Organic Blueberry Production in Florida[1]

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Introduction

There is a growing market in the United States and globally for fresh fruits and vegetables with reported health-enhancing properties. This includes blueberries, which are high in antioxidants and have been reported to improve heart health and contain anticancer properties. Fresh-market blueberry sales (conventional and organic) increased by 27% between 2013 and 2017, and that trend is expected to continue. In addition, there is an increasing level of consumer interest in organically grown produce (for environmental conservation, taste, and other perceived benefits), for which some consumers are willing to pay a premium over the price for a conventionally produced crop.

The United States is the largest producer of blueberries globally, as well as a major source of organic blueberries. According to the 2019 USDA Certified Organic Survey, there were 539 organic blueberry farms in the United States (10,300 acres), with 77.5 million pounds sold at a market value of $205.2 million. During the same period in Florida, there were 43 organic blueberry farms with 1.9 million pounds sold. This publication provides an overview of organic production of blueberries in Florida. Any practices or inputs recommended or discussed in this document must be approved by the producer's certifying agency prior to adoption or use.

Organic Certification

Organic production systems generally have higher costs than conventional systems, but the additional costs can often be balanced by price premiums for organic produce. The use of chemical inputs is restricted to naturally derived pesticides, herbicides, and fertilizer, and growers are required to utilize an ecological soil and pest management program. Successful organic blueberry producers recognize it as the *production system* itself that is certified; the products simply bear the label. In order for produce to be marketed as organic, the production system must be certified under the USDA National Organic Program (NOP) rules. These rules require, among other things, that no prohibited substances be applied to the land for three years immediately prior to the first harvest that will be marketed as organic, as well as in subsequent years. This generally includes most synthetic substances, unless specifically permitted. The Organic Materials Review Institute (OMRI) provides independent reviews under organic standards for fertilizers, sanitizers, pest controls, and other inputs intended for use in certified organic production, and it publishes compliant products in the OMRI products list (https://www.omri.org/omri-lists). However, not all products listed in OMRI will be allowed by your certification agency, so always check with your certifier before making any purchases.

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The organic certification process begins with selecting an accredited certifying agency, who will work with producers as they develop a written Organic System Plan (OSP) to describe the soil and pest management strategies and other important features of their production systems. An inspector will perform an on-site inspection to ensure the producer's OSP is complete and accurate. The OSP is designed to help the producer be successful by creating a proactive action plan. The OSP must be specific to the activities to be certified, outlining the plans and practices for achieving and maintaining compliance with the USDA organic regulations. This includes documentation of each production input's composition and source, as well as descriptions of monitoring practices, the recordkeeping system, and practices and barriers to keep organic and nonorganic systems separate. Once certified, the OSP must be updated and provided to the certifier annually to continue certification. Additional details are available in the USDA's National Organic Program Handbook (https://www.ams.usda.gov/rules-regulations/organic/handbook) and EDIS publication HS720, *Introduction to Organic Crop Production* (https://edis.ifas.ufl.edu/cv118).

If producers are transitioning from a conventional system, they will be asked to provide management records from the past three years, including all inputs, their rate of application, and copies of labels and invoices. Nursery stock is also considered an input. Items purchased in bulk, such as mulch, will also require documentation. If producers are breaking new ground, they will be asked to provide records of the previous field history.

If producers intend to maintain both conventional and organic acreage, the two systems must be clearly separated at all steps in the production cycle. For example, specialty equipment such as planters and harvesters can be shared between systems, but they must be cleaned according to an approved SOP in the organic plan prior to using on certified land. Items that cannot be thoroughly cleaned must be labeled "organic use only." Storage facilities for inputs and produce must have dedicated, labeled space for organic production.

Sourcing and Selecting Plants

If producers are establishing a new orchard, stock plants should preferably be sourced from a certified organic nursery operation. Organic stock will allow producers to sell the fruit with an organic label in the first year of establishment, provided that the farming system was certified before the new plants were installed. If stock is purchased from a noncertified source, producers must provide evidence that an equivalent organic stock was not available, and they are not allowed to market or label fruit from that plant or the plant itself as organic until 12 months after planting.

Because there are limited management tools for disease and pest control in organic systems, growers should consider planting cultivars that are resistant to some of the more common diseases and pest damage. For information on University of Florida southern highbush blueberry cultivars, see EDIS publication HS1245, *Southern Highbush Blueberry Cultivars from the University of Florida* (https://edis.ifas.ufl.edu/hs1245), and the UF blueberry breeding program website (https://www.blueberrybreeding.com/varieties). Growers may also want to consider purchasing larger plants to achieve more rapid canopy closure, which can help minimize weed pressure.

Fertilization

Blueberries have shallow, fibrous root systems with no root hairs, so their capacity to take up water and nutrients is limited. In Florida, blueberries are typically planted in pine bark beds on top of the soil, in soil beds amended with pine bark, or in containers with pine bark media. Neither pine bark nor Florida's sandy soils hold water and nutrients well, requiring modifications to traditional fertilization practices to use lighter, more frequent applications. In mature plants, nutrient demand is highest in the spring during fruit development and in summer through early fall when rapid canopy growth occurs. See EDIS publication HS1356, *Nutrition and Fertilization Practices for Southern Highbush Blueberry in Florida* (https://edis.ifas.ufl.edu/hs1356), for additional details.

Organic Fertilizer Sources

Always check with your organic certifier before using any of these products, and make sure any products are listed in your Organic System Plan.

Nitrogen (N)

- Blood meal (12%–13% N)
- Feather meal (12% N)
- Fish meal (10% N)
- Fish emulsion or hydrolysate (2%–5% N)
- Broiler litter (1.4% N)
- Organic cotton seed meal (6% N)
- Chilean nitrate (15% N) (may be restricted in some areas with saltwater intrusion concerns)

Phosphorous (P)
- Bone meal (7%–15% P)
- Rock phosphate (3%–26% available P)
- Blood meal, fish meal, broiler litter, and cottonseed meal also contain some levels of P

Potassium (K)
- Potassium sulfate (50% K)
- Potassium magnesium sulfate (22% K)
- Blood meal, broiler litter, and cottonseed meal also contain some levels of K

It is important to perform foliar analysis tests at least annually to determine whether the current fertilizer program is providing the plants with nutrients at the recommended levels and to adjust the program accordingly. The beds' or containers' pH level should also be tested regularly to ensure that the recommended range of 4.5–5.5 is maintained.

Weed Management

Weed management can be one of the most significant issues in Florida blueberry production in both organic and conventional systems. Weeds compete for water and nutrients, act as alternate hosts for disease pathogens and insect pests, and alter the plant's microclimate. See EDIS publication HS90, *Weed Management in Blueberry* (https://edis.ifas.ufl.edu/wg016), for additional information. However, the herbicide products permitted to be used in organic systems are very limited, with moderate and inconsistent effectiveness. Available weed control methods are listed below.

Cultural Controls

- Remove perennial weeds prior to planting to help eliminate weed roots, tubers, and seed sources from the planting area.
- Plant grasses between rows to minimize weeds within the planting area.
- Practice mechanical weed suppression between rows, including rotary hoes, weed cutting equipment (mowers and handheld weed trimmers), steam equipment, and hand pulling.
- Use weed mat in the planting beds (although this will limit fertilizer types to those that can be applied through drip lines, such as fish emulsion, and will hinder adding pine bark to the beds).
- Apply pine bark mulch on top of uncovered beds to help suppress weeds.
- Regularly mow areas around the field to avoid weed seeds blowing into the production field.
- Use coconut coir discs for container production to help exclude weeds from the containers and minimize their growth in the media.

Organic Chemical Herbicides

Always check with your organic certifier before using any of these products, and make sure any products are listed in your Organic System Plan.

This is not intended to be a comprehensive list of organic weed control products.

Preemergent
- Corn gluten meal

Postemergent
- AXXE (ammonium nonanoate)
- Scythe (Pelargonic acid)
- Suppress (capric + caprylic acid)
- WeedSlayer (Eugenol)
- Vinegar (acetic acid)
- Lemongrass oil

Recent trials by Oregon State University showed excellent weed control with saturated steam and a mechanical weeder with a rotary brush attachment. In addition, effective control was observed with AXXE and Suppress (following a successful initial treatment). Trials in Georgia on rabbiteye blueberry found that organic herbicides did not perform well on grasses.

Disease Management

In Florida's hot, humid climate, several diseases can be issues in blueberry production, including fungal leaf diseases, fruit rots, stem blight, and parasitic algae. See EDIS publications *Florida Blueberry Leaf Disease Guide* (https://edis.ifas.ufl.edu/pp348), *Anthracnose on Southern Highbush Blueberry* (https://edis.ifas.ufl.edu/pp337), *Botryosphaeria Stem Blight on Southern Highbush Blueberry in Florida* (https://edis.ifas.ufl.edu/pp347), *Algal Stem Blotch in Southern Highbush Blueberry in Florida* (https://edis.ifas.ufl.edu/pp344), and *2019 Florida Blueberry Integrated Pest Management Guide* (https://edis.ifas.ufl.edu/hs380) for descriptions of symptoms and typical timing for these diseases. Samples of plant tissue with disease symptoms can be sent to the UF/IFAS Plant Diagnostic Center for analysis and diagnosis (https://plantpath.ifas.ufl.edu/extension/plant-diagnostic-center/).

In order for infectious plant disease to occur, there must be (1) an active pathogen, (2) a susceptible plant host, and (3) environmental conditions that are favorable for infection. Removing any of these three conditions through control measures can be successful in reducing the incidence of disease. Many chemical controls for blueberry diseases are not allowed in organic production, including most conventional fungicides. In addition, under NOP rules all available cultural and biological controls must be used first before using approved pesticides. Methods for organic disease control are listed below.

Figure 1. Leaf rust on blueberry.
Credits: D. Phillips, UF/IFAS

Cultural Controls

- Consider using cultivars that are known to be resistant to (or tolerant of) more prevalent diseases, or are not known to be overly susceptible to certain diseases.
- Carefully consider site selection for new fields. In particular, avoid planting blueberries in very wet areas, because these areas could increase the possibility of developing *Phytophthora* root rot. Also, ensure good drainage by using raised beds, drains, or both to minimize root rots.
- Avoid bringing disease into the field—start with disease-free planting materials, consider using approved sanitizing products on recycled surface water irrigation systems, avoid reusing bark in production fields or media in container production, disinfect containers before reusing, disinfect pruning equipment frequently, and clean and disinfect other equipment (including tractors and implements) before moving between fields.
- Consider using drip or microjet irrigation instead of overhead to minimize the spread of water-transferred pathogens and reduce leaf wetness duration, or time overhead irrigation to minimize leaf wetness periods.
- Prune out and destroy diseased canes and open the plant canopy for increased air flow. Remove and destroy fallen twigs and leaf litter to remove inoculum from the field.
- Remove and destroy bacteria-infected plants (e.g., *Ralstonia*, *Xylella*).
- Practice good weed control to remove possible alternative hosts for disease pathogens and allow good airflow through plant canopies.
- Avoid plant stress through good general management practices, including proper irrigation, so plants are not drought-stressed or too wet; fertilization, so plants are not lacking any nutrients in advance of need; and maintaining soil/media pH in the recommended range (4.5–5.5) to maximize availability of nutrients. Excessive nitrogen fertilization can result in more succulent leaf growth, which may be susceptible to some diseases.
- Promptly harvest ripe fruit, and rapidly cool harvested fruit to reduce the occurrence of postharvest fruit rots.

Organic Chemical Control Products

Always check with your organic certifier before using any of these products, and make sure any products are listed in your Organic System Plan.

Products can generally be divided into two categories, including general biocides derived from naturally occurring elements and biological products containing live cultures or an organismal by-product of some kind.

Among general biocides, ionic copper from a variety of mixtures and reactions (see below) has been the most widely used for plant disease management since Bordeaux mixture was documented by Millardet in 1885 to prevent grape downy mildew. Copper is an essential trace element for plant growth. At higher rates, copper also can provide excellent efficacy for primarily foliar diseases caused by fungi, water molds, and bacteria, with limited data available on algal disease management. Copper is only effective as a protectant prior to infection, and applications are generally recommended to begin two weeks prior to disease occurrence. Predicting when disease is likely to occur can be difficult, leaving growers to rely on calendar-based sprays prior to periods when environmental conditions may favor disease. Copper products do offer varying levels of residual protectant activity after application but must be reapplied regularly. Rain and rapid plant growth can reduce the window of copper products' efficacy from about seven days to less than three.

Because copper is a general biocide, applications also can have negative effects on plants and soil health. Copper applied to tender young growth, or in an acidic solution, can result in a type of foliar burn referred to as phytotoxicity. Long-term negative effects of repeated applications at high rates over years include buildup of toxic copper levels in soils, as has been the case in Florida grapefruit groves (https://irrec.ifas.ufl.edu/IRSWS/publications/Zhou_SS-SAJ_2011.pdf). For Florida blueberries, copper products are recommended postharvest to control algal stem blotch. In organic systems, copper is allowed with restrictions on its use to minimize soil accumulation. Producers using copper are encouraged to test annually for soil copper concentration. If copper increases significantly over time relative to the baseline in a particular field, the producer's certification agency will require a copper management plan. If the soil pH is 5.0 or less, the addition of lime will make the copper less available to plants, thus minimizing risk of copper toxicity.

Lime sulfur is another general biocide that is used primarily during dormancy due to the potential for phytotoxicity. Lime sulfur is recommended in Georgia for control of exobasidium diseases of blueberry. However, these are not known to be problematic in Florida. Lime sulfur is not currently recommended for use on blueberry in Florida, particularly in evergreen production systems.

Naturally occurring peroxides include a group of chemicals that degrade into or contain a reactive peroxide group. Peroxides react with organic compounds and can act as effective sanitizing agents when applied to pots, benches, equipment, or other impermeable surfaces. The use of these products as sanitizing agents as described above is recommended and encouraged. Peroxides have no residual activity and only affect pathogens that come into contact with the solution (i.e., they do not penetrate organic matter that may be harboring pathogens, so remove as much plant debris as possible prior to sanitation efforts). Foliar applications have to be timed for after pathogens land on a susceptible plant and before infection occurs (because the products do not penetrate), and after infection, pathogens are protected within the plant. For this reason, peroxide products do not generally give consistent efficacy for diseases as foliar sprays.

Biological and biologically derived products have been the source of increasing interest and research. Products may include a culture or by-product of a microorganism in the genera *Bacillus*, *Psuedomonas*, *Streptomyces*, *Trichoderma*, or others. Another group of products may contain essential oils or other extracts of various plants, including cinnamon, neem, rosemary, thyme, and others. Labels on both types of biological products may include a wide range of diseases on the labels and may have demonstrated some level of efficacy in one or more research trials. However, efficacy data from university evaluations of these products in general show inconsistent results that are not necessarily as advertised. Growers should explore new product opportunities in this promising area using caution and encourage company representatives to continue to invest in independent evaluations of their products' label claims in Florida's challenging production system.

The following chemicals and biological products are listed in various organic production publications, with varying and often inconsistent levels of effectiveness in managing and controlling plant disease. This is not intended to be a comprehensive list of organic disease control products.

Chemicals

- Bordeaux (a mixture of copper sulfate and lime)
- Copper (copper sulfate, copper hydroxide, copper octanoate, copper oxide, copper oxychloride)
- Lime sulfur
- Sulfur
- Peroxyacetic acid
- Oxidate (hydrogen dioxide, peroxyacetic acid)
- Suffoil-X (aliphatic petroleum solvent)
- Milstop (potassium bicarbonate)
- Kaolin clay

Biological Products

- Serenade (*Bacillus subtilis*)
- Kodiak (*Bacillus subtilis*)
- Rhapsody (*Bacillus subtilis*)
- Sonata, Yield Shield (*Bacillus pumilis*)
- Companion (*Bacillus subtilis*)
- Contans (*Coniothyrium minitans*)
- Mycostop Biofungicide (*Streptomyces griseoviridis*)
- SoilGard (*Trichoderma virens*)
- Blight Ban (*Pseudomonas fluorescens*)
- PlantShield (*Trichoderma harzianum*)
- Primastop (*Gliocladium catenulatum*)
- Actinovate (*Streptomyces lydicus*)
- Double Nickel (*Bacillus amyloliquefaciens*)

As with the use of any chemical products, note preharvest interval (PHI) and reentry interval (REI) time periods, follow all label instructions, and check with your organic certifier to confirm acceptability for use in an organic system and on specific product formulations.

Pest Management

Some of the most problematic insect/mite pests on blueberries in Florida are chilli thrips, flower thrips, gall midge, southern red mites, spotted wing drosophila (SWD), flat-headed borer (*Chrysobothris* spp.), and citrus root weevil (*Diaprepes* spp.), among others. See the publications *Chilli Thrips on Blueberries in Florida* (https://edis.ifas.ufl.edu/in1298), *Florida Flower Thrips* Frankliniella bispinosa *Morgan (Insecta: Thysanoptera: Thripidae)* (https://edis.ifas.ufl.edu/in1110), *Blueberry Gall Midge on Southern Highbush Blueberry in Florida* (https://edis.ifas.ufl.edu/in1239), *Mite Pests of Southern Highbush Blueberry in Florida* (https://edis.ifas.ufl.edu/in1284), flat-headed borer (https://vscnews.com/beetle-borer-in-blueberries/), *Citrus Root Weevil on Southern Highbush Blueberry in Florida* (https://edis.ifas.ufl.edu/in1241), and *2019 Florida Blueberry Integrated Pest Management Guide* (https://edis.ifas.ufl.edu/hs380) for descriptions and typical timing for these pests.

Many conventional insecticides and miticides are not allowed in organic production systems. Pesticides approved for organic use typically have a shorter residual activity and are generally less toxic than conventional insecticides. Growers producing blueberries using organic pest management techniques must explore preventative and cultural techniques before they are allowed to use pesticides labeled for organic use. Organic insect control methods are listed below.

Figure 2. Adult chilli thrips.
Credits: L. Osborne, UF/IFAS

Cultural Controls

- Consider using cultivars that are known to be resistant to (or tolerant of) arthropod pests, or that are not known to be susceptible to certain pests.
- Practice good weed control to remove possible alternative hosts for insect pests.
- Prune to create a more open canopy that is less hospitable to certain pests, such as SWD, and to improve spray coverage.
- Consider the use of weed mat in the beds to create a barrier to insect larvae dropping to the soil to pupate, including gall midge, SWD, and Diaprepes.
- If practical, consider the use of exclusion netting to exclude certain pests such as SWD.
- Promptly harvest ripe fruit to minimize accumulation of ripe or overripe fruit that could attract SWD, and rapidly cool harvested fruit to 35°F to stop development of any eggs and larvae in fruit. Remove and destroy any overripe fruit or fruit on the ground.
- Use traps to monitor the presence of insect pests in production fields. Conventional control thresholds may not be appropriate for organic production due to generally lower mortalities and residual effects for many organic controls.
- Avoid plant stress through good general management practices, including adequate moisture control.

Organic Chemical Control Products

Always check with your organic certifier before using any of these products, and make sure any brand name products are listed in the Organic System Plan.

The following chemicals and products are listed in various organic production publications, with varying and often inconsistent effectiveness levels. Except Entrust and Azera, most organic pesticides generally do not have high levels of effectiveness and require repeat applications in a few days, especially if infestations are high. This is not intended to be a comprehensive list of organic insect control products.

COMMON PESTICIDES USED IN ORGANIC BLUEBERRY PEST MANAGEMENT

Biologicals

- Dipel (*Bacillus thuringiensis*)
- Entrust (Spinosad) (*Saccharopolyspora spinosa*)
- Grandevo (*Chromobacterium subtsugae*)

Botanicals
- Azera (Azadirachtin + Pyrethrins)
- Neem (*Azadirachta indica*)
- Oils—horticultural oils
- PyGanic (Pyrethrins, *Chrysanthemum* spp.)
- Ryania (*Ryania speciosa* stems)
- Sabadilla (*Schoenocaulon officianale* seeds)
- Soaps

Minerals
- Copper
- Sulfur

Azera (azadirachtin + pyrethrins)—Recommended for control of flea beetles, SWD, Diaprepes, flat-headed borers, blueberry gall midge, blueberry leafrollers, flower thrips, fire ants, and scale insects.

Dipel (*Bacillus thuringiensis*)—Used against leafrollers.

Entrust (spinosad) (*Saccharopolyspora spinosa*)—A naturally occurring soil bacterium, recommended for organic control of gall midge, flower thrips, SWD, and fruit worms.

Grandevo (*Chromobacterium substugae*)—Can be used against spider mites and in a rotational program with Entrust and PyGanic against SWD.

Horticultural oil—Used for control of blueberry bud mite, spider mites, and scale insects (should not be used when there are blossoms or fruit on the bush or when temperatures are above 85°F).

Jet-Ag and OxiDate—Can be used in rotation with Entrust, PyGanic, and Azera against SWD.

Neem oil (*Azadirachta indica*)—Can be used to repel flower thrips, scale insects, and mealy bugs.

Organocide (sesame oil)—Used for control of scale and spider mites.

PyGanic (pyrethrins, *Chrysanthemum* spp.)—A pyrethrum-based insecticide that can be used against flea beetles, leafhoppers, thrips, and fire ants. It can be used in rotation with Entrust to manage SWD.

Sabadilla (*Schoenocaulon officianale* seeds)—Used for control of caterpillars, leafhoppers, thrips, and stink bugs.

Suffoil-X—Used for control of scale insects.

Sulfur—Used against spider mites.

Surround WP (kaolin clay)—Can be used to reduce blueberry maggot injury (blueberry maggot is typically found only in northern Florida).

Common beneficial predators in blueberry production systems:

- Minute pirate bugs (*Orius insidiosus*) feed on thrips, mites and eggs of small insects.
- Big-eyed bugs (*Geocoris* spp.) feed on moth eggs and many other lepidopteran eggs.
- Larvae of lacewings (*Chrysoperla* spp.) feed on thrips, aphids, scale insects, and eggs of small insects.
- Larvae of flower flies feed on aphids, thrips and scale insects.

As with the use of any chemical products, note PHI and REI time periods, heed warnings about negative impacts to pollinators and other nontarget insects, follow all label instructions, and check with your organic certifier for confirmation of acceptability for use in an organic system and on specific product formulations.

Container Production

Many Florida growers use container production for organic blueberries. Until recently, they could sell the fruit as organic without applying the three-year waiting period for in-ground production where prohibited substances had been used on the land. Containers were considered an independent system because they did not include the location's soil for crop production. Crops produced in pots filled with soilless media (such as pine bark and compost) on landscape fabric would be an example of this type of system.

On June 3, 2019, the USDA notified accredited organic certifying agents of a clarification to the rules covering certification of organic container production. Under this clarification, containers and soil are no longer mutually exclusive; both now need to be certified. The clarified rule states "the legal requirements related to the three-year transition period apply to all container systems built and maintained on land."

The National Organic Program (NOP) views containers as an extension of the soil. If the soil on which the containers are situated would not meet the criteria for organic certification, then the container will also not meet the criteria.

Certifiers are instructed to assess land use histories for container system sites in the same way that an in-ground system is assessed. If the land on which the container production system is situated has had any prohibited substances applied, then the container system cannot be certified as organic until three years have passed between the last such application and the first harvest. Also, following certification no prohibited substances may be applied anywhere in the system, including on the underlying land. This clarification is not retroactive to operations and sites that were certified prior to the issuance of the USDA notification.

Figure 3. Blueberry container production.
Credits: D. Phillips, UF/IFAS

Under existing certifier practice, used or repurposed containers must have an auditable record history describing all materials the container has come into contact with, previous uses of the container, and known locations of previous use. All previous use must be documented, and containers must be free from contact with any prohibited substances for three years before any crops can be sold with a certified organic label.

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