

Southeast Regional Organic Blueberry

PEST
MANAGEMENT
GUIDE

2024



2024 Southeast Regional Organic Blueberry Pest Management Guide

for managing diseases, insects, weeds and wildlife in blueberries in the Southeast

A publication of the Southern Region Small Fruit Consortium

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Recommendations are based on information from the manufacturer's label and performance data from research and extension field tests.

Because environmental conditions and grower application methods vary widely, suggested use does not imply that performance of the pesticide will always conform to the safety and pest control standards indicated by experimental data.

This publication is intended for use only as a guide. Specific rates and application methods are on the pesticide label, and these are subject to change at any time. Always refer to and read the pesticide label before making any application! The pesticide label supersedes any information contained in this guide, and it is the law.

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Pesticide Emergencies

1-800-222-1222

This number automatically connects you with a local Poison Control Center from anywhere in the United States.

Symptoms of Pesticide Exposure

- Tightening of the chest, mental confusion, blurred vision, rapid pulse, intense thirst, vomiting, convulsions, and unconsciousness are always serious symptoms! Dial 911!
- Pesticides with ‘DANGER’ or ‘DANGER/POISON’ on the product label can cause severe injuries or death very quickly, even with small exposures. Take immediate action!
Other symptoms of pesticide poisoning: headache, fatigue, weakness, restlessness, nervousness, profuse sweating, tearing and drooling, nausea, diarrhea, or irritation of the skin/ eyes/nose/throat. Consult the product Material Safety Data Sheet (MSDS or SDS) for symptoms associated with a particular pesticide.

Pesticide on Skin

- WASH, WASH, WASH! Immediately wash pesticide from skin as thoroughly as possible with any available water that does not contain pesticides.
- Quickly remove protective clothing and any contaminated clothing.
- *Rewash* contaminated skin with soap and water as soon as possible.
- If the victim experiences *any* symptom(s) of poisoning, get medical assistance immediately. *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.

Pesticide in Eyes

- Rinse eye(s) gently with *clean* water for *at least* 15 minutes. Be careful of water temperature.
- If the eye remains irritated or vision is blurry after rinsing, get medical attention right away! *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.

Pesticide in Mouth or Swallowed

- Provide / drink large amounts of water or milk to drink. *Do not give liquids to a person who is unconscious or convulsing!*
- Consult the label BEFORE vomiting is induced – the label may advise against inducing vomiting. Do not induce vomiting with emulsifiable concentrate (E, EC) formulations.
- *Do not induce vomiting if a person is unconscious or is convulsing!*
- Seek medical attention. *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.
- If the pesticide was not swallowed, *rinse mouth thoroughly with clean water*. If your mouth is burned or irritated, consult a physician.

Pesticide Emergencies (Cont'd)

Pesticide Inhaled

- Move victim to fresh air immediately!
- Warn others in the area of the danger.
- Loosen tight clothing.
- Administer artificial respiration, if necessary, but try to determine if the person also may have swallowed any pesticide. Avoid any pesticide or vomit that may be around the victim's mouth.
- Seek medical attention. *Take the pesticide label with you*, but do not contaminate vehicles or expose others if you must take the container with you.

Heat Stress

- Move the victim to a cooler area, remove protective clothing, and pour cool water over the person.
- Give cool liquids to drink. *Do not give liquids to a person who is unconscious or convulsing!*
- Pesticide poisoning may mimic heat illness! Get medical attention if the person is unconscious or if the person is not fully recovered within 15 minutes of cooling down and drinking liquids.

Signal Words

- The pesticide signal word will appear on the pesticide label. It provides information about the acute risks of the pesticide to people.
 - DANGER/POISON: *Highly toxic* - less than a teaspoon can kill an adult.
 - DANGER: *Highly toxic* - pesticide can cause severe eye and/or skin injury.
 - WARNING: *Moderately toxic* - two tablespoons or less can kill an adult.
 - CAUTION: *Slightly toxic* - an ounce or more is required to kill an adult.

Understand that the signal word does *not* provide information about long term pesticide exposure risks (e.g., cancer) or allergic effects. Minimize your exposure to *all* pesticides. The signal word does *not* indicate environmental toxicity or other environmental effects.

Pesticide Spills and Environmental Emergencies

Spills on Public Roads (Usually call the state police/state highway patrol. In many cases, you can call CHEMTREK at 1-800-424-9300 or 911.)

State	Agency	Phone Number
Alabama	Alabama Highway Patrol ----- Alabama Department of Environmental Management Alabama Emergency Management Agency	Cell: call *HP ----- (334) 271-7700 (205) 280-2200
Arkansas	Arkansas Department of Emergency Management	1-800-322-4012
Georgia	Georgia State Patrol	Cell: call *GSP or 911
Louisiana	LDAF Emergency Hotline	1-855-452-5323
Mississippi	Mississippi Emergency Management Agency	1-800-222-6362
North Carolina	Regional Response Team (RRT) For spills not on public roadways, contact the Pesticide Section of NCDA&CS	911 or your RRT (919) 733-3556 or (800) 662-7956 during non- business hours
South Carolina	South Carolina Highway Patrol ----- South Carolina DHEC Emergency Response Section	Cell: call *HP ----- 1-888-481-0125
Tennessee	Tennessee Emergency Management Agency (TEMA) State Emergency Operations Center	1-800-262-3300
Virginia	Virginia Emergency Operations Center	1-804-674-2400

Environmental Emergencies (contamination of waterways, fish kills, bird kills, etc.)

State	Agency	Phone Number
Alabama	Alabama Department of Environmental Management Alabama Emergency Management Agency Alabama Department of Conservation and Natural Resources	(334) 271-7700 (205) 280-2200 (334) 242-3469
Arkansas	Arkansas Department of Emergency Management	1-800-322-4012
Georgia	Georgia Department of Natural Resources Response Team	1-800-241-4113
Louisiana	LDAF Emergency Hotline	1-855-452-5323
Mississippi	Mississippi Emergency Management Agency	1-800-222-6362
North Carolina	North Carolina Div. of Water Quality	1-800-858-0368
South Carolina	South Carolina DHEC	1-888-481-0125
Tennessee	Tennessee Wildlife Resources Agency	Region 1, West Tennessee: 1-800-372-3928 Region 2, Middle Tennessee: 1-800-624-7406 Region 3, Cumberland Plateau: 1-800-262-6704 Region 4, East Tennessee: 1-800-332-0900
Virginia	Virginia Emergency Operations Center	1-804-674-2400

Pesticide Liability and Stewardship

The **Pesticide Environmental Stewardship** website is located at <http://pesticidestewardship.org/Pages/default.aspx>. Information on proper pesticide use and handling, calibration of equipment, reading pesticide labels, disposal, handling spills, and other topics are presented.

Pesticide applicators, supervisors, and business owners may all face severe criminal and/or civil penalties if pesticides are misused – knowingly or accidentally.

The Pesticide Label: Federal and state laws require pesticide applicators to follow the directions on the pesticide label exactly. Do not exceed maximum label rates, apply a pesticide more frequently than stated on the label, or apply a pesticide to a site that is not indicated on the label. Labels change; review yours regularly.

Restricted Use Pesticides (RUP): These pesticides are clearly labeled “Restricted Use Pesticide” in a box at the top of the front label. Applicators purchasing, applying, or supervising the application of a RUP must be certified or licensed through their state pesticide regulatory agency. Some states have mandatory licensing for certain pesticide use categories whether or not RUPs are applied.

Personal Protective Equipment (PPE): Anyone handling or applying pesticides must wear the PPE stated on the pesticide label. The EPA Worker Protection Standard (WPS) requires applicators to wear the label required PPE and agricultural employers to supply the label PPE and ensure that the PPE is worn correctly by applicator employees. Do not wear PPE items longer than it has been designed to protect you. Clean, maintain, and properly store PPE. Do not store PPE with pesticides.

Reentry Interval (REI): The period of time immediately following the application of a pesticide during which unprotected workers should not enter a field.

Pre-Harvest Interval (PHI): The time between the last pesticide application and harvest of the treated crops.

EPA Worker Protection Standard (WPS): WPS changes continue to be implemented. Growers should consult the EPA website (<https://www.epa.gov/pesticide-worker-safety/agricultural-worker-protection-standard-wps>) or their local extension service for the most up to date information. Growers who employ one or more *non*-family members must comply with the WPS. This standard requires agricultural employers to protect applicator employees and agricultural worker employees from pesticide exposure in the workplace by 1) providing specified pesticide safety training, 2) providing specific information about pesticide applications made on the agricultural operation, 3) providing and ensuring that applicators wear clean and properly maintained label required PPE, 4) providing decontamination facilities for potential pesticide and pesticide residue exposures, and 5) providing timely access to medical assistance in the event of a suspected pesticide exposure. These protections apply to both restricted use pesticides *and* general use pesticides used in agricultural plant production.

Pesticide Liability and Stewardship (Cont'd)

Enclosed Structures: Pesticides labeled for field applications may not be allowed for use in enclosed structures or may have additional restrictions. Definitions of enclosed structures differ between states but may include greenhouses and high tunnels. Consult your local Extension service or state Department of Agriculture for guidance and appropriate recommendations. WPS for enclosed structures may also differ than those for field-grown plants.

Pesticide Recordkeeping: You must keep records of all RUP applications for at least two years under the Federal (USDA) Pesticide Recordkeeping Requirement if your state does not have its own pesticide recordkeeping requirements. Some states require records be kept for longer than the federal requirement. Maintaining records of all pesticide applications, not just RUP applications, indefinitely, cannot only help troubleshoot application problems, but also allows you to reference successful applications and can help protect against future liability. Consult your local Extension service for details.

Emergency Preparedness: Be prepared for emergencies. Store pesticides and clean empty containers securely. Develop and provide written plans and training to prepare your employees and family members for pesticide fires, spills, and other emergencies. Assign responsibilities to be carried out in the event of pesticide emergencies. Keep copies of the pesticide labels and MSDSs away from the area where pesticides are stored. Provide copies of product MSDSs to your community first responders. Consult your local Extension Service and insurance company for assistance.

Pesticide Disposal: Properly dispose of clean empty pesticide containers and unwanted pesticides as soon as possible. Containers can often be recycled in a pesticide container recycling program. Unwanted pesticides may pose a risk of human exposure and environmental harm if kept for long periods of time. Consult your local Extension service for assistance.

CAUTION: Specific rates, application methods, and sometimes target pests vary on product labels containing the same active ingredient and are subject to change at any time. Always refer to and read the pesticide label before making any application!!

Formulation Abbreviations: Abbreviations commonly used in product formulations that appear in the tables include DF = dry flowable; EC = emulsifiable concentrate; EW = emulsion, oil in water; F = flowable; L = liquid; SC = spray concentrate; SL = soluble concentrate; EG, WG, or WDG = water dispersible granule; W or WP = wettable powder; and WSB = water soluble bag.

Other Abbreviations: Another abbreviation that may appear in product names is XLR = xtra long residual.

Efficacy Ratings: The efficacy or importance of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, NC = no control, and ND = no data. These ratings are benchmarks; actual performance will vary. A superscript 'R' (^R) next to the efficacy rating indicates that the product may not be effective if the pathogen is resistant to the fungicide.

General Pesticide Information

Mode of Action (MOA): Pesticides affect target pests in a variety of ways, and the way a pesticide kills the target organism is called the *mode of action* (MOA). Although pesticides have different names and may have different active ingredients, they may have the same MOA. Over time, pests can become resistant to a pesticide, and typically this resistance applies to all pesticides with the same MOA. When rotating pesticides, it is important to select pesticides with different MOAs.

The **Fungicide Resistance Action Committee** (FRAC), **Insecticide Resistance Action Committee** (IRAC) and IRAC Nematode Working Group, and the **Weed Science Society of America** (WSSA) have organized crop protection materials into groups with shared MOAs and given them specific codes, which appear on pesticide labels. Some MOAs may be unknown and given a code with a U. *When selecting pesticides, avoid successive applications of materials in the same MOA group to minimize potential resistance development.* MOA categories are listed in this guide to aid in the development of resistance management programs. More information about this topic can be found at www.frac.info, www.irc-online.org, and www.hracglobal.com.

Organic Materials Review Institute (OMRI; www.omri.org): Products that are listed by OMRI are commonly accepted for use in organically certified production systems. Always consult your organic certifier prior to use. **OMRI**-listed materials are indicated in the comments section.

Generics: Many pesticide active ingredients are available in generic formulations. For brevity, these formulations are not generally listed. Listed trade names are included to aid in identifying products and are not intended to promote the use of these products or to discourage the use of generic products. Generic products generally work similarly to their brand name counterparts, but formulation changes can impact efficacy and plant response. As with any new chemical, read and follow all label instructions. Chemical names are subject to change; please check the active ingredient for all materials.

The **Pesticide Environmental Stewardship** website is located at <http://pesticidestewardship.org/Pages/default.aspx>. Information on proper pesticide use and handling, calibration of equipment, reading pesticide labels, disposal, handling spills, and other topics are presented.

Resistance Management: Insects, weeds, and disease-causing organisms are all capable of developing resistance to pesticides. To minimize the likelihood of resistance development against your material of choice:

1. Only use pesticides when necessary. When the damage caused by the pest you are controlling is greater than the cost of the pesticide and no other, effective options are available.
2. Use the appropriate material for the pest.
3. Use the recommended rate of the material. Do not use a lower rate than listed on the label.
4. If more than one treatment is needed when the same pest is present, rotate the pesticide MOA between treatments.

General Pesticide Information (Cont'd)

State Registrations: Keep in mind that this publication is a regional guide. Every product listed may not be available or registered for use in every state. Before purchasing and applying a product, verify that that product is registered for use in your state. This may be done by visiting one of several online databases (examples provided below) that provide information on the state registration status of various products, by visiting product manufacturer websites, or by contacting your Extension agent or an appropriate state Extension specialist.

Database	Web Address
Agrian Label Database	https://home.agrian.com/
Crop Data Management Systems	http://www.cdms.net/Label-Database
EPA Pesticide Product and Label System	https://ordspub.epa.gov/ords/pesticides/f?p=PPLS:1
Greenbook Data Solutions	https://www.greenbook.net/
Kelly Registration Systems ¹	http://www.kellysolutions.com
National Pesticide Information Retrieval System ²	http://npirspublic.ceris.purdue.edu/state/

¹Available for AL, AR, FL, GA, LA, MS, NC, OK, SC, TX, and VA in the southeastern U.S.

²Available for AL, AR, FL, KY, LA, TX, and VA in the southeastern U.S.

Pollinator Protection

Before making insecticide applications, monitor insect populations to determine if treatment is needed. If pesticide (fungicide, insecticide, or miticide/acaricide) application is necessary:

1. Use selective pesticides to reduce risk to pollinators and other non-target beneficial insects. Visit the Commonly Used Pesticides Grouped According to Their Relative Hazards to Honeybees table in the Georgia Pest Management Handbook for specific pesticide hazard levels.
2. Read and follow all pesticide label directions and precautions. The label is the Law! EPA now requires the addition of a “Protection of Pollinators” advisory box on certain pesticide labels. Look for the bee hazard icon in the Directions for Use and within crop specific sections for instructions to protect bees and other insect pollinators.
3. Minimize in-field exposure of bees to pesticides by avoiding applications when bees are actively foraging in the crops. Bee flower visitation rate is highest in early morning. Apply pesticides in the late afternoon or early evening to allow for maximum residue degradation before bees return the next morning. Bee foraging activity is also dependent upon time of year (temperature) and stage of crop growth. The greatest risk of bee exposure is during bloom. Consider mowing ground cover if plants are flowering prior to pesticide application.
4. Follow label directions to minimize off target movement of pesticides. Do not make pesticide applications when the wind is blowing towards beehives or off-site pollinator habitats.



Organic Production Considerations

The USDA National Organic Program (NOP) sets rules for how to use NOP-approved pesticides. NOP-approved pesticides (e.g. fungicides, herbicides, and insecticides) are usually less effective than conventional products. The cost and risks of applying an NOP-approved pesticide must be balanced against the anticipated benefit. Under NOP rules, preventative (cultural and biological) management options must be tried before resorting to using pesticides.

This publication provides Southeast-specific information on NOP-approved disease and insect management options for blueberry production and addresses the issues most encountered under the unique growing conditions of the Southeast. This publication does not provide all details on organic blueberry production but does include production methods that reduce the impact of plant diseases and insect pests. Additional details on general organic production methods are available in various online resources. A list of some of these resources is included in the organic blueberry production guide from the University of Kentucky (<http://www.uky.edu/ccd/production/crop-resources/fruit/blueberries>).

Blueberries, especially rabbiteye blueberries (*Vaccinium virgatum*, syn. *V. ashei*), show much promise for organic production in the Southeast. Rabbiteye blueberries are native to the Southeast and have fewer pest problems than most other fruit crops. Organic highbush blueberry (*V. corymbosum*) production requires more intensive management but is possible, especially in the northern portions of the Southeast. Newer southern highbush hybrids (*V. corymbosum* mixed with other southern species) can be grown in the more southern areas, but also require more intensive management than rabbiteye blueberries. Your local extension office can help you select disease-resistant, climate-adapted cultivars for your area.

The overuse of insecticides can lead to resistant insect pest populations. Therefore, treat insect and mite (arthropod) populations only if established economic thresholds are exceeded. Monitor insect populations through trapping or scouting. For arthropods that do not have established thresholds, consult local Extension specialists for treatment timing. Preventative treatment is not recommended for most arthropods. NOP-approved pesticides are not benign and should be handled with the same precautions as any other pesticide. Always read and follow the label. Even NOP-approved pesticides have the potential to reduce beneficial populations, including pollinators. Avoid the use of insecticides during bloom and always use insecticides in a targeted manner. If insecticides must be applied during bloom, apply late in the evening when bees are not foraging. Incorporating native flower plantings at field edges has been found to increase populations of some beneficial insects within the crop.

With the arrival of Spotted-Wing Drosophila (SWD), resistance management of NOP-approved insecticides, in particular Entrust (spinosad), is crucial. Entrust is the only NOP-approved insecticide with good efficacy against SWD and should only be used to manage SWD in sites with a history of SWD. Use Entrust based on the presence of adult flies as determined by monitoring. There is a limit of three Entrust applications in a cropping season. While PyGanic (pyrethrin) is a less effective alternative, PyGanic can be used in rotation with Entrust to manage SWD. Use PyGanic to manage other blueberry insect pests instead of Entrust whenever possible.

Fungicides are applied preventatively based on a history of damage and only after all other management practices have been employed. Removal of sources of disease is important for preventing many diseases. Dormant season pruning of old, weak, cold-injured or dead branches will help prevent diseases such as *Botryoslimaeeria*, anthracnose and *Phomopsis*. Other cultural practices for managing diseases are provided in this guide.

Organic growers who seek certification should check with their certifier before using any product for the first time. The NOP determines whether products are approved for organic production, but certifiers can disallow certain NOP-approved products at their discretion. The Organic Materials

Review Institute (OMRI) is a private organization that reviews products at the request of manufacturers and approves those that meet NOP standards. A list of OMRI-approved products can be found at www.omri.org. Your certifier is the final authority regarding allowed products in your operation.

Integrated Pest Management Recommendations

Establishment

Proper site selection and nutrition – Optimizing plant health begins with careful attention to soil and site conditions. Plant in full sun and only on well-drained sites in raised beds. Avoid clay soils or low, saturated areas. Make provisions for drainage, organic matter and pH prior to planting. Test soil for pH and nutrient levels before planting. Organic matter should be 3% or higher, either naturally or by addition of organic amendments. Pine bark and peat moss are two commonly used low-pH organic amendments for blueberry. Appropriate soil organic matter additions encourage a beneficial soil microbial community that will help to discourage soil diseases such as root rots and nematodes. Test the soil and adjust pH to 4.0 to 5.0. Do not use lime unless pH is below 3.6. In general, rabbiteye blueberries grow best on land not previously cropped. High soil calcium (greater than 900 lbs. per acre) will inhibit blueberry plant growth. Replanting blueberries in the same site will increase the incidence of soil borne problems, in particular nematodes. If replanting in the same site cannot be avoided, under NOP-rules the site must be rotated away from blueberries for at least one year, although three to four years out of blueberry production would be more effective to break insect and disease life cycles. If rotations are utilized, the pH of the soil must be maintained or restored to a level that is appropriate for blueberry production. This can be problematic, however, as many rotation crops require higher pH soils for maximum growth.

Selecting a site with good air circulation will reduce future disease problems, in particular foliar diseases. Wider spacing of plants and pruning to open the canopy increases air circulation. Optimizing growing conditions results in healthy vigorous plants that will be more resistant to disease problems, in particular resistance to opportunistic twig and stem blight canker pathogens such as *Botryosphaeria* and *Phomopsis*. Balanced nutrition and moderate use of nitrogen fertilization will reduce the severity of foliar diseases. Mulching with pine bark helps to maintain optimum soil conditions and, if used appropriately, will reduce the incidence of some diseases such as mummy berry. Blueberries require one to two inches of water per week by either rainfall or irrigation during the growing season.

Root rots, in particular *Phytophthora* root rot, can be damaging to all blueberry plants. Root rots often occur in poorly drained soils and bark-amended beds. The most severe problems occur on beds established in poorly drained soils; however, even well-drained sites can exhibit problems during frequent irrigation. Prevent root rots by improving drainage and avoiding re-use of old bark substrate. Even though cost effective, replanting into old bark is not a good practice. Disease-causing organisms build up in the bark, making reestablishment more difficult. Organic chemicals are not available for root rot diseases. Therefore, good site preparation is essential.

Nematode feeding on plant roots can cause a decline in plant health over time. Plant pathogenic nematode populations build up to higher numbers in sandy soils, and immediate replanting in the same spot will compound the problem. Avoid old blueberry fields for new plantings. Rotate old planting sites into cover crops for two to three years and incorporate the cover crops to increase soil organic matter. More information on cover crops can be found at: <http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>

Crown gall, caused by the bacterium *Agrobacterium tumefaciens*, results in galls at or below the soil line. Blueberries can be affected by crown gall but the disease is more damaging to other small fruits such as blackberry or grape. There is no treatment except to remove the plants. Infected planting stock is the most common source of the disease. Thus, the use of clean, disease-free planting stock is the primary means of control. A good propagation nursery will take steps to prevent infection. Once introduced into a field, the crown gall bacterium survives in the soil.

Systemic diseases - Blueberries are susceptible to a few systemic bacterial and viral diseases. There is no cure for systemic diseases, and the only treatment is to remove the infected plant to prevent spread. Obtain pathogen-free planting material if available. Plants propagated using tissue culture (rather than cuttings from field-grown plants) are preferred and are far less likely to harbor disease. Growers propagating their own plants from cuttings should be aware that viral diseases (red ring spot), bacterial diseases (bacterial scorch), fungal pathogens, and insects (blueberry bud mite) are moved through propagation of infected or infested plants. Disease susceptibility can also vary by variety.

Bacterial leaf scorch, caused by the bacterium *Xylella fastidiosa*, is transmitted by sharpshooters (xylem-feeding leafhoppers), in particular the glassy-winged sharpshooter. This disease is not widespread and has been found mainly in southern highbush cultivars in Georgia, Alabama, Louisiana, and Florida. More information on this disease and cultivar susceptibility can be found in publication “Bacterial leaf scorch of blueberry” by the University of Georgia (<https://extension.uga.edu/publications/detail.html?number=C922>).

Blueberry red ring spot, caused by blueberry red ringspot virus (**BRRV**), is a disease of concern in southern highbush blueberries. Ring spots on leaves often do not become visible until late summer or fall. Plants used for propagation should be checked for symptoms during this time. Growers should start with clean plant material and avoid propagating from infested fields. Information on scouting for BRRV can be found in the publication “Scouting your fields for blueberry red ringspot virus” on the Southern Region Small Fruit Consortium website (<https://smallfruits.org/files/2019/06/pest-BRRVscoutingguide26feb08.pdf>).

Blueberry stunt is caused by a phytoplasma vectored by sharpnosed leafhoppers; fungicides will not be effective against this disease. Bushes infected with this disease become visible when leaves mature in May in North Carolina. Stunt is a devastating disease of blueberry in North and South Carolina and has been reported in Arkansas. Symptoms include shortened internodes, small, cupped leaves and loss of productivity. Management relies on removal of infected bushes (including roots) and management of the insect vector. Stunt is rarely seen on rabbiteye cultivars but is common on highbush and Southern highbush cultivars in southeastern North Carolina. Stunt also occurs in northern states (MI and NJ) where blueberries are grown.

Bacterial wilt – Bacterial wilt of blueberry (caused by the soilborne bacterium *Ralstonia solanacearum*) has been reported in the southeastern U.S. Due to its ability to survive in the soil for long periods and its ability to readily move through soil or water transfer, there are few effective strategies for management. Current recommendations for managing bacterial wilt of blueberry rely on exclusion, reducing inoculum, and preventing spread. Host resistance is likely to be important, but limited information currently exists. Some rabbiteye cultivars may be tolerant or resistant to this disease, while some southern highbush cultivars are known to be especially susceptible, including ‘Arcadia’, ‘Avanti’, ‘Indigocrisp’, and ‘Keecrisp’. Excluding the bacteria from becoming established on the farm in the first place is critical. The following exclusion practices are recommended: (1) Purchase clean, healthy plant material; (2) Avoid movement of soil and water onto the farm; (3) Do not share equipment between farms, if possible; (4) Sanitize equipment and shoes to prevent the transfer of infested soil; (5) Sanitize tools; hedging and pruning activities may spread the bacterium; and (6) Do not use surface/recycled water for irrigation.

Dormant (before flower or leaf buds break)						
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments
Exobasidium fruit and leaf spot	Exobasidium fruit and leaf spot (<i>Exobasidium maculosum</i> .) causes spots averaging ¼ inch in diameter on berries and leaves. Spots on fruit remain green and do not ripen. Spots may be tinged red and show white fungal growth early in the season. Fruit spots do not rot but remain firm and green. Light green spots also occur on the leaves. White fungal growth is visible on the underside of leaf spots. This disease occurs sporadically but can cause significant yield loss. Dormant oil applications may increase Exobasidium. Make oil applications as early in the dormant period as possible to allow a long interval between oil and lime-sulfur applications.					
	Canopy management	N/A	E	N/A	N/A	Disease is more severe when dense canopy creates a humid microclimate. Prune to open canopy, and plant in an open, well-drained site.
	lime sulfur	5 gal in 100 gal	E	48 hr.	0 days	Apply at delayed dormant 1-2 weeks before leaf and/or flower buds break. Exobasidium is not listed on the label, but when applied for Phomopsis, suppression of Exobasidium has been observed.
Twig and stem blight and cankers	Diseased and dead wood can harbor overwintering plant pathogens such as <i>Botryosphaeria</i> , <i>Phomopsis</i> , and <i>Colletotrichum</i> .					
	Prune dead or diseased stems	N/A	E	N/A	N/A	Optimizing soil and growing conditions is the best prevention. Removal of branches close to the ground can reduce initial infections. Pruning opens the canopy to air movement to help reduce disease severity. Pruned stems should be removed from the site.
Mummy berry	Mummy berry (<i>Monilinia vaccinii-corymbosi</i>) is often the most serious disease in organic blueberry production. The primary stage of this disease (shoot blight phase) reduces yield by blighting leaf and flower shoots. The secondary or fruit infection stage infects blossoms resulting in hard, mummified fruit. Infected berries (mummies) fall to the ground and serve as the overwintering mechanism for this disease. Burying mummies with mulch helps to prevent primary infections. In-season control with organic fungicides may be necessary when there is a history of mummy berry. In fields where disking is possible, mummies can be raked or blown from underneath the bushes to the row middles and buried by disking.					
	Rake mummies to row centers and bury with soil or mulch.		G			Rake mummies to row centers and bury 1” deep with soil or mulch.
	Mulch beds to bury mummies		G			Use caution when burying mummies. Excessive mounding of soil or mulch on top of blueberry roots and stems can result in injury or plant death.
Phytophthora root rot	Root rot is generally a problem of low, poorly drained sites. Make provisions for adequate drainage prior to planting. Site selection and proper bedding operations are essential cultural practices for management of this disease. Phytophthora can also be very problematic in pine bark beds for Southern highbush varieties (see comments in the Establishment section).					

Dormant (before flower or leaf buds break)						
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments
Bagworm	Bagworms should not be confused with fall webworms, which are tan, fuzzy caterpillars that feed in groups and cover branches with extensive white silk webbing. Bagworms make a 2- to 4-inch case or “bag” from dried leaves, sticks, and other plant parts, which contain their eggs.					
	Remove and dispose of cases		E			Bagworm cases should be removed prior to April, before eggs hatch.
Scale	horticultural/ superior oil Pre-bloom use only.	1 to 3%	VG	4 hr	0 days	Apply oil at dormant or delayed dormant as needed for scale infestations. Reduce to 1% rate just before bloom. Do not apply oil during periods of high temperatures with high relative humidity. Do not spray immediately before, during, or following cold weather or freezing temperatures. Temperatures below 50°F reduce effectiveness. Do not use within 14 days of a lime sulfur application.
Gall midge	Blueberry gall midge adults are tiny flies, and larvae are tiny white or orange, carrot-shaped maggots (1-2 mm) that feed inside flower and leaf buds. Gall midge is generally not a problem in North Carolina but can be extremely injurious on some rabbiteye cultivars, including ‘Premier’ in more southerly growing areas. Midges lay their eggs in flower buds on warm winter days when bud scales initially begin to separate. Gall midge sprays should protect the earliest flower buds, which can realistically be expected to survive anticipated spring cold events. Monitor populations by using traps; details on trap use are available in the University of Georgia publication “Monitoring and Management of Blueberry Gall Midge” (https://ipm.uga.edu/2019/12/23/monitoring-and-management-of-blueberry-gall-midge/ .) Gall midge sprays may provide suppression of pre-bloom thrips populations.					
	spinosad (Entrust 80W) (Entrust SC)	1.25 to 2 oz 4 to 6 fl oz	G	4 hr 4 hr	3 days 1 day	Spinosad is toxic to bees and should be avoided during bloom. Overuse may lead to resistance in insect populations. Entrust 80W cannot be applied more than 3 times in a cropping season. Only two consecutive applications of Entrust are allowed. NOTE: Spinosad is the most effective organic approved insecticide against spotted-wing drosophila (SWD) with a limited number of applications per season. If SWD management is required, reserve use of spinosad for SWD management.
	pyrethrins (PyGanic EC1.4)	16 to 64 fl oz	F	12 hr	0 days	Not as effective as spinosad.

Pre-bloom through green tip (leaf buds) and pink bud (flower buds)

Blueberries are a pollination-sensitive crop, and they are pollinated exclusively by insects. Insecticide-related injury to bees can impair pollination and ruin fruit set. **Exercise caution when applying any pesticide during bloom to minimize impact to pollinators. Do not apply insecticides during bloom. All pesticide (including fungicide) applications should be made when bees are not actively foraging and to allow maximum drying time (evening/dusk).**

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments
Mummy berry and Botrytis blight	If mummy berry has been observed in previous years, fungicides can be important in pre-bloom sprays (for cultivars or seasons in which leaf bud break occurs before flower bud break). Start spraying when green tip occurs on the leaf buds or 1-5% open bloom (stage 6) occurs on the flower buds, whichever comes first. Continue sprays until all blooms have fallen. Efficacy of Serenade (<i>Bacillus subtilis</i>) is improved by using an OMRI-approved adjuvant such as Nufilm-P.					
	<i>Bacillus subtilis</i> (Serenade Opti) (Serenade ASO)	14 to 20 oz 2 to 4 qt	F	4 hr 4 hr	0 days 0 days	
Blueberry gall midge	See DORMANT recommendations.					
Thrips	Flower thrips can be very damaging to flower buds and blooms, especially in rabbiteye- and late-blooming cultivars. Thrips numbers often increase dramatically as corollas open and bloom progresses. Begin sampling bloom clusters for thrips in early spring when the tips of unopened flowers first become visible at stage 3. Sample once or twice per week from stage 3 up to bloom. Tap flower buds over white surface and if the thrips counts exceed 2 per individual flower, then a spray is generally recommended. Take a minimum of 5 clusters (each cluster has 5-8 flowers) per block each time. Treat if 2 or more thrips per individual flower are found.					
	spinosad (Entrust 80W) (Entrust SC)	1.25 to 2 oz 4 to 6 fl oz	G	4 hr 4 hr	3 days 1 day	Spinosad is toxic to bees. Do not apply when bees are actively foraging. Applications in the evening are preferable to minimize impact on beneficial insects. Overuse may lead to resistance in pest insect populations. Entrust 80W cannot be applied more than 3 times in a cropping season. Only two consecutive applications of Entrust are allowed. NOTE: Spinosad is the most effective organic approved insecticide against spotted-wing drosophila; reserve applications for SWD management.
	pyrethrins (PyGanic EC1.4)	16 to 64 fl oz	F	12 hr	0 days	Not as effective as spinosad.

10-20% bloom until 80-90% bloom						
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments
Mummy berry (blossom infection stage)	See recommendations in PRE-BLOOM THOUGH GREEN TIP AND PINK BUD . Continue to spray through bloom if disease has been a problem in previous years. Use shorted interval on label during bloom.					
	<i>Bacillus subtilis</i> (Serenade Opti) (Serenade ASO)	14 to 20 oz 2 to 4 qt	F	4 hr 4 hr	0 days 0 days	
Botrytis blight	Botrytis flower blight is most prevalent when rainy conditions and/or freezing conditions occur during bloom.					
	<i>Bacillus subtilis</i> (Serenade Opti) (Serenade ASO)	14 to 20 oz 2 to 4 qt	F	4 hr 4 hr	0 days 0 days	
Anthracnose (<i>Colletotrichum</i>), Phomopsis and/or Alternaria fruit rot	Fruit rots may not become obvious until berries are ripening but infection occurs any time during and after bloom. Infections are favored by rain when air temperatures are warm (>70°F). Pre-harvest infections are most common on the blossom end of fruit. These diseases are more common on highbush cultivars than on rabbiteye. Harvest fruit when conditions are dry, and harvest fruit often and completely. Chill immediately after harvest.					
	Polyoxin D zinc salt (OSO 5% SC)	6.5 to 13.0 fl oz	G	4 hr	0 days	Use 6.5 fl oz/acre before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl oz/acre. Do not apply more than 4.3 oz a.i./acre/season (6 appl. at max. rate). *Suppression only for Anthracnose*
	<i>Bacillus subtilis</i> (Serenade Opti) (Serenade ASO)	14 to 20 oz 2 to 4 qt	F	4 hr 4 hr	0 days 0 days	
	<i>Pseudomonas chlororaphis</i> (Howler)	2.5 to 7.5 lb	F	4 hr	0 days	
Cherry and cranberry fruitworm	Emergence of adult fruitworm moths can be monitored using pheromone traps. Place traps in the field three to four weeks before anticipated bloom and change traps at least every four weeks. Check for fruitworm adults in traps twice a week from full bloom until four weeks after petal fall. Egg laying begins approximately one week after pheromone trap captures begin. Examine fruit clusters for eggs on calyxes of berries. Normally, early varieties are infested first. Treatments applied when larvae are observed in fruit are too late, particularly for cherry fruitworm. Remove and destroy infested berries. Information on monitoring can be found at this Michigan State site: https://www.canr.msu.edu/news/fruitworms_in_blueberry_control_options					
	<i>Bacillus thuringiensis</i> (Dipel DF)	0.5 to 2 lb	G	4 hr	0 days	Bt is effective in controlling lepidopteran insect pests. Bt must be eaten and will not control larvae once they are inside the fruit. Time Bt treatments to egg hatch (1-3 days after peak moth captures or first eggs observed). Bt will not harm bees.

Petal fall until one month after bloom

Blueberry stunt – Blueberry stunt is caused by a phytoplasma vectored by sharpnosed leafhoppers; fungicides will not be effective against this disease. Bushes infected with this disease become visible when leaves mature in May in North Carolina. Stunt is a devastating disease of blueberry in North and South Carolina and has been reported from Arkansas. Symptoms include shortened internodes, small, cupped leaves and loss of productivity. Management relies on removal of infected bushes (including roots) and management of the insect vector. Stunt is rarely seen on rabbiteye cultivars but is common on highbush and Southern highbush cultivars in southeastern North Carolina. Stunt also occurs in northern states (MI and NJ) where blueberries are grown.

Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments
Anthracnose (<i>Colletotrichum</i> spp.) and/or Alternaria fruit rot	Fruit rots may not become obvious until ripening but infection occurs any time during and after bloom. Infections are favored by rain and warm temperatures (>70°F). Pre-harvest infections are most common on the blossom end of fruit. Fruit rots are more common on highbush cultivars. Harvest when conditions are dry and harvest fruit often and completely. Do not handle wet fruit. Chill immediately after harvest.					
	Polyoxin D zinc salt (OSO 5% SC)	6.5 to 13.0 fl oz	G	4 hr	0 days	Use 6.5 fl. oz./acre before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl oz/acre. Do not apply more than 4.3 oz a.i./acre/season (6 appl. at max. rate). *Suppression only for Anthracnose*
	<i>Bacillus subtilis</i> (Serenade Opti) (Serenade ASO)	14 to 20 oz 2 to 4 qt	F	4 hr 4 hr	0 days 0 days	
	<i>Pseudomonas chlororaphis</i> (Howler)	2.5 to 7.5 lb	F	4 hr	0 days	
Cranberry and cherry fruitworms	<i>Bacillus thuringiensis</i> (Dipel DF)	0.5 to 2.0 lb	G	4 hr	0 days	Bt is effective in controlling lepidopteran insect pests. Bt must be eaten and will not control larvae once they are inside the fruit. Time Bt treatments to egg hatch (1-3 days after peak moth captures or first eggs observed, see information in 10-20% bloom section).
Plum curculio	Plum curculio is an infrequent pest of southeastern blueberries. Fields with a history of plum curculio infestation should be treated twice on 7 to 14-day interval, beginning at petal fall, or when plum curculio injury appears. Infested fruit tends to ripen earlier, and often drops to the ground prior to picking. Damage to individual berries is more severe than with other fruit-infesting insects, so plum curculio is more likely to be noticed during harvest, and most occurs in the first picking. Where used, automated soft sorters will remove most curculio-infested fruit during postharvest sorting and packing.					
	kaolin clay (Surround WP)	25 to 50 lb	G	4 hr	0 days	Surround acts as a barrier and masks fruit from pest recognition. Wash fruit after harvest. Surround may be most appropriate for processing fruit.

Cover Sprays (green fruit stage)						
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments
Septoria and anthracnose leaf spots Sharponosed leafhopper	Septoria and anthracnose (<i>Gloesporium</i>) leaf spot pathogens can cause premature defoliation, resulting in poor bud development and loss of yield the following year. Fungicides are protectants, and applications should be timed to occur prior to the onset of visible symptoms.					
	<i>Bacillus subtilis</i> (Serenade Opti) (Serenade ASO)	14 to 20 oz 2 to 4 qt	F	4 hr 4 hr	0 days 0 days	
	spinosad					NOTE: Spinosad is the most effective organic approved insecticide against spotted-wing drosophila; reserve applications for SWD management.
Anthracnose and Alternaria fruit rot	Fruit rots may not become obvious until ripening but infection occurs any time during and after bloom. Infections are favored by rain when air temperatures are warm (>70°F). Infections are most common on blossom end of fruit. These diseases are more common on highbush varieties. Harvest fruit when conditions are dry, and harvest fruit often and completely. Chill immediately after harvest.					
	Polyoxin D zinc salt (OSO 5% SC)	6.5 to 13.0 fl oz	G	4 hr	0 days	Use 6.5 fl. oz/acre before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl oz/acre. Do not apply more than 4.3 oz a.i./acre/season (6 appl. at max. rate). *Suppression only for Anthracnose*
	<i>Bacillus subtilis</i> (Serenade Opti) (Serenade ASO)	14 to 20 oz 2 to 4 qt	F	4 hr 4 hr	0 days 0 days	
	<i>Pseudomonas chlororaphis</i> (Howler)	2.5 to 7.5 lb	F	4 hr	0 days	
Flea beetle	Flea beetles are small and dark metallic blue or green. Leaf feeding causes shot-holes. Clustering on terminals results in notching at leaf edges. Feeding on shoot tips can cause excessive branching. Healthy, well-tended mature rabbiteye plantings can lose up to 20% of leaf surface without injury. Young plantings, particularly southern highbush and less vigorous rabbiteye cultivars, may be damaged.					
	spinosad (Entrust 80W)	1.25 to 2 oz	F	4 hr	3 days	Spinosad is toxic to bees and beneficials. Overuse may lead to resistance in pest insect populations. Entrust 80W cannot be applied more than 3 times in a cropping season. Only two consecutive applications of Entrust can be made. NOTE: Spinosad is the most effective NOP approved insecticide against SWD; reserve applications for SWD management.

Pre-harvest (first color) through Harvest						
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments
<p>Blueberry maggot fly (BBM) – Fruit intended for export to Canada must be grown under systems-approach pest management protocols compliant with appropriate guidelines for scouting, spraying and post-harvest inspection of berries, including a protocol for cooking (boiling) samples of harvested fruit to test for the presence of maggot larvae.</p> <p>Fruit rots (<i>Alternaria</i> and <i>Colletotrichum</i>) – Fungicides alone do not provide adequate control; proper harvesting and handling is essential. Reduce pre- and post-harvest rots by timely harvest of all ripe fruit on the bush, followed by rapid post-harvest cooling. For hand-harvested highbush and southern highbush cultivars, harvest all ripe berries on the bush every 4-7 days or less. Rabbiteye cultivars should be clean-harvested every 10-14 days. Post-harvest cooling is critical and is best accomplished using partial-vacuum or forced-air systems that use fans to pull cold air through stacks of palletized fruit.</p>						
Alternaria rot and Anthracnose (<i>Colletotrichum</i> spp.) ripe rot	Fruit rots become obvious at ripening, but infection occurs any time during and after bloom. Infections are favored by rain and warm temperatures (>70°F). Pre-harvest infections are most often on the blossom end of fruit, however most decay occurs post-harvest at the exposed stem end of the berry. <i>Alternaria</i> is the most common post-harvest rot in the southeastern US. Fruit rots are more common on highbush cultivars than on rabbiteye cultivars. Harvest and handle fruit only when conditions are dry. Harvest often and completely. Chill immediately after harvest.					
	Polyoxin D zinc salt (OSO 5% SC)	6.5 to 13.0 fl oz	G	4 hr	0 days	Use 6.5 fl oz/acre before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl oz/acre. Do not apply more than 4.3 oz a.i./acre/season (6 appl. at max. rate). *Suppression only for Anthracnose*
	<i>Bacillus subtilis</i> (Serenade Opti) (Serenade ASO)	14 to 20 oz 2 to 4 qt	F	4 hr 4 hr	0 days 0 days	
	<i>Pseudomonas chlororaphis</i> (Howler)	2.5 to 7.5 lb	F	4 hr	0 days	
Blueberry maggot	Blueberry maggot flies are established in some southeastern blueberry fields. If present, BBM is a serious mid-and late-season fruit pest. BBM may go undetected at harvest and may ship in infested fruit. Utilize thorough field-by-field monitoring by hanging yellow sticky traps (baited with ammonium bicarbonate or ammonium carbonate), at least one trap per cultivar. Trap catches indicate presence of adult blueberry maggot flies. Hang traps in plantings before fruit begin to ripen. If BBM adults are trapped, treat within 7 days of trap capture and again after another 7 days. If no additional flies are captured, treatments can stop until flies are again caught.					

	spinosad (GF-120 NF Naturalyte Fruit Fly Bait)	Use a 1:1.5 ratio of GF-120 to water. For instance: 20 fl oz GF-120 in 30 fl oz of water/acre.	G	4 hr	0 days	Begin bait application as soon as blueberry maggot flies are caught in traps, or 2 to 3 weeks before fruit begins to ripen. Repeat every 7 days; apply more often during rainy periods and as fruit ripens. Use a coarse nozzle to apply large spray droplets (4-6 mm) as a directed spray to one side of each row, targeting the interior canopy to protect the bait from sunlight and rain. Not necessary to apply directly to fruit or leaves.
Spotted-wing drosophila	Spotted-wing drosophila (SWD, <i>Drosophila suzukii</i>) is an invasive pest of soft-skinned fruit in the United States and is found throughout the southeast. SWD damage is similar to that caused by blueberry maggot. Female flies lay their eggs in ripening and ripe fruit, and larvae develop internally. SWD larvae are much smaller than blueberry maggot larvae, and unlike blueberry maggot, SWD can have multiple, overlapping generations during blueberry harvest. Therefore, risk of SWD may be higher than blueberry maggot. Adult male SWD can be distinguished from native, non-pest <i>Drosophila</i> spp. by a single spot on the end of both wings. Traps are useful in determining SWD presence on your farm, but do not reliably predict fruit infestation. If SWD are found on or near your farm, preventative insecticide applications are recommended beginning when fruit begins to color through the end of harvest. Apply insecticides weekly. Reapply after rain events. Detailed information on SWD biology, monitoring, and management can be found in this UGA extension publication on organic management of SWD: https://extension.uga.edu/publications/detail.html?number=B1497 . Some management tools used for blueberry maggot may also be effective against SWD, and blueberry maggot and SWD management strategies should be integrated as much as possible including frequent thorough harvest and post-harvest cold storage.					
	spinosad (Entrust 80W) (Entrust SC)	1.25 to 2 oz 4 to 6 oz	G G	4 hr	3 days 1 day	Overuse may lead to resistance in insect populations. Entrust cannot be applied more than 3 times in a cropping season. Apply only two consecutive applications of Entrust. If more treatments are needed, rotate to another class of insecticide, such as PyGanic, for at least one application.
	pyrethrins (PyGanic EC1.4)	16 to 64 fl oz	F	12 hr	0 days	Not as effective as spinosad for SWD but can be rotated with spinosad if SWD pressure remains high. Short residual activity.
	Non-viable Burkholderia spp. Strain A396 (Venerate XC)	1-2 lbs	F	4 hrs.	0 days	Venerate is OMRI listed biological insecticide IRAC UNB

	Hydrogen peroxide and peroxyacetic acid (Jet-Ag)	3.9-7.8 fl oz per 5 gallons of water	F	4 hrs.	0 days	Keep unprotected persons from treated area until sprays have dried. Jet-Ag controls yeast which is a food source for spotted wing drosophila, thereby significantly reducing populations of spotted wing drosophila. Thoroughly wet all surfaces of plant, upper and lower foliage, including stems, branches and stalks to ensure full contact with plant tissue. Apply as needed. Jet-Ag can be tank-mixed with Grandevo WDG at 2 lbs./acre for enhanced control of SWD. IRAC UN
	Chromobacterium subsp. stratum PRAA4-1T and spent fermentation media (Grandevo WDG)	1-3 lbs	F	4 hrs	0 day	Grandevo is an OMRI listed biological insecticide. IRAC UN. For control of spotted-wing drosophila, apply Grandevo WDG at 3 lbs. per acre at a maximum 7-day interval when adult flies are first observed. Depending upon insect pressure, applications can be made on a shorter interval and Grandevo WDG can be tank-mixed or rotated with other insecticides active against SWD. The addition of a spreader-sticker is recommended and a pH of 6-8 is recommended. There are no tank-mix restrictions.
Blueberry stem borers	Blueberry stem borer, <i>Oberea myops</i> , is a longhorn beetle that also attacks rhododendron and azalea. This pest can be minimized by pruning out and removing the infested portion of canes, often brown and wilted, as soon as larvae are detected in the summer. Cut the stems well below their brown, hollowed section, where the stem is still green and not hollow. Promptly destroy each wilted cane containing a larva. This ensures that the larva does not migrate into the crown of the plant.					
Yellownecked, azalea, red humped caterpillars, spanworms	Late season caterpillars are often localized on a few bushes. Hand removal and/or spot treatments are typically sufficient.					
	Hand removal		E			
	<i>Bacillus thuringiensis</i> (Dipel DF)	0.5 to 2.0 lb	G	4 hr	0 days	Bt is a bacterium that is effective in controlling lepidopteran insect pests. The caterpillars must eat Bt to be effective. Apply to small, early-stage caterpillars. Safe for beneficials.

Post Harvest							
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments	
<p>During fruit maturation and/or immediately following harvest, fungicide applications may be needed for control of leaf spots and suppression of dieback diseases. Start applications before leaf spots are first observed.</p> <p>Blueberry rust (<i>Thekopsora minima</i>, syn. <i>Pucciniastrum vaccinii</i>) is predominantly a problem in the extreme southern blueberry production areas such as South Georgia. Late-season rust does occur in the Carolinas and other locations in some years. On susceptible cultivars, rust can prematurely defoliate plants by late August.</p> <p>Blueberry stunt phytoplasma disease is transmitted by leafhoppers. Symptoms become visible when leaves mature. Stunt is a devastating disease of blueberry in North and South Carolina and on highbush and Southern highbush varieties but has not been observed in Georgia. Stunt is rarely seen on rabbiteye cultivars. Symptoms include shortened internodes, small, cupped leaves and loss of productivity. Control relies on removal of infected bushes (including roots) and control of the insect vector (the sharpnosed leafhopper) that carries the disease. To avoid introduction, start with clean plants and avoid susceptible cultivars.</p>							
Leaf spots (Septoria, Anthracnose, Rust)	Leaf spots are more of a problem in highbush varieties but may be a problem in rabbiteye cultivars in South Georgia. Spring and early summer applications of fungicides protect the early flush of growth. Mowing or hedging immediately post harvest on early Southern highbush varieties can help with reducing leaf spot disease by encouraging a new flush of growth.						
	Bacillus subtilis (Serenade Opti)	14 to 20 oz	F	4 hr	0 days	To improve plant surface coverage, add a non-phytotoxic OMRI approved surfactant.	
	(Serenade ASO)	2 to 4 qts	F	4 hr	0 days		
	Fish Oil 2% (Organic Gem)	1.5 gal in 75 gal water	G				Fish oils are fertilizers and supply macro- and micronutrients. Leaf spot control has been observed with foliar applications. Use post-harvest only. Spray after sunset or during coolest part of the day.
	Copper (various)	See label	F	See label	See label	Rotate with Serenade.	
Sharpnosed leafhopper	Use yellow sticky traps to determine if sharpnosed leafhoppers are present before treating. When removing infected plants, spray with Pyganic first to keep leafhoppers from moving to another plant.						
	Pyrethrin (PyGanic EC1.4)	16 to 64 fl oz	G	12 hrs	0 days	Apply when leafhoppers are first detected and repeat four weeks later. Repeat again late September to early October. Short residual activity.	
Blueberry bud mite	The tiny, microscopic eriophyid mite infests flower buds in late summer and fall, feeding inside the buds over the winter. In spring infestations are diagnosed when the reddening/rosetting of emerging flower buds becomes evident. Cultivar susceptibility and field history determines whether treatment is warranted. Summer mowing (hedging) after harvest is a primary means of control. Pruning and removing or destroying old blueberry canes will reduce bud mite populations. Never propagate from bud mite-infested blocks.						
	Cultivar selection		VG			Most highly susceptible blueberry cultivars are no longer grown. Bud mite can occur on O'Neal and Legacy. Bud mite is generally only a problem on highbush varieties.	

Post Harvest						
Pest/Problem	Management Options	Amount of Formulation per Acre	Effectiveness or Importance	REI	PHI	Comments
	Mowing		VG			Summer topping or hedging immediately after harvest controls bud mite by removing old, infested fruiting twigs and is the control method of choice.
	Horticultural oil	1 to 2 gal (low volume) or 2 gal/100 gal (dilute spray)	F	4 hrs	0 days	Immediately after harvest and prior to flower bud formation, bud mites are exposed and susceptible to oil applications. Do not apply oil during periods of high temperatures with high relative humidity. Do not spray immediately before, during, or following cold weather or freezing temperatures. Effectiveness is reduced at temperatures below 50°F. Do not use within 14 days of lime-sulfur.

After Harvest Leaf Analysis and Soil Testing

The preferred time for leaf analysis in blueberries is the first two weeks after harvest. Soil testing is also important. See the horticulture guide on the www.smallfruits.org website for additional details.

Notes on using NOP-approved products for management of blueberry diseases and insects: NOP-approved insecticides and fungicides are usually less efficacious than conventional products. Efficacy of many biocontrol products are highly variable from year to year depending on environmental conditions and disease severity. The cost and risks of applying an NOP-approved pesticide must be balanced against the anticipated benefit. Under NOP rules, first try preventative (cultural and biological) management options before using pesticides.

Effectiveness of Selected NOP-approved Products for Blueberry Disease Management¹

Fungicide ²	FRAC Group	Relative Efficacy Rating ³								
		Alternaria rot	Anthrachnose leaf spot	Botrytis (gray mold)	Exobasidium	Mummy Berry	Phomopsis twig blight	Ripe rot (Anthrachnose)	Septoria leaf spot	Rust
<i>Bacillus subtilis</i> strain QST713 (Serenade Opti ^a , Serenade ASO)	BM02	F	F	F	ND	F	ND	F	F	F
Copper (various)	M01	NC	ND	NC	ND	ND	ND	NC	ND	F
Fish oil (Organic Gem, Neptune's Harvest)	--	ND	ND	ND	ND	ND	ND	ND	G	ND
Horticultural oil (PureSpray Green, others)	--	ND	ND	ND	ND	ND	ND	ND	ND	F
Lime sulfur (various)	M02	NC	NC	NC	E	ND	ND	NC	NC	NC
Polyoxin D zinc salt (OSO 5% SC)	19	ND	ND	ND	ND	ND	ND	G	ND	ND
<i>Pseudomonas chlororaphis</i> strain AFS009 (Howler ^b)	BM02	F	ND	ND	ND	ND	ND	F	ND	ND
<i>Streptomyces lydicus</i> strain WYEC 108 (Actinovate AG)	BM02	ND	ND	ND	ND	ND	ND	ND	ND	ND

¹ Many products are **OMRI-listed**. Listings change from year to year. Check the OMRI website (www.omri.org) for the most currently available list.

² Fungicides are sorted alphabetically by active ingredient.

³ Efficacy Ratings: The efficacy or importance of a management option is indicated by E = excellent, VG = very good, G = good, F = fair, P = poor, NC = no control, and ND = no data. These ratings are benchmarks; actual performance will vary. Efficacy ratings do not necessarily indicate a labeled use for every disease.

^aEfficacy of Serenade is improved by using an OMRI-listed adjuvant such as Nufilm-P.

^bEfficacy of Howler assumes the use of an OMRI-listed non-ionic surfactant such as Kinetic.

Seasonal “At-a-Glance” Disease Guide								
Developmental Stage	Dormant	Green tip	Bloom (2-3 applications) ^a	Petal Fall	Cover Sprays	Pre-Harvest ^b	Harvest	After Harvest (Foliage Management) ^c
Diseases potentially present (Fungicides)	Exobasidium (lime sulfur) Mummy berry (Disk or mulch to bury mummies)	Mummy berry (<i>Bacillus subtilis</i>)	Mummy berry and Botrytis (<i>Bacillus subtilis</i>) Fruit rots (OSO 5%SC, <i>Bacillus subtilis</i> , Howler)	Fruit rots (OSO5%SC, <i>Bacillus subtilis</i> , Howler)	Fruit rots (OSO5%SC, <i>Bacillus subtilis</i> , Howler) Leaf spots (<i>Bacillus subtilis</i>)	Fruit rots (OSO5%SC, <i>Bacillus subtilis</i>) Leaf spots (<i>Bacillus subtilis</i>)	Fruit rots (Timely harvest, handle fruit dry, rapid postharvest cooling)	Leaf spots and rust (<i>Bacillus subtilis</i> , fish oil fertilizer, copper, postharvest hedging)

^aBloom times vary due to varietal differences and the environment. Bloom sprays should provide protection against the primary pathogens of blooms for the entire bloom period. The number of applications required for bloom may vary from 1 to 3 sprays, depending on the season and the variety. Fruit rots are best managed with bloom sprays.

^bIn wet years, pre-harvest and post-harvest rots may be a problem. **Organic fungicides have limited value for fruit rot management. Growers should rely on other management measures, such as timely, complete harvest, handling fruit only when dry, and rapid post-harvest cooling.**

^cSeptoria leaf spot and other leaf diseases are best managed in organic southern highbush fields with post-harvest mowing (hedging) that removes old, infected leaves and forces a new flush of healthy growth.

Selected NOP-approved products for management of blueberry insects (E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown). NOP-approved insecticides and fungicides are usually less efficacious than conventional products. See IPM Management Guide above for rates and particulars. These ratings are benchmarks, actual performance will vary. Many of these products are also OMRI-listed. Since listed products will change from year to year, check OMRI website for most updated information: <http://www.omri.org/omri-lists/download>.

Common Name	Trade Name(s)	Armored scale	Soft scale	Blue- berry gall midge	Flea Beetle	Flower thrips	Glassy- winged sharp- shooter	Sharp- nosed leaf- hopper	Fruit worms	Plum curculio	Blue- berry maggot	Spotted wing drosophil a	Japanese Green June beetles	Blue- berry bud mite	Foliar feeding cater- pillars	Perio dic cicad a
azadirachtin (UN)	Neemix 4.5% plus Trilogy, AzaDirect	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	P	NA	NA	NA
Bt	Dipel DF	NA	NA	NA	NA	NA	NA	NA	VG	NA	NA	NA	NA	NA	G	NA
horticultural oil		E	VG	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	F	NA	NA
Kaolin clay	Surround WP	NA	NA	NA	NA	NA	UN	UN	UN	P	UN	NA	UN	NA	UN	G

pyrethrin	PyGanic	NA	NA	UN	NA	UN	UN	VG	NA	P	NA	F	UN	NA	UN	NA
spinosad	Entrust 80W, SC	NA	NA	G	F	VG	NA	NA	F	NA	NA	G	NA	NA	P	NA
spinosad	GF-120 NF Naturalyte Fruit Fly Bait	NA	NA	NA	NA	NA	NA	NA	NA	NA	VG	NA	NA	NA	NA	NA

Organic Weed Management in Blueberry Plantings:

An overgrowth of weeds in a blueberry planting will compete for water and nutrients. Weeds may harbor damaging pests and interfere with planting, maintenance, and harvesting. No totally effective organic herbicides are available so cultural and physical methods are used to deter weed growth.

Pre-plant: The most important step in managing weeds in perennial crops using organic practices is to eliminate perennial and problem weeds before bed establishment. This is critically important for difficult or spreading weeds such as Bermudagrass or nutsedge. This phase may take a few years of repeated cultivation and/or growing cover crops. On land previously used only for forestry, or previously not cultivated, the primary weeds are often woody perennials such as pine, maple, smilax, wild blackberry, sumac and poison ivy.

Establishment: Minimizing weed competition during establishment is critical for optimal plant health and mulch is recommended. Mulch helps control weeds, and keeps soil cool, loose, and uniformly moist. Pine bark mulch is best for helping to maintain a low pH and adding needed organic matter, although pine straw or leaves could also be used. Mulch should be 4 to 6 inches deep and should cover a 4-foot band centered on the plant row for established plantings. Replenish the mulch as it deteriorates over time. Deteriorating mulch adds organic matter to the soil and creates a favorable environment for root growth, but it can cause root exposure if not replenished.

Beds can be mulched with either plastic or landscape fabric, at least initially. Both are petroleum-based products. NOP rules specify that plastic-based products must be removed before deterioration of the product prohibits removal. Landscape fabric can be rolled up and reused, while plastic must be discarded after use. Black landscape fabric has the disadvantage over organic mulches in not adding organic matter and in raising soil temperatures under the mat around the roots. Additional hand weeding will be necessary to maintain weed-free beds.

Row middles (aisles) are kept free of weeds either by frequent shallow cultivation or, more commonly, by planting a cover crop or sod middle. Using annual or perennial cover crops in alleyways has many advantages over bare soil cultivation, from weed suppression to preventing erosion. Seed row middles with perennial grass types that do not invade planting beds, such as orchard grass, ryegrass, or turf-type fescues, as soon as the blueberry planting operation is completed. Sod middles facilitate equipment and human access, decrease weed invasion into the planting and minimize soil erosion.

Organic Weed Management in Blueberry Plantings (*continued*):

Herbicides: There are a few organic products with some activity against weeds, although they are not as effective as conventional herbicides. Most are post emergence, but weeds should be small when treated. The benefits of using these products must be weighed against the expense.

Selected NOP-approved products for management of weeds. Since listed products will change from year to year, check OMRI website for most updated information: http://www.omri.org/omri-lists/download .	
<i>Trade name</i>	<i>Active Ingredient</i>
Pre-emergence	
Corn gluten meal	Corn gluten
Post emergence – non selective	
Alldown	acetic and citric acids
Herbor-G® Herbicide	plant essential oils, soaps
Scythe	pelargonic and other fatty acids
Weed Zap	clove and cinnamon oils
Worry Free	citrus oil

Weed burners: Propane-fired burners have been used successfully to control weeds by burning down young emerging weed seedlings before they are fully established; however, the equipment must be used with great care to avoid injury to plants or to the operator.

Wildlife Damage Prevention in Blueberry Plantings	
Pest/Problem	Management Options
Birds	<p>Birds consume fruit and damage berries, increasing fruit rots and other pests such as bees and yellow jackets. Feeding pressure will be heavier in fields that are close to roosting or nesting sites such as woodlands, hedgerows, grassy fields, powerlines, and individual trees. Birds may feed, fly to these resting sites, and then return to the crop later in the day. The presence of a pond, creek or other water source nearby is another factor that may lead to increased feeding pressure. Typically, bird damage tends to be more severe in the earlier parts of the growing season and lessening as it progresses. This appears to be the case with blueberries, with early ripening highbush varieties tending to suffer more damage than rabbiteye varieties, which ripen later in the season.</p> <p>There are several control techniques, which may decrease losses to birds. They include visual and auditory repellents and exclusion (netting). For any method to be successful, it must be instituted before birds establish a feeding pattern, which generally means that they should be in place and operating at the time that color change occurs in the fruit. With the exception of exclusion, no one method should be relied on for control. Currently, there are no organically approved chemical repellents for birds.</p> <p>Auditory repellents Auditory scare devices such as propane cannons, noise makers or distress calls may offer temporary relief for some types of birds. Regardless of which one or ones is/are used, the following points should be considered to attain the best results:</p> <ul style="list-style-type: none"> • Assess the potential for objections to the noise from your neighbors. • Start before birds establish a feeding pattern. • Begin shortly before sunrise and continue until just after sunset. Early and late are often the most intense feeding times. • Vary the frequency, the direction and the timing in which auditory devices are operated. Do not fire propane cannons at intervals closer than 3 minutes. • Consider using more than one type of auditory device and possibly combine them with visual repellents. • If using distress calls, it is essential to get the specific distress calls for the type(s) of birds you want to discourage. • Reinforce the sense of danger by shooting (if allowed). <p>Visual repellents Visual repellents include scare eyes suspended above the crop, laser deterrents, mylar tape on the canopy of the crop, aluminum pie pans, and plastic owls and snakes. Effectiveness ranges from ineffective to moderately effective for a short period of time. Birds will get used to them quickly if they are not moved around or if another type of repellent is not used along with it. Yellow scare eyes suspended above the crop and allowed to move freely have been reported to have some impact on blackbirds, however, robins do not seem to be affected.</p> <p>Exclusion Exclusion (netting) is the only consistently effective method of reducing bird damage. Netting is more expensive than other types of deterrents and can require fair amounts of labor so it may not be an economically viable alternative in all situations. Nets are either laid on the canopy of the crop or suspended from a framework over the crop. The fruiting area of the plant needs to be completely protected. Birds will enter the canopy of the plant from below the net if it is open under the plant. If used with care,</p>

	<p>nets can be maintained for use over several years. For crops requiring multiple harvests such as blueberry, suspending the netting over the crop and around the sides of the field will allow easier access to the crop. If nets are placed directly on the crop canopy, birds can perch on it and feed on berries below them.</p> <p>Wild turkeys are becoming more of a problem in many areas of the country. While there is no doubt that they do consume some fruit, some research has shown that the turkeys are often after insects instead of the fruit. They do not appear to like loud and/or distressing sounds. While netting will work, turkeys can tear holes in it to access the fruit.</p> <p>Efforts to control birds and other wildlife that damage fruit crops should be focused on the perimeter of the planting first, especially on the side(s) facing favorable wildlife habitat. This is where the first damage will be observed and, in some cases, it may be sufficient to head off the problem. However, don't discontinue monitoring for wildlife damage throughout the planting.</p>
<p>Deer</p>	<p>Deer can damage blueberry plantings by foraging on succulent flower buds and new growth during the growing season or by eating fruit. In fall, bucks can damage plants by rubbing. This is more of a problem in tree fruits than blueberries. Deer can also puncture plastic mulch and possibly the irrigation tape underneath, resulting in loss of weed control. Deer numbers are increasing and, incidents of deer damaging crops are also increasing. Deer populations vary from year to year as a result of weather conditions, food supply and, possibly, hunting pressure.</p> <p>Locating the planting away from favorable habitat for deer will help to lessen losses. However, this is not always possible. Several control options do exist. Determining which one or ones to use depends on the deer population, availability of other food sources, location of favorable habitat, the duration for which protection is needed and the value of the crop to be protected.</p> <p>Repellents Both taste and smell repellents exist. Smell repellents include commercially available products or materials such as tankage, blood, putrefied egg solids, certain soaps and human hair. Repellants will not provide long-term control and will not provide control when populations are high or alternate food sources are scarce.</p> <p>Repellents work best if deer populations are below local carrying capacity. Populations may need to be lethally reduced prior to initiating non-lethal control. Both taste and odor repellents exist. Olfactory repellents include commercially available products or materials such as tankage, blood, putrefied egg solids, and certain soaps. Taste repellents include capsaicin oils or derivatives. Repellents will not provide long-term control and will not provide control when populations are high or alternate food sources are scarce. Repellents must be frequently re-applied (often weekly and always after rain or irrigation events).</p>

<p>Deer (continued)</p>	<p>Exclusion</p> <p>Exclusion (fencing) is the only truly effective long-term control for deer damage prevention. Fences can be electrified or not. Deer will try to go under a fence through a fence or over it. For non-electrified fences, the lowest wire needs to be within 10 inches or less of the lowest point in the ground around the fruit crop planting and tight enough to prevent deer from pushing under it. Do not neglect ditches or other low spots in the ground around the field because the deer will find them. The fence that is installed with outriggers should be a minimum of 5 feet. A 7-wire slant wire fence can be 4-5 feet tall. Other designs installed at this height are also effective. Some fence designs such as the Gallagher 3-wire fence (with or without electricity) can effectively deter deer at just 24 to 28 inches. Maximum fence height need not be any higher than 8 feet as deer are less likely to clear fences at this height. Wire mesh fences are more desirable than multiple strands of barbed wire.</p> <p>For electric fences, several different designs have been used and, under certain conditions, each can be effective. The simplest and least expensive electric fence uses a single high-tensile wire at about 30 inches above ground level. A solar charger can be used if access to electricity is not an option. Peanut butter can either be smeared on the wire or on aluminum foil strips which are then draped over the wire. Deer are curious animals and will investigate the fence if they are not being chased. Touching the fence results in getting shocked and turning the deer away from the field being protected. The single-wire, baited fence is relatively inexpensive, easy to construct and often adequate to protect the crop. Plastic flagging may also be tied to the fence to make it more visible to the deer. With high deer populations, when available alternate food sources are scarce or when deer have already established a feeding pattern in the area being protected, this fence may not be adequate.</p> <p>More substantial electric fences for deer control have multiple wires with the alternate wires being electrified. One design uses 5 wires and is constructed at a 45-degree angle facing away from the area to be protected. The bottom wire is within 10 inches of the ground and is electrified to keep deer from going under the fence. The middle wire is also electrified to prevent deer from going through the fence and the top wire, which may be only about 5 feet above ground, is electrified to keep deer from going over the fence. A fence constructed in this manner has height and depth, a combination that generally will discourage the deer from trying to enter the field. Poly Tape electric fence often used to contain cattle and horses works well for deer fences.</p> <p>Numerous other fence designs exist including a non-electrified mesh fence with a hot wire on top. If electric fences are used, it is important to keep weeds, grasses and other materials away from the fence to prevent it from shorting out and to increase its visibility.</p>
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