. Inconspicuous cane lesions may also develop near the bases of canes. Black raspberries are generally more resistant to leaf spot than red raspberries.

Raspberry Leaf and Cane Spot Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Susceptible varieties include, 'Killarney', 'Reveille', 'Canby', 'Boyne', 'Taylor', 'Sentry', and 'Brandywine' (purple). Less susceptible varieties include 'Citadel', 'Latham', 'Heritage', and 'Fallgold'.
Cultural management	Manage weeds and prune to promote air circulation and minimize disease spread. Fruiting canes should be removed immediately after harvest, and fallen leaves raked or cultivated before bud break to reduce fungal inoculum.
Chemical Treatment	Apply a delayed dormant spray[1] of copper.

[1] This "delayed dormant" application has always been the most important spray for the control of the major cane diseases. Thorough coverage is essential for control; therefore, this spray should be applied on a calm day and in a sufficient amount of water to soak the canes completely. Sprays applied after half inch green-tip may burn the leaves, particularly in warm weather.

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Table 7.4.9 Pesticides Labeled for Management of Raspberry Leaf and Cane Spot

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Badge X2 (copper hydroxide, copper oxychloride)	1-3.5 lb/acre	0	48	1	May cause crop injury under some conditions. Use 1-2.25 lbs/acre rate when leaf buds begin to open and when flower buds show white. Use 1.75-3.5 lbs/acre in the fall after harvest.
Basic Copper 53 (basic copper sulfate)	2.0-3.7 lb/acre	up to day	48	1	May cause crop injury under some conditions.
Champ WG (copper hydroxide)	2 or 4 lbs/acre	-	48	1	May cause crop injury under some conditions. Use 2 lb/A when leaf buds begin to open and again when flower buds show white. Use 4 lb/A for fall application after harvest.
CS 2005 (copper sulfate pentahydrate)	19.2 or 32 oz/acre	0	48	1	Use 19.2 oz/A when leaf buds begin to open and again when flower buds show white. Use 32 oz/A for fall application after harvest.
Milstop (potassium bicarbonate)	2-5 lb/acre	0	1	?	Do not mix with other pesticides or fertilizers. Not compatible with alkaline solutions.
Nordox 75 WG (cuprous oxide)	1.25 to 6.5 lb/acre	-	12	1	See label for specific rates and application timing.
Nu-Cop 50 WP (copper hydroxide)	4 lbs/A plus 1 qt of crop oil/A (raspberries) 2 or 4 lbs/100 gal water plus 1 qt crop oil/100 gallons (blackberries)	1	24	1	See label for specific rates and application timing. Discontinue use if signs of phytotoxicity appear.
Nu-Cop 50DF (copper hydroxide)	2 or 4 lbs/A	1	48	1	See label for specific rates and application timing.Discontinue use if signs of phytotoxicity

Table 7.4.9 Pesticides Labeled for Management of Raspberry Leaf and Cane Spot					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
					appear.
Nu-Cop HB (copper hydroxide)	1-4 lbs/A	1	48	1	See label for specific rates and application timing.Discontinue use if signs of phytotoxicity appear.
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	?	See label for specific use directions.
Regalia (*Reynoutria sachalinensis*)	1-4 qt/acre	0	4	?	
Trilogy (neem oil)	1% solution	up to day	4	?	Maximum labeled use of 2 gal/acre/application.Do not apply while bees are actively visiting.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.4.10 PHYTOPHTHORA ROOT ROT ***(Phytophthora spp.)***

Infected plants frequently produce few canes, most of which are weak and stunted. Leaves on the canes may be small, turn yellow, or dry and necrotic (scorched) along the edges and between the veins. Infected plants may wilt and collapse just before harvest or during the heat of summer. If spring weather is excessively wet, emerging canes may wilt and die, showing dark "water-soaked" tissue near the soil line. When dug up and examined, many of the roots and the crown are discolored and dead. During the early stages of colonization, infected roots and crowns may have a reddish cast underneath the epidermis. By comparison, healthy roots will be white underneath the epidermis. Plants in low or poorly drained field sites are frequently infected. This disease is often been misdiagnosed as "wet feet" or winter injury. One can distinguish root rot from winter injury based on the fact that primocane emergence following winter injury is usually vigorous, whereas primocane emergence is poor from plants infected with root rot. Black raspberry cultivars are generally least susceptible to this disease.

Phytopthora Root Rot Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Susceptible varieties include 'Titan', 'Lauren', 'Ruby', 'Canby', 'Dinkum', 'Polana', and 'Encore'. The least susceptible varieties include 'Prelude', 'Anne', 'Latham', 'Nova', 'Boyne', 'Josephine', 'Caroline', 'Jaclyn', 'Moutere', 'Killarney', 'Brandywine' (purple) and 'Royalty' (purple).
Cultural management	The disease is caused by a group of soil-borne, aquatic pathogens that are active only during very wet conditions. Therefore, planting only on well-drained sites and providing supplemental drainage are crucial components of a management program. Establishing raspberries on beds raised 10-14 inches helps promote drainage, and in turn, minimizes the potential for infection. Chemical treatment can provide some benefit, but it is most effective when used in combination with site selection/modification for good drainage and proper selection of cultivars. Highly susceptible cultivars should not be planted on sites where drainage is inadequate. These cultivars are likely to die in such cases, even with raised beds and chemical applications.
Chemical Treatment	Chemical treatment is most effective in combination with cultural management.

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Table 7.4.10 Pesticides Labeled for Phytopthora Root Rot

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Actinovate AG (*Streptomyces lydicus* WYEC 108)	3-12 oz/acre soil drench	0	until dry	?	Since Actinovate AG contains live spores of a microbe, best results will be obtained if used prior to disease onset.
BIO-TAM (*Trichoderma asperellum, Trichoderma gamsii*)	1.5-3 oz/1000 row ft in-furrow treatment	-	1	?	
BIO-TAM (*Trichoderma asperellum, Trichoderma gamsii*)	2.5-3 lb/acre band	-	1	?	
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	?	See label for specific use directions.
RootShield Granules (*Trichoderma harzianum*)	2.5-6 lb/half acre in-furrow treatment	-	0	?	
RootShield PLUS+ Granules (*Trichoderma harzianum, Trichoderma virens*)	2.5-6 lb/half acre in-furrow treatment	-	0	?	
RootShield PLUS+ WP (*Trichoderma harzianum, Trichoderma virens*)	0.5-1.5 lb/20 gal water or dip in powder dip 16-32 oz/acre in-furrow treatment	0 (greenhouse) until dry (field)	4	?	Do not apply when above-ground harvestable food commodities are present.
RootShield WP (*Trichoderma harzianum*)	0.5-2.5 lb/ 5 gal water or dip in powder dip 16-32 oz/acre in-furrow treatment	-	0	?	
TerraClean 5.0 (hydrogen dioxide, peroxyacetic acid)	25 fl oz/200 gal water/1000 ft^2 treated soil drench	up to day	0	?	
Zonix (Rhamnolipid Biosurfactant)	0.5 or 0.8 fl oz/gal water	-	4	?	Prepare enough solution based on plant density and soil conditions to ensure thorough coverage.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.4.11 LATE LEAF RUST *(Pucciniastrum americanum)*

Small pale yellow spots develop on the undersides of leaves in late summer/early fall. Spots later turn brown. Heavily infected leaves may drop prematurely, leaving canes bare by September on susceptible varieties. Flowers, petioles, and fruit may also be infected. Black raspberries are reportedly more resistant to late leaf rust. Because the disease does not develop until late in the summer it is generally only considered a disease of importance for fall fruiting cultivars.

Late Leaf Rust Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Susceptible varieties include 'Heritage' and 'Festival'. Less susceptible varieties include 'Nova'.
Cultural management	Use only healthy disease-free planting stock. Inspect material on arrival before planting. Select sites with good air movement and full sun exposure. Cultural practices to increase air circulation (cane thinning, maintaining narrow rows, good weed control). Remove alternate hosts, white spruce (*Picea americanum*) and wild raspberry, within 500ft.
Chemical Treatment	Fungicide options are limited. Although fungicides may be helpful for managing disease on primocane-fruiting cultivars, they are almost never needed on floricane-fruiting cultivars.

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Table 7.4.11 Pesticides Labeled for Late Leaf Rust

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Glacial Spray Fluid (mineral oil)	0.75-1.5 gal/100 gal water	up to day	4	1	See label for specific application volumes and equipment
JMS Stylet-Oil (paraffinic oil)	3-6 qt/100 gal water	0	4	1	A high volume of water is needed for thorough coverage. Many common pesticides are phytotoxic when applied with or close to oil sprays (e.g., sulfur). Check label for restrictions.
Omni Supreme Spray (mineral oil)	0.75-1.5 gal/acre	-	12	?	See label for specific precautions.
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	?	See label for specific use directions.
SuffOil-X (aliphatic petroleum solvent)	1-2 gal/100 gal water	up to day	4	?	Do not use in combination with or immediately before or after spraying with fungicides containing sulfur.
Trilogy (neem oil)	1% solution	up to day	4	?	Maximum labeled use of 2 gal/acre/application. Do not apply while bees are actively visiting.
TriTek (mineral oil)	1-2 gal/100 gal water	up to day	4	?	See comment for SuffOil-X.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.5 Other Diseases of Note

7.5.1 FIREBLIGHT *(Erwinia amylovora)*

The most obvious symptoms of this bacterial disease is that cane tips become brownish black and curve downward in a characteristic shepherd's-crook. Cane lesions may produce abundant bacterial ooze. Flowers and fruits may also be infected. Warm temperatures and light rain favor infections. Fire blight is fairly rare in brambles, and it may be more cost-effective to prune affected canes and eradicate affected plants instead of applying biological controls.

Fireblight Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Susceptible varieties include 'Boyne', 'K81-6', 'Latham', and 'Fallgold' (golden).
Cultural management	Remove infected canes by pruning. Encourage rapid drying of canes and foliage.
Chemical Treatment	

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Table 7.5.1 Pesticides Labeled for Management of Fire Blight

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Actinovate AG (*Streptomyces lydicus* WYEC 108)	3-12 oz/acre	0	until dry	?	
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	?	See label for specific use directions.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.5.2 VERTICILLIUM WILT *(Verticillium sp.)*

Symptoms of infection may develop during the summer of the first year of infection. Leaves wilt, turn yellow, and fall off, starting from the bottom of the cane and progressing toward the top. Severely wilted canes may have diagnostic blue streaks along their length. Symptoms frequently appear on only one side of a cane, or only on one or two canes out of an entire planting. Disease severity will largely depend on the previous cropping history of the field. Potatoes, tomatoes, eggplants, and peppers are particularly susceptible to wilt. This disease is also much more severe on black raspberries than on red varieties.

Verticillium Wilt Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Susceptible varieties include 'Polana'.
Cultural management	The disease is caused by a soil-borne fungus, which also attacks a number of other crops, including potato, tomato, eggplant, pepper, strawberry, cherry, squash, and cucumber. Before planting raspberries on sites where these crops have been grown, non-host crops such as wheat or corn should be grown for at least 2 years prior to planting. Many weeds, particularly nightshade, horse nettle, ground-cherry, redroot pigweed, and lambsquarters, are hosts of the *Verticillium* fungus. These weeds should be strictly controlled in current and future planting sites to keep the Verticillium population low. Plant only certified (virus-indexed) nursery stock

Verticillium Wilt Management Options	
Chemical Treatment	If rotations and cover crops fail to suppress the disease a fumigant can help to treat the soil before planting.

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Table 7.5.2 Pesticides Labeled for Management of Verticillium Wilt

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Actinovate AG (*Streptomyces lydicus* WYEC 108)	3-12 oz/acre soil drench	0	until dry	?	Since Actinovate AG contains live spores of a microbe, best results will be obtained if used prior to disease onset.
BIO-TAM (*Trichoderma asperellum, Trichoderma gamsii*)	1.5-3 oz/1000 row ft in-furrow	-	1	?	
BIO-TAM (*Trichoderma asperellum, Trichoderma gamsii*)	2.5-3 lb/acre band	-	1	?	
PERpose Plus (hydrogen peroxide)	1 fl oz/gal Initial/curative 0.33 fl oz/gal Preventative See comments	-	1 hr (high tunnel) or until dry (field)	?	See label for specific use directions.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.5.3 RASPBERRY BUSHY DWARF *(Raspberry Bushy Dwarf Virus, RBDV)*

Though the disease is less common in blackberries, RBDV can cause serious losses in susceptible cultivars and it occurs wherever raspberries are grown. The primary symptom of RBDV is crumbly fruit due to poor drupelet set. Leaf chlorosis from very pale to bright yellow also develops on some cultivars of red raspberry and blackberry, but this has not been observed on black or purple raspberries. In mixed infections with other viruses, dwarfing of the plant may occur and crumbly berry symptoms may be more pronounced. Early investigations of the bushy dwarf disease only recovered RBDV and not the co-infecting virus, Black raspberry necrosis virus, associated with dwarfing. The name "Bushy Dwarf" is misleading—RBDV rarely causes bushy dwarf symptoms by itself.

RBDV is spread from plant to plant by pollen and, therefore, is difficult to control once the virus is present in a field. Bees readily travel up to one-half mile, so isolation from infected plantings is important. In large plantings, blocks of susceptible cultivars can be isolated from other susceptible blocks by planting blocks of resistant cultivars between them. This reduces the movement of pollen between the susceptible cultivars by bees. Because pollination is inefficient across species of *Rubus*, only commercial plantings of black raspberries (*R. occidentalis*) are at risk for RBDV if wild black raspberries are growing nearby. The best strategy for growers is to use planting stock that has tested free of RBDV, especially since infected plants may not show symptoms.

Raspberry Bushy Dwarf Virus Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Susceptible varieties include: Autumn Britten, Autumn Bliss, Cascade Delight, Chemainus, Malahat, Meeker, Tulameen. Resistant varieties include Boyne, Killarney, Cowichan, Bristol (Black) Latham, Octavia, Heritage,Dormanred, Willamette, Moutere, Newburgh, Kiwigold Marion blackberries are susceptible; Chester, Triple Crown blackberries are considered resistant.
Cultural management	Use only healthy disease-free planting stock.
Chemical Treatment	None.

7.5.4 CROWN GALL *(Agrobacterium tumefaciens and A. rubi)*

Crown gall can occur on blackberries and red, black, and purple raspberries, as well as many other plant species. Galls are rough, spongy-to-hard, tumorous growths an inch or more in diameter found most often on roots of red raspberries and on the crowns of black and purple raspberries (*A. tumefaciens*). Galls can also occur on the lower portions of the canes (*A. rubi*). Although the disease causes little economic damage, crown galls can stunt and weaken severely infected plants. Crown gall bacteria persist in and on infected plant tissue and in infested soil. The bacterium enters a plant through wounds on the roots or crown caused by growth cracks, insect feeding, winter injury or cultivation.

Crown Gall Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Some varieties may be less susceptible, though any resistance may break down in the presence of lesion nematodes feeding on roots or root and crown injury.
Cultural management	Use only healthy disease-free planting stock. Inspect material on arrival to make sure it is free of galls before planting. Avoid planting into a field with a history of crown gall. Plant into fields in which a non-host crop, such as strawberries or most vegetables, has been grown for two or more years. Minimize root and crown injury during cultivation.
Chemical Treatment	None.

7.6 Insects and Mites of Primary Concern

The insects and mites that are considered major pests in raspberries and blackberries can vary in occurrence both from year to year and from site to 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 is 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 raspberry and blackberry plantings.

7.6.1 RASPBERRY FRUITWORM *(Byturus rubi)*

In early May fruitworm adults feed on the buds and young leaves, skeletonizing the foliage and hindering fruit development. The small larvae feed inside the flower buds and then bore into the young fruits, which may then dry up or decay and fall off. The full-grown larva is yellowish white and quarter inch long. The fruitworm adult is a small, light brown beetle. Fruitworms are mostly a problem in weedy fields. Adults become active in early May. Because fruitworm larvae fall to the ground by the end of July, fall-fruiting raspberries often escape injury. Injury by this insect can coincide with that of raspberry sawfly.

Raspberry Fruitworm Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known. Not generally a problem for fall-fruiting raspberries or blackberries.
Cultural management	Cultivation of plant rows during late summer and early fall may kill the larvae and pupae in the soil.
Chemical Treatment	Insecticide sprays should be applied early pre-bloom as blossoms appear and late pre-bloom before blossoms open.

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Table 7.6.1 Pesticides Labeled for Management of Raspberry Fruitworm

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	?	Foliar spray or soil drench
AzaGuard (azadirachtin)	8-16 fl oz/acre	0	4	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
AzaSol (azadirachtin)	6 oz/acre	-	4	?	
Azatrol-EC (azadirachtin)	0.29-0.96 fl oz/ 1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide. Repellant
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide. Repellant
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Entrust SC (spinosad)	4-6 oz/acre	1	4	?	
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
Neemix 4.5 (azadirachtin)	4-10 fl oz/acre	0	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment for PyGanic EC 1.4 II

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.6.2 RASPBERRY SAWFLY *(Monophadnoides geniculatus)*

The sawfly adult is a small, black, thick-bodied insect about ¼ inch long. The sawfly larva is a ¼ inch long, pale green worm that usually feeds on the outer edges of the leaves, later chewing out irregular holes or in severe cases, skeletonizing the foliage. This insect appears in May as leaves begin to unfold. Injury by this insect can coincide with that of raspberry fruitworm.

Raspberry Sawfly Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known. Not generally a problem for fall-fruiting raspberries or blackberries.
Cultural management	Cultivation of plant rows during late summer and early fall may kill the larvae and pupae in the soil.
Chemical Treatment	Insecticide sprays should be applied early pre-bloom as blossoms appear and late pre-bloom before blossoms open.

At the time this guide was produced, the following materials were labeled 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 (DEC) to be used legally in NY. Those pesticides meeting requirements in EPA Ruling 40 CFR Part 152.25(b) (also known as 25(b) pesticides) do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System (PIMS) website http://pims.psur.cornell.edu. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.6.2 Pesticides Labeled for Management of Raspberry Sawfly

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
AzaGuard (azadirachtin)	10-16 fl oz/acre	0	4	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
AzaSol (azadirachtin)	6 oz/acre	-	4	?	
Azatrol-EC (azadirachtin)	0.29-0.96 fl oz/1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Entrust (spinosad)	1.25-2 oz/acre	1	4	?	
Entrust SC (spinosad)	4-6 oz/acre	1	4	?	
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
Neemix 4.5 (azadirachtin)	7-16 fl oz/acre	0	4	?	
PureSpray Green (white mineral oil)	Dilute: 0.75-1.5 gal/100 gal waterConcentrate: 1.5-3 gals/A	up to day	4	?	For sawfly eggs.
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
Safer Brand #567 II (potassium laurate, pyrethrins)	6.4 oz/gal of water	until dry	12	?	Apply one gallon of mixed spray per 700 sq. ft. of plant surface area. Larvae only.
SuffOil-X (aliphatic petroleum solvent)	1-2 gal/100 gal water	up to day	4	?	Do not use in combination with or immediately before or after spraying with fungicides containing sulfur.
TriTek (mineral oil)	1-2 gal/100 gal water	up to day	4	?	See comment for SuffOil-X.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.6.3 TARNISHED PLANT BUG *(Lygus lineolaris)*

These insects appear when fruit buds form and plants begin to bloom. Their feeding on buds, blossoms, and developing berries results in deformed and crumbly fruit. Adults are ¼ inch long, oval, somewhat flattened, and greenish-brown with reddish brown marking on the wings. Nymphs are pall green and less than 1/16 inch long. Overwinted adults first become active from late April to mid-May, however two to four generations may occur annually. Populations and damage become more extensive later in the growing season.

Tarnished Plant Bug Management Options	
Scouting/thresholds	For effective tarnished plant bug control, scout for nymphs after petal fall by striking the cane over a flat, low-sided, light-colored dish. Suggested threshold = 10-20% of canes infested.
Variety susceptibility	No resistant varieties known. Highly productive cultivars appear less susceptible to feeding injury.
Cultural management	Minimize proximity to preferred habitat. Tarnished plant bug pressure is often highest in weedy fields or in fields bordered by woody shrubs.
Chemical Treatment	Insecticides should be applied just before blossoms open and later as fruit begins to color.

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Table 7.6.3 Pesticides Labeled for Management of Tarnished Plant Bug

Trade 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	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
AzaSol (azadirachtin)	6 oz/acre	-	4	?	
Azatrol-EC (azadirachtin)	0.24-0.96 fl oz/1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
DES-X (insecticidal soap)	2% formulation sprayed at 75-200 gallons/acre	1/2	12	?	
Ecotec (rosemary oil, peppermint oil)	1-4 pts/acre	-	-	?	25(b) pesticide
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
Molt-X (azadirachtin)	10 oz/acre	0	4	?	
Neemix 4.5 (azadirachtin)	7-16 fl oz/acre	0	4	?	
PFR-97 20% WDG (*Isaria fumosorosea* Apopka str. 97)	1-2 lb/acre	-	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment for PyGanic EC 1.4 II

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.6.4 JAPANESE BEETLE ***(Popillia japonica)***

Beetle larvae are serious pests of lawns, vegetables, and nursery stock. Adult beetles chew holes in the fruit, making the fruit susceptible to infection. Beetles emerge in July and can cause significant leaf damage, which appears as skeletonization. Although there are Japanese beetle traps, research has shown that the traps may attract more beetles into a planting than they eliminate in the traps.

Japanese Beetle Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known. Japanese beetles prefer, 'Ruby', 'Heritage', 'Reveille', 'Latham', 'Newburgh', 'Southland', and 'Fallgold' over other cultivars.
Cultural management	None established.
Chemical Treatment	Chemical sprays may be needed at late prebloom, just before blossoms open. Japanese beetles may continue to cause problems during and after bloom, however it is more difficult to avoid harming pollinators during this time.

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Table 7.6.4 Pesticides Labeled for Management of Japanese Beetle

Trade 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	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
AzaSol (azadirachtin)	6 oz/acre	-	4	?	
Azatrol-EC (azadirachtin)	0.29-0.96 fl oz/1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide Repellant
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide Repellant
Cedar Gard (cedar oil)	1 qt/acre	-	-	?	25(b) pesticide
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
Molt-X (azadirachtin)	8 oz/acre	0	4	?	
Neemix 4.5 (azadirachtin)	7-16 fl oz/acre	0	4	?	
PFR-97 20% WDG (*Isaria fumosorosea* Apopka str. 97)	1-2 lb/acre	-	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment for PyGanic EC 1.4 II
Safer Brand #567 II (potassium	6.4 oz/gal of water	until dry	12	?	Apply one gallon of mixed spray

Table 7.6.4 Pesticides Labeled for Management of Japanese Beetle					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
laurate, pyrethrins)					per 700 sq. ft. of plant surface area.
Surround WP (kaolin clay)	20-50 lb/acre	up to day	4	?	Suppression only. Only use before fruit set as residues may be difficult to remove after harvest.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.6.5 STRAWBERRY SAP BEETLE *(Stelidota geminata)* PICNIC BEETLE *(Glischrochilus fasciatus)*

Sap beetle adults make cavities in ripe and overripe fruit as well as spread spores of decay organisms. The larvae also feed on ripe and overripe fruit and are a source of contamination in harvested fruit. Sap beetles are occasionally found in high numbers in later fruiting raspberry and blackberry plantings throughout the state. Two species feed on raspberry and blackberry fruits: the common picnic beetle, one quarter inch long with four yellow spots on the back, and the smaller, brown strawberry sap beetle without distinctive markings. Strawberry sap beetle is the more serious pest because it does not limit its activity to over-ripe fruit. Beetles overwinter at the edge of woodlots and under other perennial fruit crops, such as brambles and blueberries. As raspberries and blackberries ripen beetles begin feeding and laying eggs. Fruit touching the ground appears particularly vulnerable since adult strawberry sap beetles are secretive and most active near the ground.

IPM fact sheet Strawberry Sap Beetle nysipm.cornell.edu/factsheets/berries/ssb.pdf

Strawberry Sap Beetle/Picnic Beetle Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known. Fall fruiting cultivars may be particularly susceptible to infestation. Cultivars that keep fruit off the ground may be less vulnerable to adult feeding and larval contamination.
Cultural management	Control other damaging insects and promptly harvest ripe berries. Keep the field free of ripe and over-ripe fruit. Good sanitation in berry crops and other fruit crops on the farm will help reduce food resources.
Chemical Treatment	Sprays should be applied as fruit begins to color or as soon as beetles are seen.

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Table 7.6.5 Pesticides Labeled for Management of Sap Beetle					
Trade 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	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
AzaSol (azadirachtin)	6 oz/acre	-	4	?	
Azatrol-EC (azadirachtin)	0.29-0.96 fl oz/1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide. Repellant
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide. Repellant

Table 7.6.5 Pesticides Labeled for Management of Sap Beetle					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
Molt-X (azadirachtin)	8 oz/acre	0	4	?	
Neemix 4.5 (azadirachtin)	7-16 fl oz/acre	0	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.6.6 SPOTTED WING DROSOPHILA *(Drosophila suzukii)*

Spotted Wing Drosophila (SWD) is becoming established throughout Northeast; it was first detected in NY in 2011. There is potential for significant impact from this pest, especially for fall-fruiting varieties, when populations tend to increase. Summer fruiting raspberries may escape injury.

SWD looks superficially like your everyday Vinegar Fly *Drosophila melanogaster* of genetics fame, but vinegar flies are generally not a serious economic threat to fruit growers. Female vinegar flies typically lay eggs in damaged and/or overripe fruit and hence, are mostly just a nuisance. On the other hand, female SWD have very robust ovipositors (the rear end portion of the fly used for egg laying) and lay their eggs in ripe, marketable fruit leading to damage and contamination with maggots. SWD appears to have the capability to survive winter conditions in the Northeast. They are found in similarly cold areas of Japan. However, populations at the start of the growing season tend to be quite low indicating high mortality over the winter.

SWD appear similar to other vinegar flies. Adult flies are 2-3 mm in length, with red eyes, tan-colored body with darker bands on abdomen. Males have characteristic single spots at the leading edge of the tip of the wing and two dark spots on their front legs. Females lack wing spots and leg spots, but is distinguished by a robust, serrated ovipositor (visible under magnification). Larvae are white, nondescript and legless maggots.

Monitoring can be helpful for this pest, especially for floricane cultivars. Traps and baits are now commercially available for monitoring SWD. Or homemade traps and baits, based on a fermenting mixture of yeast, sugar, water, and whole wheat flour with an apple cider vinegar drowing solution can be constructed (see http://www.fruit.cornell.edu/spottedwing/ for more information).. Fruit should also be inspected for evidence of larval feeding. Immersing fruit in a salt solution (1 Tbsp. table salt/cup water (14.8 cc/236.6 ml)) will cause larvae to float to surface. At least 100 fruit per block per harvest should be observed for infestation.

Spotted Wing Drosophila Management Options	
Scouting/thresholds	None specifically established but customer tolerance for infested fruit is likely to be very low. For summer raspberry, evidence of any SWD in the area of the planting indicates a significant infestation risk. Monitoring and thresholds for primocane raspberries is not very helpful since populations are very high at this time anyway.
Variety susceptibility	No resistant varieties known. Primocane berries that bear fruit late in the season appear most susceptible since SWD populations build during the season, although

Spotted Wing Drosophila Management Options	
	floricane cultivars can experience significant damage.
Cultural management	Good sanitation is very important. Try to prevent the buildup of ripe and over-ripe fruit. Pruning to allow for a more open canopy will allow for better coverage of insecticides. Maintain a good cold chain between harvest and sale. Display farm market fruit in a cooler— refrigeration slows or stops SWD development in fruit.
Chemical Treatment	A few insecticides have recently been granted 2ee label exemptions for control of SWD. SWD adults appear sensitive to several different chemistries, although their high reproductive rate, short generation time, and mobility may necessitate multiple applications for control.

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Table 7.6.6 Pesticides Labeled for Management of Spotted Wing Drosophila

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
Aza-Direct (azadirachtin)	1-2 pts/acre	0	4	2	
AzaGuard (azadirachtin)	8-16 fl oz/acre	0	4	2	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	2	
Azatrol-EC (azadirachtin)	0.29-0.96 fl oz/1000 ft^2	0	4	2	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	2	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide Repellant
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide Repellant
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	2	
Entrust (spinosad)	1.25-2 oz/acre	3	4	1	2(ee) recommendation. User must have a copy of the recommendation in their possession at the time of application.
Entrust SC (spinosad)	4-6 oz/acre	3	4	1	2(ee) recommendation. User must have a copy of the recommendation in their possession at the time of application
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Molt-X (azadirachtin)	10 oz/acre	0	4	2	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	2	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	2	See comment for PyGanic EC 1.4 II.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.6.7 BORERS/CANE GIRDLERS *(various species of beetles)*

A number of borers burrow through the canes of brambles; their presence may be indicated by a generally symmetrical swelling in the cane, from 1 to 3 inches long and usually a few inches, but as much has 4 feet, above the ground (i.e. Rednecked cane borer,

Agrilus ruficollis, bronze cane borer, *Agrilus rubicola*). Some canes may wither and die; in other cases, the affected area is broken off or severed in the region of the swelling. With other borer species, no swelling is evident but the tips of new canes may wilt and blacken (Raspberry cane borer, *Oberea bimaculata*). Adults are active in spring to mid-summer. First observed damage is usually the wilting of cane tips and laterals in early June.

Borer/Cane Girdler Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known. Very susceptible cultivars are 'Heritage' and 'Polka".
Cultural management	As a preventative measure, cane with swellings should be removed and burned during the dormant season. Canes showing withered tips should be clipped several inches below the affected portion and the damaged tissue destroyed during the growing season.
Chemical Treatment	Sprays are directed at adults and are applied at late pre-bloom, just before blossoms open.

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Table 7.6.7 Pesticides Labeled for Management of Borers/Cane Girdlers

Trade 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	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
Azatrol-EC (azadirachtin)	0.29-0.96 fl oz/1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide Repellant
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide Repellant
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment for PyGanic EC 1.4 II

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.6.8 RASPBERRY CROWN BORER ***(Pennisetia marginata)***

The adult of this species is an attractive clear-winged moth resembling a yellow jacket that is active during the day. The first indication of injury is wilting and dying of foliage on the affected cane. Several canes of a bush can be weakened by the activity of a single larva in the crown, and the entire bush may be killed. The adults appear in early August and are present during most of September.

Raspberry Crown Borer Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known.
Cultural management	During the growing season destroy dying canes, including the crown, or any canes showing evidence of infestation. Eradicate wild brambles in the area.
Chemical Treatment	Insecticides are applied as a heavy drench in the early spring to kill larvae, and as a spray between mid-August to September to kill adults.

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Table 7.6.8 Pesticides Labeled for Management of Raspberry Crown Borer

Trade 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	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide. Repellant
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide. Repellant
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
Molt-X (azadirachtin)	10 oz/acre	0	4	?	
Neemix 4.5 (azadirachtin)	7-16 fl oz/acre	0	4	?	
PFR-97 20% WDG (Isaria fumosorosea Apopka str. 97)	1-2 lb/acre	-	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment for PyGanic EC 1.4 II

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.6.9 TWO-SPOTTED SPIDER MITE *(Tetranychus urticae)*

In early spring, mites begin feeding on the undersides of new leaves, sometimes resulting in small yellow spots on the upper leaf surfaces. These symptoms do not occur in all cases. Brownish dry areas on the lower leaf surfaces are characteristic of damage. Later, the entire lower leaf may become dry and brown, giving it a bronzed appearance. Heavily infested plants look dry and stunted, and their sparse new growth is yellowish and distorted. Damage is first seen and is most prevalent in dry areas of a field. Mild growing areas in New York (Hudson Valley and Long Island) experience problems with mites most frequently. Also, brambels grown in high tunnels often experience problems with two-spotted spider mitesw.

Two-Spotted Spider Mite Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known. Black raspberries are especially susceptible. Predominantly a problem in greenhouse and high tunnel raspberry production.
Cultural management	Avoid a high rate of fertilization as it may encourage mites. Maintain adequate irrigation. Naturally occurring predatory mites can maintain spider mite populations at low levels. Releasing insectary-reared predatory mites has proven effective in managing spider mites in high tunnels. They should be released at first sign of spider mite feeding. Repeat applications may be necessary.
Chemical Treatment	Chemical control of spider mites is often not completely effective because of their high mobility, tendency to reside on the underside of leaves where it is difficult to reach with miticides, high reproductive rate, and resistance to some pesticides. Good coverage of the plants, particularly the undersides of the leaves, is critical for adequate protection. Use adequate water (200 - 300 gal/A) for maximum effectiveness of the miticide. Repeat at 7- to 10-day intervals as necessary unless otherwise noted on label.

At the time this guide was produced, the following materials were labeled 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 (DEC) to be used legally in NY. Those pesticides meeting requirements in EPA Ruling 40 CFR Part 152.25(b) (also known as 25(b) pesticides) do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System (PIMS) website http://pims.psur.cornell.edu. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.6.9 Pesticides Labeled for Management of Two-spotted Spider Mite

Trade 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	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
Azatrol-EC (azadirachtin)	0.24-0.96 fl oz/1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide Repellant
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide Repellant
Cinnerate (cinnamon oil)	13-30 fl oz/100 gal water	-	-	?	25(b) pesticide
DES-X (insecticidal soap)	2% formulation sprayed at 75-200 gallons/acre	1/2	12	?	
Ecotec (rosemary oil, peppermint oil)	1-4 pts/acre	-	-	?	25(b) pesticide
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide See label for specific information.
GC-Mite (garlic oil, clove oil, cottonseed oil)	1.5 fl oz/1 gal water	-	-	?	25(b) pesticide Conduct compatibility test prior to application.
Glacial Spray Fluid (mineral	0.75-1.5 gal/100 gal	up to day	4	?	See label for specific application

Table 7.6.9 Pesticides Labeled for Management of Two-spotted Spider Mite					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
oil)	water				volumes and equipment
GrasRoots (cinnamon oil)	1 part GrasRoots: 9 parts water	-	-	?	25(b) pesticide.
JMS Stylet-Oil (paraffinic oil)	3-6 qt/100 gal water	0	4	2	A high volume of water is needed for through coverage. Many common pesticides are phytotoxic when applied with or close to oil sprays (e.g., sulfur). Check label for restrictions.
M-Pede (insecticidal soap)	1-2% vol:vol	0	12	2	Works by contact. Good coverage is important
Nuke Em (citric acid)	Normal: 1 fl oz/31 fl oz water	-	-	?	25(b) pesticide
Omni Supreme Spray (mineral oil)	0.75-1.5 gal/acre	-	12	?	See label for specific precautions.
Organocide (sesame oil)	1-2 gal/100 gal water	-	-	?	25(b) pesticide
PFR-97 20% WDG (*Isaria fumosorosea* Apopka str. 97)	1-2 lb/acre	-	4	?	
PureSpray Green (white mineral oil)	Dilute: 0.75-1.5 gal/100 gal water. Concentrate: 1.5-3 gals/A	up to day	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment on PyGanic EC 1.4 II.
Sil-Matrix (potassium silicate)	0.5-1% solution	up to day	4	?	
SuffOil-X (aliphatic petroleum solvent)	1-2 gal/100 gal water	up to day	4	?	Do not use in combination with or immediately before or after spraying with fungicides containing sulfur.
Trilogy (neem oil)	1% solution	up to day	4	?	Maximum labeled use of 2 gal/acre/application. Do not apply while bees are actively visiting.
TriTek (mineral oil)	1-2 gal/100 gal water	up to day	4	?	See comment on SuffOil-X.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.6.10 RASPBERRY APHID ***(various species)***

The two species of aphids that are most damaging in plantings are the small raspberry aphid (*Aphis rubicola*) and large raspberry aphid (*Amphorophora agathonica*). Direct feeding damage causes curling of leaves and reduction of plant growth. Both can transmit some of the more detrimental raspberry viruses such as raspberry mosaic and raspberry leaf curl viruses.

Raspberry Aphid Management Options	
Scouting/thresholds	None established.
Variety susceptibility	Susceptible varieties include 'Redwing' and 'Summit' Less susceptible varieties include 'Algonquin', 'Festival', 'Titan', 'Tulameen', and 'Royalty'
Cultural management	All infected planting must be removed and destroyed. New planting stock should be aphid-resistant cultivars that are certified virus free. A distance of 500-1000 ft or windbreaks should be established between new plantings and virus-infected plantings.
Chemical Treatment	Sprays can be applied to nursery stock to control aphids.

At the time this guide was produced, the following materials were labeled 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 (DEC) to be used legally in NY. Those pesticides meeting requirements in EPA Ruling 40 CFR Part 152.25(b) (also known as 25(b) pesticides) do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System (PIMS) website http://pims.psur.cornell.edu. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.6.10 Pesticides Labeled for Management of Aphids

Trade 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	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
AzaSol (azadirachtin)	6 oz/acre	-	4	?	
Azatrol-EC (azadirachtin)	0.24-0.96 fl oz/1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide Repellant
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide Repellant
BioRepel (garlic oil)	1 part BioRepel to 100 parts water	-	-	?	25(b) pesticide
DES-X (insecticidal soap)	2% formulation sprayed at 75-200 gallons/acre	1/2	12	?	
Ecotec (rosemary oil, peppermint oil)	1-4 pts/acre	-	-	?	25(b) pesticide
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
GC-Mite (garlic oil, clove oil, cottonseed oil)	1.5 fl oz/1 gal water	-	-	?	25(b) pesticide. Conduct compatibility test prior to application.
Grandevo (*Chromobacterium subtsugae* str. PRAA4-1)	2-3 lb/acre	0	4	?	
GrasRoots (cinnamon oil)	1 part GrasRoots: 9 parts water	-	-	?	25(b) pesticide.
Molt-X (azadirachtin)	10 oz/acre	0	4	?	

Table 7.6.10 Pesticides Labeled for Management of Aphids					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
M-Pede (insecticidal soap)	1-2% vol:vol	0	12	?	Works by contact. Good coverage is important
Neemix 4.5 (azadirachtin)	5-7 fl oz/acre	0	4	?	
Nuke Em (citric acid)	Normal: 1 fl oz/31 fl oz water	-	-	?	25(b) pesticide
Organocide (sesame oil)	1-2 gal/100 gal water	-	-	?	25(b) pesticide
PFR-97 20% WDG (*Isaria fumosorosea* Apopka str. 97)	1-2 lb/acre	-	4	?	
PureSpray Green (white mineral oil)	Dilute: 0.75-1.5 gal/100 gal water Concentrate: 1.5-3 gals/A	up to day	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment for PyGanic EC 1.4 II.
Safer Brand #567 II (potassium laurate, pyrethrins)	6.4 oz/gal of water	until dry	12	?	Apply one gallon of mixed spray per 700 sq. ft. of plant surface area.
Sil-Matrix (potassium silicate)	0.5-1% solution	up to day	4	?	
SuffOil-X (aliphatic petroleum solvent)	1-2 gal/100 gal water	up to day	4	?	Do not use in combination with or immediately before or after spraying with fungicides containing sulfur.
TriTek (mineral oil)	1-2 gal/100 gal water	up to day	4	?	See comment for SuffOil-X.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.7 Other Insects of Concern

Many insects found in raspberry and blackberry plantings of New York, while having the capacity to cause economic damage, may not occur on a yearly basis at damaging levels and therefore are considered minor or sporadic pests. For these reasons it is important to be familiar with the life cyde 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. And again, it is important to know when a potential pest is not causing significant economic damage so that unnecessary controls can be avoided.

7.7.1 POTATO LEAFHOPPER ***(Empoasca fabae)***

Damage from the potato leafhopper occurs throughout eastern North America and may reduce plant growth. Adults and nymphs feed along the veins on the undersides of leaves. Upper leaves curl upwards and margins of affected leaves develop a light yellow color. Adults are bright green and about $^{1}/_{8}$ inch long while nymphs are smaller and light green. Adults migrate into New York State in early to mid-June. Avoid proximity to alfalfa plantings, which provide a major source of potato leafhopper population build-up.

Potato Leafhopper Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known. 'Polka' and 'Jaclyn' appear to be particularly sensitive.
Cultural management	None established.
Chemical Treatment	The potato leafhopper is adequately controlled by several broad-spectrum pesticides.

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Table 7.7.1 Pesticides Labeled for Management of Potato Leafhopper

Trade 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	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
Azatrol-EC (azadirachtin)	0.24-0.96 fl oz/1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
BioLink (garlic juice)	0.5-2 qt/acre	-	-	?	25(b) pesticide. Repellant
BioLink Insect & Bird Repellant (garlic juice)	0.5-4 qt/acre	-	-	?	25(b) pesticide. Repellant
BioRepel (garlic oil)	1 part BioRepel to 100 parts water	-	-	?	25(b) pesticide
Cedar Gard (cedar oil)	1 qt/acre	-	-	?	25(b) pesticide
DES-X (insecticidal soap)	2% formulation sprayed at 75-200 gallons/acre	1/2	12	?	
Ecotec (rosemary oil, peppermint oil)	1-4 pts/acre	-	-	?	25(b) pesticide
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
Molt-X (azadirachtin)	10 oz/acre	0	4	?	
M-Pede (insecticidal soap)	1-2% vol:vol	0	12	2	Works by contact. Good coverage is important
Neemix 4.5 (azadirachtin)	7-16 fl oz/acre	0	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment for PyGanic EC 1.4 II

Table 7.7.1 Pesticides Labeled for Management of Potato Leafhopper					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Safer Brand #567 II (potassium laurate, pyrethrins)	6.4 oz/gal of water	until dry	12	?	Apply one gallon of mixed spray per 700 sq. ft. of plant surface area.
Surround WP (kaolin clay)	20-50 lb/acre	up to day	4	?	Suppression only. Only use before fruit set as residues may be difficult to remove after harvest.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.7.2 TREE CRICKET *(Oecanthus sp.)*

The tree cricket is a greenish-white, slender-bodied insect with dark antennae that are usually longer than its body. During the summer, both nymphs and adults can be found on bramble canes. In late summer, adults lay eggs in the canes, leaving long rows of punctures and greatly weakening the cane above.

Tree Cricket Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known.
Cultural management	Remove and burn infested canes. Eliminate old fruiting canes and wild brambles from the immediate area.
Chemical Treatment	Insecticides may be applied from late August to mid-September.

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Table 7.7.2 Pesticides Labeled for Management of Tree Cricket					
Trade Name (active ingredient)	**Product Rate**	**PHI (Days)**	**REI (Hours)**	**Efficacy[1]**	**Comments**
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
Neemix 4.5 (azadirachtin)	7-16 fl oz/acre	0	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment for PyGanic EC 1.4 II.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.7.3 BROWN MARMORATED STINK BUG *(Halymorpha halys)*

Raspberries and blackberries may be particularly vulnerable compared to other crops. Adult stink bugs are about 1.5 cm in length and brown in color, resembling other species of native stink bugs. Antennae have characteristic light-colored bands and the rear edge of the abdomen has light and dark banding. Immatures (nymphs) vary in color depending on stage, but have white bands on legs and red eyes. Adult and immature bugs feed on developing and ripe fruit, causing tissue scaring and off flavors. They can be very numerous and although they do not bite, they can release an unpleasant odor.

Brown Marmorated Stink Bug Management Options	
Scouting/thresholds	Visual scouting for adult and immature bugs on fruit is currently the best approach. Thresholds not established.
Variety susceptibility	No resistant varieties known.
Cultural management	None known. Research is ongoing to develop better lures and traps.
Chemical Treatment	None known.

At the time this guide was produced, the following materials were labeled 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 (DEC) to be used legally in NY. Those pesticides meeting requirements in EPA Ruling 40 CFR Part 152.25(b) (also known as 25(b) pesticides) do not require registration. Current NY pesticide registrations can be checked on the Pesticide Product, Ingredient, and Manufacturer System (PIMS) website http://pims.psur.cornell.edu. ALWAYS CHECK WITH YOUR CERTIFIER before using a new product.

Table 7.7.3 Pesticides Labeled for Management of Brown Marmorated Stink Bug

Trade 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	?	
AzaMax (azadirachtin)	1.33 fl oz/1000 ft^2	0	4	?	
AzaSol (azadirachtin)	6 oz/acre	-	4	?	
Azatrol-EC (azadirachtin)	0.24-0.96 fl oz/1000 ft^2	0	4	?	
Azera (azadirachtin, pyrethrins)	1-3.5 pts/acre	-	12	?	
DES-X (insecticidal soap)	2% formulation sprayed at 75-200 gallons/acre	1/2	12	?	
Ecozin Plus 1.2% ME (azadirachtin)	15-30 oz/acre	0	4	?	
Envirepel 20 (garlic juice)	10-32 oz/acre	-	-	?	25(b) pesticide. Repellant.
Garlic Barrier AG (garlic juice)	see comments	-	-	?	25(b) pesticide. See label for specific information.
Molt-X (azadirachtin)	10 oz/acre	0	4	?	
Neemix 4.5 (azadirachtin)	7-16 fl oz/acre	0	4	?	
PyGanic EC 1.4 II (pyrethrins)	16-64 fl oz/acre	until dry	12	?	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.
PyGanic EC 5.0 II (pyrethrins)	4.5-17 fl oz/acre	0	12	?	See comment for PyGanic EC 1.4 II

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.7.4 YELLOW JACKETS AND HORNETS *(Vespa sp.)*

During droughty conditions in the late summer and fall ripe and over-ripe fruit become very attractive to yellow jackets and hornets (various species) as a source of moisture and sugar. Damaged fruit is particularly attractive, although adults have chewing mouthparts and can make their own holes.

For more information on managing these pests see: Gangloff-Kaufman, J., 2011, Wasp and Bee Management: A Common Sense Approach. Natural Resource, Agriculture, and Engineering Service (NRAES) publication no. 185, NRAES Cooperative Extension, PO Box 4557, Ithaca, NY 14852-4557.

Yellow Jacket and Hornet Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No resistant varieties known.
Cultural management	Avoid accumulation of over-ripe or injured berries. Removal of nests in surrounding area may be helpful. Traps with attractive baits have been partially successful in reducing numbers.
Chemical Treatment	As a general rule, insecticides to control wasps and hornets in the crop are not very effective and may interfere with harvest.

7.7.5 BLACKBERRY PSYLLID *(Trioza tripunctata)*

Early season curling and stunting of shoots and leaves of thornless and thorny blackberries: curled leaves are often darker green in color as compared to normal ones. Flower buds and fruiting spurs may also be stunted. Psyllid damage is often mistaken for a plant disease since the curling continues for some time after the adult insects are gone. Damage occurs only when blackberries are grown in close proximity to conifers, which serve as an overwintering site for adults. Adults move from conifers to blackberries in mid-May for egg-laying; leaf curling becomes visible 7-10 day later. Nymphs may cause continuing symptoms on infested plants.

Blackberry Pysllid Management Options	
Scouting/thresholds	None established; the feeding of just one adult psyllid is sufficient to initiate cone stunting and leaf curl.
Variety susceptibility	No resistant cultivars known.
Cultural management	Avoid sites within 250 yards of conifer plantings (*Pinus* spp, *Juniperus* spp, *Picea* spp).
Chemical Treatment	

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Table 7.7.5 Pesticides Labeled for Management of Blackberry Psyllid

Trade Name (active ingredient)	Product Rate	PHI (Days)	REI (Hours)	Efficacy[1]	Comments
AzaSol (azadirachtin)	6 oz/acre	-	4	?	
Neemix 4.5 (azadirachtin)	7-16 fl oz/acre	0	4	?	
Surround WP (kaolin clay)	20-50 lb/acre	up to day	4	?	Suppression only. Only use before fruit set as residues may be difficult to remove after harvest.

[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 - re-entry interval, - = pre-harvest interval isn't specified on label.

7.8 Wildlife Management

Damage to fruit by birds is a serious problem in many areas of New York. Flocking birds can destroy a crop in a matter of days. Visual scare devices such as whirlers, streamers, flash tape, reflectors, and plastic hawk and owl models are seldom effective if used alone. Sound devices such as exploders, alarms, or recorded devices with bird distress calls may provide limited short-term control. For sound devices to be effective, their location and the frequency of sounds should be changed daily. They also should be in place just before the fruit ripens. Some towns have passed ordinances regulating the use of sound devices, so make sure you are in compliance with local laws. Netting is the most effective way to limit bird damage to raspberries and other small fruits.

Various rodents can damage a raspberry or blackberry planting, especially as they feed under mulch in the winter. Closely mowing the area around the planting in early November will reduce the habitat for voles and mice. The habitats (woodlots) of predators that

feed on rodents (hawks, owls, foxes) should be protected around the area. A number of toxic baits are labeled for use in agricultural areas. To be most effective, baits should be placed in feeding stations that exclude large animals and are replenished throughout the winter.

Deer browsing can devastate berry plantings. Multiple strategies are required to discourage deer from feeding on berry plantings. Refer to Reducing Deer Damage to Home Gardens and Landscape Plantings by P. Curtis and M. Richmond for recommended methods. Fencing is the best way to keep deer and other mammals out of berry plantings. Some deer repellents are registered for use on fruit crops during the non-bearing season.

When using dogs and invisible fence to manage vertebrate pests in a planting, there is food safety risk associated with the dog excrement. If the dog consistently excretes in an area away from the field, or keeps other vertebrate animals from using the field, the food safety risk is somewhat reduced. Using dogs primarily in the winter and early spring when deer browsing is greatest (and avoiding use during harvest) will also minimize food safety risk.

Table 7.2. Vertebrate Damage Mitigation Practices

Animal Pest	Management Practices[1]
Birds	Avoid sites with woods along the edge(s) because these will support bird populations. Netting; visual scare devices (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). Songbirds are protected and cannot be killed. All state and local firearms laws or regulations must be followed*.
Mice and voles	Removal of dropped fruit; habitat manipulations including elimination of unmowable areas surrounding plantings; monitor to determine the need for management. Mow closely in late fall around the planting and apply winter mulch only after mowing. Population control through trapping by landowner.
Raccoons	Avoid sites with woods along the edge(s) because these will support raccoon populations. 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	Tend to chew on irrigation lines. Manipulation including elimination of protective cover around plantings. 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.
White-tailed deer	Exclusion fencing (8 ft. [250 cm] high-tensile woven wire or 5 to 6 ft. [150 to 200 cm] electric exclusion fencing; peanut-butter baited electric fences; invisible fencing with dogs); habitat manipulation including elimination of protective cover around plantings. Population reduction through shooting by licensed hunters, landowners or their agents with DMAP or deer damage permits. Unlike some other vertebrate pests, landowners cannot kill nuisance deer without a permit.
Woodchucks	Exclusion fencing (electrified exclusion fencing); habitat manipulation including removal of brush piles. Population reduction through shooting by licensed hunters or landowners; through trapping by landowner or by licensed nuisance wildlife control agent.

* 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. Shooting also may require a permit, depending on animal and season. 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.

7.9 Considerations During Harvest and Renovation

During harvest operations some pests can become a nuisance, e.g. wasps and yellow jackets, particularly in U-pick operations. Wasp and yellow jacket nests can be destroyed during the growing season as they are found in the planting and surrounding areas. Some species are ground-nesting and such nests can be destroyed by drenching with hot water. Traps baited with sugary liquids, such as Hi-C, provide a means of reducing the population of wasps and yellow jackets, but the effectiveness of this tactic is unknown.

During harvest much can be done to reduce disease and insect pressure by eliminating infested and infected fruit from the planting. Separate damaged fruit from healthy fruit as it is being picked. Designate pickers to cull such fruit from the field at harvest time.

Then bury or burn the diseased and infested fruit. This is helpful to combat gray mold, anthracnose and the strawberry sap and picnic beetles (through the removal of overripe or infested fruit).

After harvest, a post-harvest grading table will provide an excellent opportunity to grade out damaged, diseased and infected fruit which will lower quality and market value (be sure to sanitize this table after use, see Section 8). All culled fruit should be destroyed by burning or burying. Cleanliness or sanitation in the planting is very important, removing dropped berries during harvest will reduce risk from gray mold, anthracnose, and strawberry sap and picnic beetles, as described above. At this time also make note of trouble spots in the field, or the presence of unthrifty plants, foliar diseases, leaf damage, etc. and plan steps to maintain a healthy planting. After harvest do a thorough job of pruning canes, chopping mulch, and removing infected and infested plant parts.

Keep in mind your production goals and recognize that it should be possible to obtain good yields in organic raspberry and blackberry production. Maintain good records of the planting condition and pest pressure, amount harvested, and know the market demands.

8. FOOD SAFETY

Attention to microbial food safety is important for crops that are eaten raw. Continuing produce-associated foodborne illness outbreaks have resulted in many buyers requiring the implementation of food safety practices on the farm and the development of the first ever produce safety regulations as part of the Food Safety Modernization Act (FSMA). Pathogens can contaminate food during all phases of production, harvesting, and packing. Wild and domesticated animals, manure, irrigation water, inadequate worker hygiene, unclean picking containers, unsanitized post-harvest water, and unclean packaging materials are all potential vectors of microbiological contaminants. Growers should conduct a risk assessment to identify microbial hazards and then implement appropriate practices to reduce risks. There are many resources available to help including those at the National GAPs Program or the Produce Safety Alliance. Regardless of farm size, commodities or cultural practices, Good Agricultural Practices can be used to identify and possibly reduce microbial risks.

Implementing just a few simple practices can reduce risks significantly. One of these is to wash hands using potable water and sanitizer prior to any contact with the crop, particularly after using the restroom or eating. Do not allow workers who are ill to handle produce. If they are able to work, assign jobs that do not involve contact with produce or customers. Prevent animals or animal manure from contacting produce, by discouraging animals (including pets) from entering production fields and by not using irrigation water that may have been contaminated with manure. Manure should only be applied before planting so it can be incorporated into the soil. For fall-fruiting berries, composted manure can be applied to the soil in spring if it has been composted prior to application. Ensure that picking containers are clean and free from mouse droppings. Following these steps can dramatically reduce risks of pathogen contamination. Conduct a full assessment of your farm to identify other high risk practices.

NOTE: Postharvest dips are not recommended for soft fruits such as raspberries and blackberries, because they greatly promote mold growth by wetting the fruit.

The Food Safety Modernization Act (FSMA) will apply to farms that grow, harvest, pack or hold most fruits and vegetables when those fruits and vegetables are in an unprocessed state, and will govern practices affecting: water, worker hygiene, manure and other soil additions, animals in the growing area, and equipment, tools and buildings When the FSMA is finalized, the Food and Drug Administration (FDA) will be mandated to enforce preventive control measures, and to conduct inspections across the food supply system. Updates and information on this proposed rule are available at the United States Food and Drug Administration's Food Safety Modernization Act website.

Table 8.1 Rates for Sanitizers Labeled for Raspberry and Blackberry Postharvest Facilities		
Active ingredient **Product name**	***Uses***	
	Food contact surfaces[1]	**Hard surface, non-food contact[1]**
chlorine dioxide		
CDG Solution 3000	50 ppm solution	500 ppm dilution
Oxine[2]	100 ppm solution	500 ppm solution
Pro Oxine[2]	50-200 ppm solution	500 ppm solution
hydrogen peroxide/peroxyacetic acid		
Enviroguard Sanitizer	-	2.5-20 fl oz/5 gal water
Oxonia Active	1-1.4 oz/4 gal water	1 oz/8 gal water.
Peraclean 5	1-1.5 fl oz/5 gal water	-
Peraclean 15	0.33 fl oz/5 gal water	-
Perasan 'A'	1-6.1 oz/6 gal water	
Per-Ox	1-2.25 fl oz/5 gal water	1-10 fl oz/15 gal water
SaniDate 5.0	1.6 fl oz/ 5 gal water	1.6 fl oz/ 5 gal water
Shield-Brite PAA 5.0	1.6fl oz/5 gal water	1.6fl oz/5 gal water
StorOx 2.0	0.5 fl oz/1 gal water	0.5 fl oz/1 gal water
VigorOx 15 F & V	0.31-0.45 fl oz/5 gal water-	1.1-9.5 fl oz/5 gal water -
VigorOx LS-15	0.31-0.45 fl oz/5 gal water	1.1-9.5 fl oz/5 gal water
sodium hypochlorite		
San-I-King No. 451	100 ppm chlorine in solution	-

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

9. SMALL-SCALE SPRAYER TECHNOLOGY

9.1 Spraying Small Raspberry and Blackberry Plantings

On many small-scale raspberry and blackberry plantings, spraying often requires special attention to calibration, 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. 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 bushes that you can spray on both sides with the spray tank (e.g. 48 bushes covered)
3. Determine the total number of bushes per acre (e.g. 968 bushes per acre)
4. Calculate the spray volume required per acre:

   Spray volume/acre = (bushes per acre ÷ bushes covered per spray tank) **x** volume applied in spray tank
   e.g. 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 on concrete.
3. Fill sprayer to a known level, mark the fill level.
4. Spray the area on the concrete.
5. Refill sprayer to the fill mark.
6. Compare quantity collected with nozzle chart and desired amount.

STATIC CALIBRATION

1. Select correct nozzle and pressure.
2. Measure and mark off an area 10 feet x 10 feet on concrete.
3. Spray the area and record time taken.
4. Carry out stationary run of same time duration, catching liquid in a graduated measuring jug.
5. Compare quantity collected with nozzle chart and desired amount.

CALCULATING THE AMOUNT OF PESTICIDE TO USE

Some organically approved pesticides are typically sold for large-scale plantings and give application rates on a per acre basis. When converting a known quantity per acre to spray a smaller area, the first step is to measure the area to be sprayed using a tape measure. Divide the number of square feet you have measured by 43,560 to obtain the acreage (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 you 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.

Table 9.1. How much powder or granules should I use?

Volume of liquid	*100 gallons*	*25 gallons*	*5 gallons*	*1 gallon*
Amount of powder or granules to use	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

Table 9.2. How much liquid should I use?

Volume of liquid	*100 gallons*	*25 gallons*	*5 gallons*	*1 gallon*
Amount of liquid to use	1 gal	2 pts	6 ½ oz	1 ¼ oz
	4 pts	1 pt	3 ¼ oz	5/8 oz
	2 pts	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

Table 9.3. 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

Powders and granules

Example: The label states 3 lbs of powdered product per 100 gallons but you only wish to use a backpack sprayer with a 5-gallon tank. Table 8.1 shows you need to mix in 2 3/8 oz of powder. Use dean weighing scales to provide the correct amount of powder, NEVER use a volumetric measure, e.g. a measuring cup, because the bulk density of different products varies.

Liquids

Example: The label states 4 pts of a liquid product per 100 gallons of spray but you only wish to use a backpack sprayer with a 5-gallon tank. Table 8.2, below, shows you need to mix in 3¼ fl oz of liquid product. Use a dean measuring cylinder or vessel to provide the correct amount of liquid.

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 the bulk density of products varies.

Safety. Be sure to wear the proper protective dothing and equipment as required on the pesticide label. Always be aware of watercourses, neighboring properties and changes in the weather.

9.2 Selecting a Small Sprayer for the Small, Organic Raspberry and Blackberry Planting

There are many important points to consider before purchasing a sprayer, not the least of which is the area to spray, the proximity of the local supplier, standard of manufacture, etc. There are many growers with small plantings who need spraying equipment ranging 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 filling hole at the top is also important.

There are three factors affecting application rate - forward speed, pressure, and nozzle tip size. Unfortunately most inexpensive backpack sprayers have no pressure gauge. Pay more money and purchase a backpack sprayer with a pressure gauge or, better still, purchase a spray management valve as standard or as an option. Normally output increases or decreases according to the pressure in the system, (which is dependent upon how vigorous you are in pumping the handle up and down). A spray management valve, such as a CF valve, will ensure a constant output irrespective of hand pump action. The CF valve evens out fluctuations in pressure, e.g. will only allow a maximum and minimum pressure thus ensuring even flow. The Fountainhead Group sells a backpack sprayer with a simple valve which ensures the correct pressure is not exceeded.

An alternative to the hand-operated backpack sprayer is an electrically-operated backpack sprayer, which utilizes a small rechargeable battery. Maximum pressure is relatively low and it is easier than using a traditional hand pump system, particularly if you have many rows of plants to spray. Similarly a small back pack sprayer fitted with a small gas engine is available. The electric version is quieter to use, but you must remember to recharge the batteries otherwise spraying will be delayed.

Portable mist and air blower backpacks

These are ideal where canopy penetration is required, e.g. denser, vigorous plantings. A small gas engine drives a fan blower which creates an airstream which passes along a hand-held tube (similar to a leaf blower). The tube has a nozzle situated at the end so that liquid spray can be squirted into the airstream. The operator directs the spray cloud towards the canopy by pointing the hand-held tube. It is preferable to point the tube backwards to avoid walking into the spray cloud. Engine speed can be reduced which enables a slower airspeed to match a smaller canopy in early season. They are very good at rustling the canopy and getting good penetration and deposition. They are heavy! Noise is a problem, so ear protection must be worn.

Portable engine-driven gas sprayers

If weight is a problem, and ground conditions are relatively smooth, a number of manufacturers offer a sprayer with a small gas engine and a 10 to 12 gallon tank. Larger capacity tanks (14 to 100 gallons) are often trailed and can be pulled by a lawn tractor, ATV, Gator, or small tractor.

Small, mounted sprayers

Ideal for mounting onto the carrier rack of an ATV, 15 to 25 gallons, they use a small electric pump to provide up to 70 psi. When used with a hand wand and a hose, they can be used to spray short rows. The same system is ideal for weed control and spot spraying of weeds.

Large, skid mounted sprayers

Ideal for fitting into the back of a pick-up truck, these sprayers have a tank capacity of 35 to 200 gallons, and an electric-start gas engine.

HERBICIDE OR GROUND APPLICATION SPRAYERS

Backpack, small ATV-mounted tank, and hand-lance sprayers

These sprayers can be used for herbicide application **BUT** be very careful that there is no carry-over from herbicide residues in the sprayer, therefore wash them out very thoroughly before using them to apply materials other than herbicides. Alternatively, have dedicated herbicide-only equipment.

Controlled Droplet Applicators (CDA)

The use of CDA's will considerably reduce the need to carry vast amounts of water. A spinning disc (battery powered) will produce 95% of the same-size droplets, thus reducing herbicide rates by at least 50% and water rates by 75%. Herbi and Mantis (trade names) are both hand-held CDA sprayers. ATV- or tractor-mounted shielded CDA sprayers such as the Environmist also reduce spray rates while shielding the plants from the spray.

Wick wipers

Where occasional weeds and access over wet land are a problem, the use of a hand-held wick wiper is an easy-to use, effective option. A small tank, usually contained in the handle, holds the liquid, which soaks a rope wick or a sponge. The rope or sponge can then be wiped against the weeds.

For further information on pesticide application technology visit http://web.entomology.cornell.edu/landers/pestapp/.

10. PESTICIDES MENTIONED IN THIS PUBLICATION

Table 10.1 Fungicides and Bactericides

Trade Name	Active Ingredient	EPA Reg. No.
Acoidal	*sulfur*	62562-4
Actinovate-AG	*Streptomyces lydicus WYEC 108*	73314-1
Agricure	*potassium bicarbonate*	70870-1
Badge X2	*copper oxychloride, copper hydroxide*	80289-12
Basic Copper 53	*copper sulfate*	45002-8
BIO-TAM	*Trichoderma asperellum, Trichoderma gamsii*	80289-9-69592
Champ WG	*copper hydroxide*	55146-1
Cinnerate	*cinnamon oil*	Exempt - 25(b) pesticide
CS 2005	*copper sulfate pentahydrate*	66675-3
Cueva Fungicide	*copper octanoate*	67702-2-70051
Defend DF	*sulfur*	62562-8
Double Nickel 55	*Bacillus amyloliquefaciens str. D747*	70051-108
Double Nickel LC	*Bacillus amyloliquefaciens str. D747*	70051-107
Ecotec	*(rosemary and peppermint oil)*	Exempt - 25(b) pesticide
Glacial Spray Fluid	*mineral oil*	34704-849
Gras Roots	*cinnamon oil*	Exempt - 25(b) pesticide
JMS Stylet Oil	*paraffinic oil*	65564-1
Kaligreen	*potassium bicarbonate*	11581-2
Microthiol Disperss	*sulfur*	70506-187
Micro Sulf	*sulfur*	55146-75
Mildew Cure	*cottonseed,corn and garlic oil*	Exempt - 25(b) pesticide
Milstop	*potassium bicarbonate*	70870-1-68539
M-Pede	*potassium salts of fatty acids*	10163-324
Nordox 75 WG	*cuprous oxide*	48142-4
Nu-Cop 50 WP	*copper hydroxide*	45002-7
Nu-Cop 50 DF	*cupric hydroxide*	45002-4
Nu-Cop HB	*cupric hydroxide*	42750-132
Nuke Em	*citric acid*	Exempt - 25(b) pesticide
Omni Supreme Spray	*mineral oil*	5905-368
Optiva	*Bacillus subtilis*	69592-26
Organocide	*sesame oil*	Exempt - 25(b) pesticide
OxiDate 2.0	*hydrogen dioxide, peroxyacetic acid*	70299-12
PERpose Plus	*hydrogen peroxide/dioxide*	86729-1
PureSpray Green	*petroleum oil*	69526-9
Regalia	*Reynoutria sachalinensis*	84059-3
RootShield Granules	*Trichoderma harzianum Rifai str T-22*	68539-3
RootShield PLUS+ Granules	*Trichoderma harzianum Rifai str T-22, Trichoderma virens str. G-41*	68539-10
RootShield PLUS+ WP	*Trichoderma harzianum Rifai str T-22, Trichoderma virens str. G-41*	68539-9

Table 10.1 Fungicides and Bactericides		
Trade Name	**Active Ingredient**	**EPA Reg. No.**
RootShield WP	*Trichoderma harzianum Rifai str KRL-AG2*	68539-7
Serenade ASO	*Bacillus subtilis*	69592-12 and 264-1152
Serenade MAX	*Bacillus subtilis*	69592-11 and 264-1151
Serenade Opti	*Bacillus subtilis*	264-1160
Sil-Matrix	*potassium silicate*	82100-1
SuffOil-X	*petroleum oil*	48813-1-68539
TerraClean 5.0	*hydrogen dioxide, peroxyacetic acid*	70299-13
Thiolux	*sulfur*	34704-1079
Trilogy	*neem oil*	70051-2
TriTek	*mineral oil*	48813-1
Zonix	*Rhamnolipid Biosurfactant*	72431-1

Table 10.2 Insecticides and Miticides		
Trade Name	**Active Ingredient**	**EPA Reg. No.**
Aza-Direct	*azadirachtin*	71908-1-10163
AzaGuard	*azadirachtin*	70299-17
AzaMax	*azadirachtin*	71908-1-81268
AzaSol	*azadirachtin*	81899-4
Azatrol EC	*azadirachtin*	2217-836
Azera	*azadirachtin, pyrethrins*	1021-1872
BioLink Insect Repellant	*garlic juice*	Exempt - 25(b) pesticide
BioLink Insect and Bird Repellant	*garlic juice*	Exempt - 25(b) pesticide
BioRepel	*garlic oil*	Exempt - 25(b) pesticide
Cedar Gard	*cedar oil*	Exempt - 25(b) pesticide
Cinnerate	*cinnamon oil*	Exempt - 25(b) pesticide
DES-X	*insecticidal soap*	67702-22-70051
Ecozin Plus 1.2% ME	*azadirachtin*	5481-559
Entrust	*spinosad*	62719-282
Entrust SC	*spinosad*	62719-621
Envirepel 20	*garlic juice*	Exempt - 25(b) pesticide
Garlic Barrier AG+	*garlic juice*	Exempt - 25(b) pesticide
GC-Mite	*cottonseed, clove and garlic oil*	Exempt - 25(b) pesticide
Glacial Spray Fluid	*mineral oil*	34704-849
Grandevo	*Chromobacterium subtsugae str. PRAA4-1*	84059-17
GrasRoots	*cinnamon oil*	Exempt - 25(b) pesticide
JMS Stylet Oil	*paraffinic oil*	65564-1
M-Pede	*potassium salts of fatty acids*	10163-324
Molt-X	*azadirachtin*	68539-11
Neemix 4.5	*azadirachtin*	70051-9
Nuke Em	*citric acid*	Exempt 25(b) pesticide
Omni Supreme Spray	*mineral oil*	5905-368
Organocide	*sesame oil*	Exempt 25(b) pesticide
PFR-97 20% WDG	*Isaria fumosorosea Apopka Strain 97*	70051-19
PureSpray Green	*petroleum oil*	69526-9
PyGanic EC 1.4 II	*pyrethrins*	1021-1771
PyGanic EC 5.0 II	*pyrethrins*	1021-1772
Safer Brand #567 Pyrethrin & Insecticidal Soap Concentrate II	*pyrethrins & potassium salts of fatty acids*	59913-9

Table 10.2 Insecticides and Miticides		
Trade Name	**Active Ingredient**	**EPA Reg. No.**
Sil-Matrix	*potassium silicate*	82100-1
SuffOil-X	*petroleum oil*	48813-1-68539
Surround WP	*kaolin*	61842-18
Trilogy	*neem oil*	70051-2
TriTek	*petroleum oil*	48813-1

Table 10.3. Herbicides		
Trade Name	**Active Ingredient**	**EPA Reg. No.**
AXXE Broad Spectrum Herbicide	*ammonium nonanoate*	70299-23

Table 10.4 Sanitizers mentioned in this publication		
Trade Name	**Active Ingredient**	**EPA Reg. No.**
CDG Solution 3000	*chlorine dioxide*	75757-2
Enviroguard Sanitizer	*hydrogen peroxide/peroxyacetic acid*	63838-1-527
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 5.0	*Peroxy acetic acid/hydrogen peroxide*	70299-19-64864
Shield-Brite PAA 12.0	*hydrogen peroxide/peroxyacetic acid*	70299-18-64864
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

* Restricted-use pesticide in New York State

10.1 Pesticides Labeled for use in Organic Raspberry and Blackberry Production

At the time the guide was released, the pesticides listed in this guide were allowable for organic production under the National Organic Program Rule and registered for use in New York. The authors relied mainly on the Organic Materials Review Institute OMRI list for pesticides to include. Always check with your certifier before using any new pesticide.

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 the previous section, 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.

10.2 Pesticide Regulatory Considerations

Organic production 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. Pesticides mentioned in this organic production guide are registered by the United States Environmental Protection Agency (EPA) or meet the EPA requirements for a "minimum risk" pesticide. At the time of publication, the pesticides mentioned in this guide meet New York State Department of Environmental Conservation (NYS DEC) registration requirements for use in New York State. See Cornell's Product, Ingredient, and Manufacturer System website 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 7 CFR Part 205, sections 600-606 The Organic Materials Review Institute (OMRI) is one organization that reviews products for compliance with the NOP regulations and publishes lists of compliant products, but other entities also make product assessments. 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 products that may have properties that reduce the impact of pests. Examples of home remedies include the use of beer as bait to reduce slug damage in strawberries or dish detergent to reduce aphids on plants. These materials 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? The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) defines two categories of pesticides: general-use and-restricted use. NYS DEC also defines additional restricted-use pesticides. 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 on property they own or rent do not need to be certified pesticide applicators. However, we do encourage anyone who applies pesticides to become certified.

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 Worker Protection Standard (WPS). Having a pesticide applicator certification is one of the qualifications needed to be a WPS trainer. Certified pesticide applicators meet the WPS training requirements. For more information on the Worker Protection Standard see How To Comply with the Worker Protection Standard. See Revisions To the Worker Protection Standard for a summary of new worker protection standards that will take effect January 2017. Find more information on pesticide applicator certification from the list of State Pesticide Regulatory Agencies or, in New York State, see the Cornell Pesticide Management Education Program website at http://psep.cce.cornell.edu.

10.3 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 quickly broken down in the environment. 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. OMRI lists adjuvants in OMRI Products List, Web Edition http://www.omri.org/ubersearch/results/adjuvant?type[]=opd_listed_product&type[]=opd_prohibited_product&type[]=opd_removed_product&d[]=16997&rb[]=17013 . 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.

11. REFERENCES AND RESOURCES (All links accessed April 2016)

- A & L Eastern Agricultural Laboratories, Inc. 2006. al-labs-eastern.com/.
- Agri Analysis, Inc. 2009. www.agrianalysis.com/.
- Agricultural Analytical Services Laboratory. Pennsylvania State University. 2016. aasl.psu.edu.
- Agro-One. 2015. dairyone.com/analytical-services/agronomy-services/about-agro-one/ Analytical Laboratory and Maine Soil Testing Service, University of Maine. http://anlab.umesci.maine.edu/

- Berry Diagnostic Tool. Pritts, M. and Heidenreich, C. Cornell University. http://www.fruit.cornell.edu/berrytool/
- Berry Soil and Nutrient Management - A Guide for Educators and Growers. Pritts, M., Heidenreich, C., McDermott, L. and Miller, J. (eds). 2015. NE SARE 174 pp. http://www.fruit.cornell.edu/berry/production/soilnutrientmgmt/pdfs/BerrySoilandNutrientManagementGuide.pdf.
- Buffer pH to Derive Lime Guidelines. 2010. Ketterings, Q., Rao, R., Dietzel, K., and Ristow, P. Agronomy Fact Sheet Series, Fact Sheet 48, Cornell University. http://nmsp.cals.cornell.edu/publications/factsheets/factsheet48.pdf
- Building Soils for Better Crops, 3rd edition. 2010. Magdoff, F., and VanEs, H. The Sustainable Agriculture Network, Beltsville, MD. 294 pp. www.sare.org/publications/soils.htm.
- Cornell University Fruit Resources: Berries. http://www.fruit.cornell.edu/berry/
- Cornell University Insect Diagnostic Laboratory. http://idl.entomology.cornell.edu/ Cornell University Pest Management Guidelines for Berry Crops. Updated yearly. https://ipmguidelines.org/
- Cornell University Plant Disease Diagnostic Clinic http://www.plantclinic.cornell.edu/
- Cover Crops for Vegetable Growers, Cover Crop Decision Tool. 2008. Björkman, T. Cornell University. http://covercrops.cals.cornell.edu/decision-tool.php Dairy One Forage Lab. Cornell University. http://www.dairyone.com/forage/
- Elements of IPM for Raspberries in New York. 2000. NYS IPM Program, Cornell University. http://nysipm.cornell.edu/elements/raspb.asp
- FIFRA Regulation 40 CFR Part 152.25(f) Exemptions for Pesticides of a Character Not Requiring FIFRA Regulation. http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&rgn=div5&view=text&node=40:24.0.1.1.3&idno=40#40:24.0.1.1.3.2.1.2
- Minimum-risk Pesticides. 2015. http://www2.epa.gov/minimum-risk-pesticides
- The Mid Atlantic Berry Guide. 2008. Rudisill, A. Edt. Penn State College of Agricultural Sciences. http://pubs.cas.psu.edu/freepubs/MAberryGuide.htm
- National Organic Program. 2016. United States Department of Agriculture: Agricultural Marketing Service (USDA: AMS). https://www.ams.usda.gov/about-ams/programs-offices/national-organic-program For products allowed - click on "National List of Allowed and Prohibited Substances".
- For certifying requirements https://www.ams.usda.gov/services/organic-certification/faq-becoming-certified
- National Sustainable Agriculture Information Service (formerly ATTRA). 2009. National Center for Appropriate Technology (NCAT). https://attra.ncat.org/organic.html
- Network for Environment and Weather Applications (NEWA). 2009. Cornell University. http://newa.cornell.edu/
- New York Berry News. Heidenreich, M.C., ed. Cornell University. http://www.fruit.cornell.edu/nybn/
- New York State Berry Growers Association. Cornell University. www.hort.cornell.edu/grower/nybga/.
- New York State Department of Agriculture and Markets: Organic Farming Resource Center. http://www.agriculture.ny.gov/AP/Organic/OrganicFarmingResourceCenter.html For a list of accredited organic certifiers in NYS – click on "How to Become Certified Organic" and then follow the link under "Organizations Providing Organic Certification Services".
- New York State IPM Fact Sheets for Berries. http://nysipm.cornell.edu/factsheets/berries/
- New York State Fruit IPM. 2009. http://nysipm.cornell.edu/fruits/
- New York State Pesticide Product, Ingredient, and Manufacturer System (PIMS). 2016. Cooperative Extension, Cornell University. http://pims.psur.cornell.edu/
- New York Vineyard Site Evaluation System. 2009. Cornell University and the Institute for the Application of Geospatial Technology. http://arcserver2.iagt.org/vll/
- Northeast Cover Crop Handbook. 1994. Sarrantonio, M. Rodale Institute, PA. Online purchase http://www.amazon.com/Northeast-Cover-Handbook-Health-Series/dp/0913107174
- Northeast Organic Farming Association of New York. http://www.nofany.org/
- Nursery Guide for Berry and Small Fruit Crops. 2009. Cornell University. http://www.fruit.cornell.edu/berry/nurseries/blueberries.html
- Organic Materials Review Institute. http://www.omri.org/
- OMRI Products List. http://www.omri.org/omri-lists
- Organic Weed Management Website http://weedecology.css.cornell.edu/manage/
- Penn State Agronomy Guide 2015-2016. Department of Agronomy, The Pennsylvania State University. http://extension.psu.edu/agronomy-guide
- Pesticide Application Technology. Cornell University. http://web.entomology.cornell.edu/landers/pestapp/

- Pesticide Management Education Program (PMEP). 2016. Cooperative Extension, Cornell University. http://pmep.cce.cornell.edu/
- Raspberry and Blackberry Production Guide for the Northeast, Midwest and Eastern Canada. 2008. NRAES publication #35. http://palspublishing.cals.cornell.edu/nra_order.taf?_function=detail&pr_booknum=nraes-35
- Reducing Deer Damage to Home Gardens and Landscape Plantings, Paul D. Curtis and Milo E. Richmond, Department of Natural Resources, Cornell University, Ithaca, New York 14853. http://www.clemson.edu/psapublishing/Pages/AFW/afw6.pdf Rodale Institute: Leaders in Organic Solutions. 2009. http://www.rodaleinstitute.org/
- Soil and Nutrient Management for Berry Crops. 2015. http://fruit.cornell.edu/berry/production/soilnutrientmgmt/index.html
- Soil Health Website. 2007. Cornell University. http://soilhealth.cals.cornell.edu/
- Soil Health Testing http://soilhealth.cals.cornell.edu/testing-services/
- Soil and Plant Tissue Testing Laboratory. 2016. University of Massachusetts. http://www.umass.edu/soiltest/
- Title 7. National Organic Program Regulations – from https://www.law.cornell.edu/cfr/text/7/part-205
- Using Manure and Compost as Nutrient Sources for Fruit and Vegetable Crops. 2005. Rosen, C. J. and Bierman, P. M. University of Minnesota. http://www.extension.umn.edu/distribution/horticulture/M1192.html
- Using Organic Nutrient Sources. 2009. Sánchez, E., Richard, R. Penn State University. http://pubs.cas.psu.edu/FreePubs/pdfs/uj256.pdf
- Weeds of the Northeast. 1997. Uva, R., J. Neal, and J. DiTomaso. Cornell University Press. 397 pp.

12. GLOSSARY

(Adapted from: Wikipedia, www.wikipedia.org/, the free online encydopedia)

Adjuvant – any substance added to the spray tank or combined in a pesticide formulation that helps improve the performance of a pesticide.

Agroecosystem – all of the living and non-living components, including inputs and outputs, that comprise a spatial and functional coherent unit of agricultural activity.

Allelopathy – condition in which one plant emits substances that affect germination, development or growth of other plants in contact with the substance.

Annual – a plant that completes its life cycle within one year (germination, flowering, seed production, death).

Biennial – a flowering plant that takes two years to complete its biological life cycle.

Buffer zone – a physical space of sufficient size that separates two or more areas of activity so that these areas do not affect each other.

Cation exchange capacity – (CEC) is the capacity of a soil to retain and substitute cations (positively charged ions, e.g. potassium) between the soil and the soil solution. CEC is a measure of nutrient retention capacity.

Compost – a combination of plant, animal and other organic materials that have been decomposed largely through aerobic processes into a substance rich in carbon, nutrients, and biological activity.

Crop rotation – the practice of growing, in the same area, in sequential seasons, a series of dissimilar types of crops to avoid the build up of pathogens and pests that often occurs when one species is continuously cropped.

Frost pocket – an area where still air, cooled by ground-level radiation, travels downhill, replaces warm air, and accumulates to form pockets of very cold air in depressions, valleys, and hollows.

Green manure – a type of cover crop grown for a specific period of time, then incorporated into the soil to add nutrients and organic matter for soil improvement.

Humus – organic matter that is well-decomposed, stable, and contributes to soil tilth and cation exchange.

Immobilization – is when organic matter decomposes and is absorbed by micro-organisms, therefore preventing it being accessible to plants for periods of time. Immobilization is the opposite of mineralization.

Integrated Pest Management (IPM) – a management strategy aimed at insects, mites, plant diseases, weeds, and other pests that uses a variety of planned, complementary tactics including: mechanical devices, physical devices, genetic resistance, biological control, cultural practices, and chemical treatment. It is an ecological approach with a main goal of significantly reducing or eliminating the use of pesticides while at the same time managing pest populations at an acceptable level.

Macroclimate – refers to the regional climate of a broad agricultural area. It can include an area on the scale of tens to hundreds of kilometers.

Mesoclimate – refers to the climate of a particular planting site and is generally restricted to a space of tens or hundreds of meters.

Microclimate – refers to the specific environment in a small restricted space such as a row of plants or corner of a field.

Mineralization – refers to the process where an organic substance is converted to an inorganic substance that can be taken up by the plant.

Nitrogen assimilation – process by which plants expend energy to take up nitrate and ammonium ions and incorporate them into organic molecules required for growth.

Nitrogen budget – accounting that quantifies the nutrients entering the farm (e.g. fertilizers, manure, legumes crops, soil residual nitrogen) and the nutrients leaving the farm (crop harvest, runoff, leaching, volatilization) for the purpose of balancing inputs and exports.

Nitrogen fixation – the biological process by which nitrogen gas (N_2) in the atmosphere is converted into ammonium compounds that are used by plants.

Organic certification – a certification process for producers of organic food and products that requires strict adherence to production standards for growing, storing, processing, packaging and shipping.

Perched water table – accumulated water above the level of the local water table because impermeable rock or sediment prevents downward movement of water into the local water table.

Perennial –a plant that completes its life cycle (germination, flowering, seed production) over more than one year.

Summer annual – an annual plant that germinates, flowers, produces seed and dies within the same growing season.

Surfactant – (or wetting agent) a soap-like adjuvant added to water or some other liquid to increase wetting properties by reducing the surface tension of the droplets.

Threshold – the density of a pest (insect, mite, plant disease, weed, etc.) at which a control treatment will provide an economic return.

Tilth – a term describing soil that is friable, crumbly, and not compacted which allows rainfall to penetrate and roots to grow without obstruction.

Wind break – (or shelterbelt) is a planting around the edge of a field consisting of one or more rows of trees or shrubs planted in such a manner as to provide shelter from the wind and to protect soil from erosion.

Winter annual – a plant that germinates in the fall or winter, then flowers, produces seed and dies within one year.