2019 Southeast Regional Organic Blueberry Pest Management Guide

A Guide for Managing Diseases, Insects, Weeds and Wildlife in Blueberries in the Southeast

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General Considerations

The USDA National Organic Program (NOP) sets rules for how to use NOP-approved pesticides. NOP-approved insecticides and fungicides are usually less efficacious 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 pest management options for blueberry production and addresses the issues most commonly encountered under the unique growing conditions of the Southeast. This publication is not intended to provide all details on organic blueberry production. It does, however, include the production methods that reduce the impact of plant diseases and insect pests. There are several online publications that provide more detail on general organic production methods. The organic blueberry production guide from the University of Kentucky (http://www.uky.edu/ccd/production/crop-resources/fruit/blueberries) includes a list of reliable on-line resources.

Blueberries, in particular 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.

The overuse of insecticides can lead to resistant insect pest populations. Therefore, insect and mite (arthropod) populations should only be treated if established economic thresholds are exceeded. Insect populations may be monitored 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 use insecticides in a targeted manner at all times. If insecticides must be applied during bloom, apply late in the evening when bees are not foraging.

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 of Entrust should be 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 is a less effective alternative, PyGanic can be used in rotation with Entrust to manage SWD. PyGanic should be used 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. In particular, dormant season pruning of old, weak, cold-injured or dead branches will help prevent diseases such as *Botryosphaeria,* 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 Guide

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. Provisions for drainage, organic matter and pH must be made prior to planting. Soil should be tested 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. Lime is usually not needed unless pH is below 4.0. In general, rabbiteye blueberries grow best on land not previously cropped. High 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 will also increase air circulation. Optimizing growing conditions results in healthy vigorous plants that will be more resistant to disease problems. 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 either by rainfall or irrigation during the growing season.

Root rots – Root rots of blueberry, in particular *Phytophthora* root rot, can be damaging to all blueberry plants. Root rots have been observed 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. Root rots are best addressed through 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 disease. Therefore, good site preparation is essential.

Nematodes – 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. Old blueberry fields should be avoided for new plantings. Old planting sites should be rotated into cover crops for two to three years, and the cover crops incorporated to increase soil organic matter. More info 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* affects mainly the crown area of plants producing galls at or below the soil line. Blueberries can be affected by crown gall but the disease is not as damaging to blueberry as it is 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. These diseases cannot be cured and the only treatment is to remove the infected plant to prevent spread. Purchase certified disease 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. Always use plants of known status. Disease susceptibility can also vary by variety.

Bacterial leaf scorch, caused by *Xylella fastidiosa*, is transmitted by plant leafhoppers, in particular the glassy-winged sharp shooter. This disease is not widespread and has been found mainly in southern highbush cultivars in Georgia, Alabama, Louisiana, and Florida. Details on cultivar resistance and susceptibility can be found at this site in the January 6, 2011 agent training: http://www.smallfruits.org/training.html

Blueberry red ring spot virus 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 under pest information at: http://www.smallfruits.org/crops/blueberries.html

Blueberry stunt phytoplasma – Stunt is a devastating systemic bacterial disease of blueberry in North and South Carolina This disease has been reported from Arkansas but has not been observed in Georgia. Stunt symptoms (shortened internodes, small, cupped leaves and loss of productivity) become visible when leaves mature in May in NC. Control relies on removal of infected bushes (including roots) and control of the insect vector (the sharpnosed leafhopper) that carries the pathogen from bush to bush. Stunt is rarely seen on rabbiteye cultivars but is common on highbush and Southern highbush cultivars in southeastern NC. This disease also occurs in northern production areas, including Michigan and New Jersey.

Dormant (before flower or leaf buds break) (**E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown)**						
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 (*Exobasidium* spp.) causes spots averaging ¼ inch in diameter on berries. Spots remain green and do not ripen. They may be tinged red and may 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. This disease occurs sporadically but can cause significant yield loss.					
	Canopy management		E			Disease is more severe when dense canopy creates a humid microclimate. Prune to open canopy, plant in an open, well-drained site.
	Lime sulfur	5 gallons/acre in 100 gallons total spray volume	E	48 hrs.	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 *Botryosphaeria*, *Phomopsis*, and *Colletotrichum acutatum*.					
	Prune dead or diseased stems, remove from site		E			Removal of branches close to the ground will reduce early leaf and fruit infections. Pruning opens up the canopy to air movement to help reduce disease severity.
Mummy berry	Mummy berry (*Monilinia vaccinii-corymbosi)* 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 the blossoms resulting in hard, mummified fruit resulting in reduced yields and a serious post-harvest grading problem. Infected berries (mummies) fall to the ground and serve as the overwintering mechanism for this disease, so burying or mulching mummies 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 to prevent germination.					
	Remove or cover mummies		E			Rake mummies to row centers and bury 1” deep. Cover mummies with mulch within rows. 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. Provisions for adequate drainage must be made prior to planting. Site selection and/or proper bedding operations are essential cultural practices for control of this disease. *Phytophthora* can also be very problematic in pine bark beds for southern highbush varieties (see comments above).					
Bagworm	Remove and dispose of cases		E			Bagworm cases should be removed in the dormant season, prior to April, before eggs hatch.

Dormant (con't)						
Pest/Problem	***Management Options***	***Amount of Formulation per Acre***	***Effectiveness or Importance***	***REI***	***PHI***	***Comments***
Scale	Horticultural/ Superior oil **Pre-bloom use only**	1 to 3%	VG	4 hrs	0 days	Apply oil dormant or delayed dormant as needed for scale infestations. Reduce to 1% rate just before bloom. Do not apply oil when temperatures are expected to be higher than 65°F or lower than 30°F within 24 hrs. Do not use within 14 days of lime sulfur.
Red imported fire ant	Ant baits can be applied as needed from late winter to spring and in the fall. Apply on warm sunny days when grass is dry, the soil is moist with a soil temperature of at least 60°F, and ants are actively foraging. Foraging activity can be gauged by placing a food item, such as a potato chip, near the mound for 30 minutes. If ants are feeding on the chip within 30 minutes, conditions are right to apply baits. Allow 4 weeks to work.					
	spinosad (Seduce Fire Ant Bait)	20-44 lb	G	4 hrs	3 days	
Gall midge	**Blueberry gall midge** adults are tiny flies, and larvae are tiny white or orange, carrot-shaped maggots which feed inside flower buds and leaf buds. Gall midge is generally not a problem in North Carolina but in rare cases may be extremely injurious, especially on certain rabbiteye cultivars like 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.** Gall midge sprays may provide suppression of pre-bloom thrips populations.					
	spinosad (Entrust 80W)	1.25 to 2 oz	G	4 hrs	3 days	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 can be made. **NOTE: Spinosad is the most effective organic approved insecticide against spotted wing drosophila with a limited number of applications per season. If SWD management is required, use should be reserved for SWD management.**
	Entrust 2SC					

Pre-bloom through green tip (leaf buds) **and pink bud** (flower buds) (**E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown)**						
Blueberries are a pollination-sensitive crop; they are pollinated exclusively by insects, and an insect must visit each flower for a berry to form. 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. Insecticides should not be applied 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 Botrytis blight	If mummy berry disease 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 is improved by using an OMRI-approved adjuvant such as Nufilm-P.					
	Serenade MAX	1-3 lbs	F	4 hrs	0 days	
	Serenade ASO	2-6 qts	F	4 hrs	0 days	
Blueberry gall midge	See **DORMANT** recommendations.					
Thrips	Flower thrips can be very damaging to flower buds and blooms, especially in rabbiteye 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)	1.25 to 2 oz	G	4 hrs	3 days	Spinosad is toxic to bees, and should not be applied when bees are actively foraging. 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 and use should be reserved for SWD management.**

10-20% bloom until 80-90% bloom (**E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown**)						
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.					
	Serenade MAX	1-3 lbs	F	4 hrs	0 days	
	Serenade ASO	2-6 qts	F	4 hrs	0 days	
Botrytis blight	Botrytis flower blight is most prevalent when rainy conditions and/or freezing conditions occur during bloom.					
	Serenade MAX	1-3 lbs	F	4 hrs	0 days	
	Serenade ASO	2-6 qts	F	4 hrs	0 days	
Anthracnose (*Colletotrichum*), 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.					
	Serenade MAX	1-3 lbs	F	4 hrs	0 days	
Cherry and cranberry fruitworm	Emergence of adult fruitworm moths can be monitored through the use of pheromone traps. Traps should be placed in the field three to four weeks before anticipated bloom and changed at least every four weeks. Check for fruitworm adults in traps twice a week from full bloom until four weeks after petal fall. Fruitworm treatments should be timed to egg hatch. Egg laying begins approximately one week after pheromone trap captures begin. Examine fruit clusters for eggs on calyxes of berries. Early varieties are normally infested first. Treatments applied when larvae are observed in fruit are too late, particularly for cherry fruitworm.					
	Bacillus thuringiensis (Dipel DF)	0.5-2 lbs	G	4 hrs	0 days	Bt is a bacterium that is effective in controlling lepidopteran insect pests. Bt must be eaten to be effective and will not control larvae once they are inside the fruit. Bt treatments should be timed to egg hatch (1 – 3 days after peak month captures or first eggs observed). Bt will not harm bees.

Petal fall until one month after bloom (E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown)

Blueberry stunt – Bushes infected with this disease become visible when leaves mature in May in NC. Stunt is a devastating disease of blueberry in North and South Carolina, and has been reported from Arkansas but has not been observed in Georgia. 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 pathogen from bush to bush. Stunt is rarely seen on rabbiteye cultivars but is common on highbush and Southern highbush cultivars in southeastern NC.

Pest/Problem	*Management Options*	*Amount of Formulation per Acre*	*Effectiveness or Importance*	*REI*	*PHI*	*Comments*
Anthracnose (*Colletotrichum* 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 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. Harvest fruit when conditions are dry, and harvest fruit often and completely. Do not handle wet fruit. Chill immediately after harvest.					
	Serenade MAX	1-3 lbs	F	4 hrs	0 days	
Cranberry and Cherry fruitworms	**spinosad** Entrust 80W	1.25 to 2 oz	F	4 hrs	3 days	Spinosad should not be used if a pre-bloom treatment was applied for thrips. Spinosad is toxic to bees and beneficials, and should not be applied when bees are actively foraging. Overuse may lead to resistance in pest insect populations. Entrust 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 organic approved insecticide against spotted wing drosophila and use should be reserved for SWD management**.
	Bacillus thuringiensis (Dipel DF)	0.5 to 2.0 lb	G	4 hrs	0 days	Bt is a bacterium that is effective in controlling lepidopteran insect pests. Bt must be eaten to be effective and will not control larvae once in the fruit. Bt treatments should be timed to egg hatch (1 – 3 days after peak month captures or first eggs observed).
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 – 14 day interval, beginning at petal fall, or when plum curculio injury appears. Fruit infested by plum curculio 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.					
	kaolin clay (Surround WP)	25 to 50 lb	P	4 hrs	0 days	Surround acts like a barrier and masks fruit from pest recognition. Fruit should be washed after harvest, and Surround may be most appropriate for processing fruit.

Cover Sprays (green fruit stage) (**E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown**)						
Pest/Problem	***Management Options***	***Amount of Formulation per Acre***	***Effectiveness or Importance***	***REI***	***PHI***	***Comments***
Septoria and anthracnose leaf spots	Septoria and anthracnose (*Colletotrichum*) 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.					
	Serenade MAX	1-3 lbs	F	4 hrs	0 days	
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.					
	Serenade MAX	1-3 lbs	F	4 hrs	0 days	
Flea beetle	Flea beetles are small, dark metallic blue or green foliage feeders that shot-hole blueberry foliage, often clustering on terminals and causing characteristic notching at leaf edges. Bushes in healthy, well-tended mature rabbiteye plantings can normally lose up to 20% of leaf surface before any injury is sustained. Young plantings, particularly southern highbush and less vigorous rabbiteye cultivars, may be easily hurt by flea beetles. Feeding on shoot tips can cause excessive branching.					
	spinosad (Entrust 80W)	1.25 to 2 oz	F	4 hrs	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 and use should be reserved for SWD management**.
Spotted wing drosophila	Spotted wing drosophila (*Drosophila suzukii*) is an invasive pest of soft-skinned fruit (including blueberries) in the United States and has been detected throughout the Southeast. SWD damage is similar to blueberry maggot. Female flies lay their eggs in ripening and ripe fruit, and larvae develop internally. SWD larvae are smaller than blueberry maggot larvae and, unlike blueberry maggot, SWD can have multiple, overlapping generations during blueberry harvest. Adult male SWD can be distinguished from native, non-pest *Drosophila* spp. by a single spot on the end of both wings. Traps are useful in determining SWD presence on your farm, but do not predict fruit infestation. If SWD has been found on or near your farm, preventative insecticide applications are recommended beginning when fruit begins to color through the end of harvest. In situations where SWD risk is high, insecticides should be applied weekly and reapplied after rain events. Detailed information on SWD biology, monitoring, and management can be found in this UGA extension publication on organic management of SWD: http://extension.uga.edu/publications/detail.html?number=B1497&title=Management%20Recommendations%20for%20Spotted%20Wing%20Drosophila%20in%20Organic%20Berry%20Crops Many management tools used for SWD may also be effective against blueberry maggot, and blueberry maggot and SWD management strategies should be integrated as much as possible.					

Pre-Harvest (first color) **through Harvest** (**E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown)**

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.

Fruit rots (*Alternaria* and *Colletotrichum*) – Fungicides alone do not provide adequate control; proper harvesting and handling is essential. Pre- and post-harvest rots can be greatly reduced by timely, complete 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 through the use of partial-vacuum or forced-air systems that use fans to pull cold air through stacks of palletized fruit. Short harvest intervals are also used to reduce the risk of SWD infestation.

Pest/Problem	*Management Options*	*Amount of Formulation per Acre*	*Effectiveness or Importance*	*REI*	*PHI*	*Comments*
Alternaria rot and Anthracnose (*Colletotrichum* spp.) ripe rot	Fruit rots may not become obvious until ripening but infection occurs any time during and after bloom. Infections are favored by Infections are favored by rain when air temperatures are warm (>70°F). Pre-harvest infections are most often on blossom end of fruit, however most decay occurs post-harvest at the exposed stem end of the berry. Alternaria is the most common post-harvest rot in the southeastern US. These diseases are more common on highbush cultivars. Harvest and handle fruit only when conditions are dry, and harvest fruit often and completely. Chill immediately after harvest.					
	Serenade MAX	1-3 lbs	F	4 hrs	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. **Traps should be hung in plantings by 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. Apply from 10 fl oz GF-120 NF in 15 fl oz water/acre to 20 fl oz GF-120 NF in 30 fl oz water/acre.	G	4 hrs	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. It is not necessary to apply directly to fruit or leaves. GF-120 applications made for blueberry maggot management may not provide control of spotted wing drosophila.
Japanese Beetles	**Neemix 4.5** plus **Trilogy 2%**		P	4 hrs	0 days	

Pre-Harvest (first color) **through Harvest** (con't)						
Pest/Problem	***Management Options***	***Amount of Formulation per Acre***	***Effectiveness or Importance***	***REI***	***PHI***	***Comments***
Spotted Wing Drosophila	Spotted wing drosophila (SWD, *Drosophila suzukii*) is an invasive pest of soft skinned fruit in the United States and has been detected 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 unlikely 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 *Drosophila* spp. by a single spot on the end of both wings. Traps are useful in determining SWD presence on your farm, but do not predict fruit infestation. If SWD has been found on or near your farm, preventative insecticide applications are recommended beginning when fruit begins to color through the end of harvest. Insecticides should be applied weekly and reapplied after rain events which reduce efficacy. Detailed information on SWD biology, monitoring, and management can be found in this UGA extension publication on organic management of SWD: http://extension.uga.edu/publications/detail.html?number=B1497&title=Management%20Recommendations%20for%20Spotted%20Wing%20Drosophila%20in%20Organic%20Berry%20Crops 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.					
	spinosad (Entrust 80W) Entrust SC	1.25 to 2 oz 4 - 6 oz	G G	4 hrs	3 days 1 day	Overuse may lead to resistance in insect populations. Entrust cannot be applied more than 3 times in a cropping season. Only two consecutive applications of Entrust can be made. 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/A	F	12 hrs	0 days	Not as effective as spinosad for SWD but can be rotated with spinosad if SWD pressure remains high. Short residual activity.
Blueberry stem borer	Blueberry stem borer, *Oberea myops*, is a longhorn beetle and 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			
	Bacillus thuringiensis (Dipel DF)	0.5 to 1.0 lb	G	4 hrs	0 days	Bt is a bacterium that is effective in controlling lepidopteran insect pests. Bt must be eaten to be effective. Apply to small, early-stage caterpillars. Safe for beneficials.
Fire ants	**See DORMANT recommendations**					

Post harvest (E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown)

During fruit maturation and/or immediately following harvest, fungicide applications may be warranted for control of leaf spots and suppression of dieback diseases. Start applications as soon as leaf spots are first observed.

Blueberry rust (*Pucciniastrum vaccinii)* 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.

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.

Pest/Problem	*Management Options*	*Amount of Formulation per Acre*	*Effectiveness or Importance*	*REI*	*PHI*	*Comments*
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.					
	Serenade MAX	1-3 lbs	F	4 hrs	0 days	To improve plant surface coverage, add a non-phytotoxic OMRI approved surfactant.
	Organic Gem 2%	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		F			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.					
	Pyganic (PyGanic EC1.4)	16 – 64 fl oz/A	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.
Japanese Beetles	**Neemix 4.5** plus **Trilogy** 2%	7-16 fl oz	F	4 hrs	0 days	
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.
	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.

Post harvest (con't)						
Pest/Problem	***Management Options***	***Amount of Formulation per Acre***	***Effectiveness or Importance***	***REI***	***PHI***	***Comments***
Blueberry bud mite (con't)	**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 when temperatures are expected to be higher than 65°F or lower than 30°F within 24 hrs. 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.

Selected NOP-approved products for management of blueberry diseases (E = excellent, VG = very good, G = good, F = fair, P = poor, NA = not recommended, UN = control unknown) These ratings are benchmarks, actual performance will vary. See IPM Management Guide above and label for rates and particulars. Many of these products are 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)	Exobasidium	Mummy Berry	Botrytis (gray mold)	Alternaria rot	Phomopsis twig blight	Ripe rot (Anthracnose)	Septoria leaf spot	Anthracnose leaf spot	Rust
Bacillus subtilis strain QST713	Serenade MAX[a] Serenade ASO	UN	F	F	F	UN	F	F	F	F
Fish Oil	Organic Gem, Neptune's Harvest	UN	UN	UN	UN	UN	UN	G	UN	UN
Lime sulfur	Various brands	E	UN	NA	NA	UN	NA	NA	NA	NA
Streptomyces lydicus WYEC 108	Actinovate AG	UN	UN	UN	UN	UN	UN	UN	UN	UN
Copper	Various brands	UN	UN	NA	NA	UN	NA	UN	UN	F

[a] Efficacy of Serenade is improved by using an OMRI-approved adjuvant such as Nufilm-P.

Seasonal 'at a glance' fungicidal spray timing for blueberry

Developmental Stage	Dormant	Green tip	Bloom (2-3 applications)[a]	Petal Fall	Cover Sprays	Pre-Harvest[b]	After Harvest Foliage Management[c]
Disease Controlled: Product	**Exobasidium:** Lime-sulfur	**Mummy Berry:** Serenade	**Mummy Berry, Fruit Rots and Botrytis:** Serenade	**Fruit Rots:** Serenade	**Fruit Rots, Leaf spots:** Serenade	**Fruit Rots, Leaf Spots:** Serenade	**Fruit Rots, Leaf Spots:** Serenade, Fish Oil Fertilizer

[a]Bloom 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 1-3, depending on the season and the variety. Fruit rots are best controlled with bloom sprays.
[b]In wet years, pre-harvest and post-harvest rots may be a potential problem. Organic fungicides have limited value for fruit rot control. Growers should rely more on other control measures, such as timely, complete harvest, handling fruit only when dry, and rapid post-harvest cooling.
[c]Septoria leaf spot and other leaf diseases are best controlled in organic southern highbush fields through the use of 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) 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)	Fire Ants	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 drosophila	Japanese/ Green June beetles	Blue-berry bud mite	Foliar feeding cater-pillars
azadirachtin (UN)	Neemix 4.5% plus Triology, AzaDirect	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	P	NA	NA
Bt	Dipel DF	NA	NA	NA	NA	NA	NA	NA	NA	VG	NA	NA	NA	NA	NA	G
horticultural oil		NA	E	VG	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	F	NA
Kaolin clay	Surround WP	NA	NA	NA	NA	NA	NA	UN	UN	UN	P	UN	NA	UN	NA	UN
pyrethrin	PyGanic	NA	NA	NA	UN	NA	UN	UN	VG	NA	G	NA	F	UN	NA	UN
spinosad	Entrust 80W	NA	NA	NA	G	F	VG	NA	NA	F	NA	NA	G	NA	NA	P
spinosad	GF-120 NF Naturalyte Fruit Fly Bait	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	VG	NA	NA	NA	NA
spinosad	Seduce fire ant bait	G	NA	NA	NA	NA	NA	NA	NA	NA	NA	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 also harbor damaging pests and interfere with planting, maintenance, and harvesting. No totally effective organic herbicides are available so growers must rely on cultural and physical methods 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. Beds should be covered with mulch to suppress weeds. Bark mulch helps to maintain plant health over the long term, although beds can be mulched with either plastic or landscape cloth at least initially. Landscape cloth can be rolled up and reused while plastic must be discarded every year.

Additional hand weeding will be necessary to maintain weed-free beds.

Row middles 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 have many advantages over bare soil cultivation from weed suppression to preventing erosion.

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.	
Trade name	***Active Ingredient***
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	Crop losses to birds appear to be increasing in blueberry fields. Not only do birds consume fruit, but the damage they cause can result in increased problems with fruit rots and other pests such as bees and yellow jackets. Robins, starlings and mockingbirds are among the more common ones, but orioles, cedar waxwings and finches may also feed on blueberries. 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. While birds can and do fly fairly long distances to feed, the further they have to fly, the more apt they are to not find the fruit crop or to be distracted by another food source. 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. There are several control techniques which may be of value in decreasing 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. **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: • 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 in the day often most intense feeding times. • Vary the frequency, the direction and the timing in which auditory devices are operated. Propane cannons should not be fired 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). **Visual repellents** Visual repellents include scare eyes suspended above the crop, 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.

Wildlife Damage Prevention	
Pest/Problem	**Management Options**
Birds (con't)	**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, 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. 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. 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.
Deer	Deer can damage blueberry plantings by foraging on succulent 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. As with bird control, 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. **Repellents** Both taste and smell repellents exist. Smell repellents include commercially available products or materials such as tankage, blood, putrified 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.

Wildlife Damage Prevention	
Pest/Problem	**Management Options**
Deer (con't)	**Exclusion** 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 needs to be at least 8 feet high or higher as deer can easily clear this height. Wire mesh fences are more desirable than multiple strands of barbed wire. 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. Plastic flagging may also be tied to the fence to make it more visible to the deer. 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. 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. 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. 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.


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