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Blueberries: Organic Production

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Blueberries are the most widely grown fruit crop in the United States. Blueberries are well-suited to organic culture, and good markets exist for organically grown blueberries. This production guide addresses key aspects of organic blueberry production, including soils and fertility, cultural considerations, pests, weeds, and diseases, as well as marketing. Additional resources are provided for further investigation.

Introduction

This publication focuses on organic blueberry production, specifically the highbush and rabbiteye species, and is most relevant to production conditions east of the Rocky Mountains. It does not go deeply into some of the basics of blueberry culture—variety choice, planting, irrigation, pruning, and training—which are largely the same under both organic and conventional management. Such general information is available from the Cooperative Extension Service and many horticulture books, periodicals, and bulletins. Nor does this publication address organic production of lowbush blueberries. (The University of Maine provides information on organic management of wild, lowbush blueberries. See the Further Resources section.)

Although anyone may choose to grow organically, the USDA National Organic Program (NOP) regulates the labeling, marketing, and record-keeping procedures of all products labeled as organic. If you have a commercial farm and plan to market your produce as organic, you will need to be certified, unless your gross farm income is less than $5,000.

Blueberries ready for harvest. Photo: Ryan Neal, Neal Family Farm

Blueberries adapt well to organic culture. Production costs may be somewhat higher using organic methods, but this can be effectively counterbalanced by premium prices. Many cultural practices, such as the use of deep mulching and sodded row-middles, work for both conventional and organic blueberry production systems, offering a more sustainable approach to commercial horticulture.

When ATTRA first published this title, it was the only comprehensive production guide to organic blueberry production in the country. Since then, in large part because of the development of the Internet, information on organic blueberry production has proliferated. Cornell University,

University of Maine, University of Kentucky, University of Florida, Washington State University, Oregon State University and other institutions and individuals have published online information on organic blueberry production (see Further Resources at the end of this publication). It would behoove the aspiring organic blueberry grower to find information from as close to their production site as possible.

Related ATTRA Resources
ATTRA.NCAT.ORG

- Alternative Pollinators: Native Bees
- Beneficial and Pest Birds: Vertebrate IPM Tipsheet
- Climate Change and Perennial Fruit and Nut Production: Investing in Resilience in Uncertain Times
- Composting: The Basics
- Farmscaping to Enhance Biological Control
- Manures for Organic Crop Production
- Overview of Cover Crops and Green Manures
- Sustainable Management of Soil-borne Plant Diseases
- Tree Fruits: Organic Production Overview

Understanding the Blueberry Plant: Key to understanding production systems

The growing conditions for successful blueberry production are different from nearly any other woody perennial fruit crop grown in the United States. Understanding that blueberries evolved as a bog or marsh plant can go a long way to understanding the biggest challenges in blueberry production, whether the producer is organic or not.

As a marsh plant, the native blueberry thrives in acidic, moist soils. Because it did not need root hairs (a feature of most terrestrial plants) in the marsh, it never evolved root hairs. The otherwise-fibrous roots of the blueberry plant do some of the work of taking up water and nutrients, but specific fungal mycorrhizae, in a mutually beneficial relationship with the blueberry plant, do much of the water and nutrient uptake. The practical consequence of this fact is that growers must provide abundant water and maintain conditions favorable to the mutualistic fungal mycorrhizae. So, besides providing lots of water, the grower will need to maintain a low pH (acidic) in a high-organic-matter soil and not disturb that soil with cultivation, all factors necessary to preserve the mycorrhizae.

In addition to not having root hairs, the blueberry does not produce an extensive root system. In its natural marsh environment, nutrients and water come to the plant, especially with the aid of the mycorrhizae. Blueberry roots rarely extend much beyond three feet from the crown or soil surface. The negative side of this for the producer is that the plant is intolerant of weed competition. Also, any fertilizer materials must be applied under the plant canopy, just a foot or two from the main trunk. One positive aspect of this limited root system is that even large blueberry plants are easy to transplant, relative to other woody perennials.

Still on the topic of roots, a commercially significant root disease, incited by the fungal pathogen *Phytophthora cinnamomi*, is favored by standing water. This at first might seem paradoxical, but there is more water circulation in a marsh than might at first be apparent and there are natural drying-out periods even in most marshes. The upshot of this for the aspiring grower is that blueberries are at their healthiest and most productive on raised beds of sandy loam (or similarly well-drained) soil with nearly constant drip irrigation. In the early days of the Arkansas and Missouri Ozarks blueberry industry, phytophthora root rot was rampant, and afflicted plants were often easy to find simply by following plant rows across a hilly site: the disease was often limited to where the row dipped into a low spot, and plants on nearby higher ground might be completely unaffected.

One other characteristic of the blueberry, peculiar to its natural environment, is that the crucial plant

Shaping raised beds in preparation for planting. Photo: Ryan Neal, Neal Family Farm

nutrient nitrogen is not available in the nitrate form in acidic conditions, like those of a marsh. The blueberry plant needs its nitrogen in the ammonium form. Luckily, when organic matter breaks down, it "mineralizes" into ammoniacal nitrogen. In other words, organic growers who are already reliant on organic materials for nitrogen nutrition are automatically doing the right thing for their blueberry crop.

An understanding of the evolution and ecology of the blueberry plant should help the production details that follow fit into a comprehensive and comprehensible whole.

Choosing a Species

Blueberries are members of the genus *Vaccinium* and belong to the Rhododendron family (Ericaceae). The *Vaccinium* genus includes several species of economic importance. The highbush blueberry *(Vaccinium corymbosum)* is the most widely cultivated, grown from the Mid-Atlantic to California, Oregon, and Washington, and from the Upper Midwest to the Mid-South. The lowbush (wild) blueberry *(V. angustifolium)* is adapted to the far North and is commercially important in Maine, Eastern Canada, and parts of New Hampshire, Massachusetts, Michigan, and Wisconsin. Rabbiteye *(V. ashei)* is a large bush well-adapted to the South, in the region roughly south of Interstate 40. Southern highbush *(V. corymbosum x V. darrowi)*, a new hybrid, is adapted to the southern rabbiteye zone, as well as the coastal South. It has a lower chilling-hours requirement, and it flowers and fruits earlier than either highbush or rabbiteye varieties.

Blueberries have fewer pest problems than most other fruits, offering an advantage for organic production. In some areas, most insect and disease problems can be controlled through cultural manipulation and proper cultivar selection. Weather fluctuations and geographic seasonal advantage are the major economic considerations for variety selection.

Organic planting stock is required, if commercially available, for certified organic fruit production. If organic planting stock is not available, organic growers must document their search for organic stock and its lack of commercial availability. Most certifiers interpret the organic standards as requiring organic management of non-organic planting stock for at least 12 months before harvesting a crop that is to be sold as certified organic.

Climate Change and Blueberries

Like almost every other agricultural crop, blueberries are being hurt by climate change. Some of the problems are exactly what you'd expect: heat stress and drought. Heat stress can be alleviated somewhat by overhead sprinkler irrigation, but that's an added expense, since almost all highbush blueberry production is trickle irrigated. Wild blueberry production is especially vulnerable because, at least historically, they were not irrigated at all.

But perhaps the most serious challenge posed by climate change to blueberry production is the increasing prevalence of crop loss from freeze damage to blueberry blossoms. This is happening in both highbush and rabbiteye production areas because warmer winters are inducing earlier bloom—sometimes by as much as a month—and then late freezes, which occur roughly at the same time they always have, swoop in and destroy the tender blossoms, thereby damaging the crop.

Floating row covers can help keep tender blossoms a little warmer but can't be expected to protect much past a couple of degrees below freezing. Being able to overhead irrigate can protect down to 22°F. This frost threat is probably a common enough occurrence now that growers should strongly consider budgeting a frost-protection system from the outset.

Freeze-damaged blueberry flowers. The white flowers are undamaged. Photo: Ryan Neal, Neal Family Farm

Blueberry flowers under a protective layer of ice provided by overhead sprinklers. Photo: Ryan Neal, Neal Family Farm

Soils and Fertility

The Importance of Soil pH

Blueberries are distinct among fruit crops in their soil and fertility requirements. As members of the Rhododendron family, blueberries require an acidic (low pH) soil, preferably in the 4.8 to 5.5 pH range. When soil pH is appreciably higher than 5.5, iron chlorosis often results; when soil pH drops below 4.8, the possibility of manganese toxicity arises. In either case, plants do not perform well.

Blueberries have a relatively low nitrogen requirement and thrive on organic fertilizers.

Blueberries have a relatively low nitrogen requirement and thrive on organic fertilizers. Soil pH also plays a significant role in nitrogen management for blueberries. Research shows that blueberries prefer soil and fertilizer nitrogen in the ammonium form, absorbing and using it much more efficiently than nitrate nitrogen—the form preferred by most other commercial crop plants. Neutral and high-pH soils favor *nitrification*—the rapid conversion of ammonium nitrogen to nitrate through the activity of nitrifying microorganisms. In an acidic soil, however, the ammonium form of nitrogen predominates and is readily available to blueberries. For instance, when a slow-release organic fertilizer, like fishmeal, is applied, the nitrogen in the proteins is converted first into ammonium. This ammonium—which would rapidly convert to nitrate under neutral soil conditions and be leached out of the root zone—tends to remain in the desired, ammoniated form in acidic soil and thus be held in the soil for uptake.

The most common method of lowering soil pH in organic culture is by applying sulfur. Pre-plant incorporation of sulfur to lower the pH to an optimal blueberry range of 4.8 to 5.5 should be based on a soil pH test. Because soil pH is subject to considerable seasonal fluctuation—especially on cropped soils—it is advisable to do soil sampling and testing in winter or very early spring, when biological activity is low. Table 1 provides guidelines for sulfur or lime to raise or lower pH on different types of soil.

Single applications of sulfur should not exceed 400 pounds per acre. Best results are obtained by applying up to 200 pounds in spring, followed by up to 200 in the fall, for as many applications as are required to deliver the total amount. It is advisable to re-test the soil one year after each application to determine whether additional acidification is necessary (Pritts and Hancock, 1992).

Organic growers should be conservative in the application of soil sulfur. Sulfur has both fungicidal and insecticidal action and can detrimentally affect soil biology if overused. Organic growers usually add between five and 10 gallons of peat moss at planting time, since it too is a soil acidifier (pH 4.8), reducing the need for sulfur. While costly, peat is resistant to decomposition and provides the benefit of soil humus. Those seeking alternatives to sphagnum peat moss might consider pine bark or similar amendments incorporated in the planting rows or holes. While less desirable than sphagnum peat moss, pine bark often can be obtained locally at a much lower cost.

It is advisable to monitor soil pH over time because production practices can cause gradual changes to occur. Irrigation water often contains calcium and magnesium, which may cause soil pH to creep upwards, while repeated use of acidifying fertilizers, such as cottonseed meal, may lower pH. Fortunately, the presence of abundant organic materials, such as peat, and the breakdown products of sawdust and woodchip mulches tend to buffer soil pH. Several organic growers have even observed that blueberries grown in high-organic-matter soils will perform well at a pH as high as 6.0 with few apparent problems. As a result, additional sulfur (or lime, for that matter) seldom is needed. When needed, sulfur is usually applied as a top dressing, but delivery of soluble sulfur through drip irrigation lines also is an option. Vinegar or citric acid solutions

Table 1: Approximate pounds per acre of sulfur or ground limestone to change soil pH one unit

Soil Texture	Pounds per acre of sulfur to lower soil pH one unit (e.g., 6.0 to 5.0)	Pounds per acre of lime to raise soil pH one unit (e.g., 4.0 to 5.0)
Sand (CEC=5)	435 to 650	1,000
Loam (CEC=15)	870 to 1,300	2,800
Clay (CEC=25)	1,300 to 1,750	4,400

may also be applied through drip lines to provide acidity, but such changes are generally short-lived and will probably need to be repeated often, as indicated by soil tests.

Blueberry Fertilization Practices

Soil-building practices prior to establishment can go a long way toward providing the fertility necessary for a healthy blueberry planting. High levels of soil organic matter are especially important in blueberry culture, contributing to the soil's ability to retain and supply moisture to the crop, buffering pH, and releasing nutrients through decay. Soils rich in organic matter are also a desirable environment for symbiotic mycorrhizal fungi that assist blueberry roots in absorbing water, nitrogen, phosphorus, and other minerals (Yang et al., 2002). Utilizing green manures in advance of planting can play an important part in cycling organic matter into the soil system, as can applications of composts and livestock manures. ATTRA has several publications that can be useful in these areas, including *Overview of Cover Crops and Green Manures, Manures for Organic Crop Production,* and *Composting: The Basics.*

Once a blueberry planting is established, it is possible to apply supplemental fertilization in a number of forms and by several means. Generally, supplemental nitrogen is the greatest concern, followed by potassium. Blueberries have a low phosphorus requirement and typically require little, if any, phosphorus fertilization. In fact, excessive phosphorus has been one of the factors linked to iron chlorosis in blueberries. High calcium levels are also undesirable.

Nitrogen fertilizer recommendations vary somewhat from region to region. As a general guideline, 100 to 120 pounds of nitrogen per acre are commonly recommended on mulched berries; a reduced rate of 50 to 60 pounds per acre is advised where little or no mulch is used. In conventional production, nitrogen is often applied in three split applications—one at bud break, followed by two more at six-week intervals. Adjustments may be necessary for less-soluble organic fertilizers. One rule of thumb suggests that these fertilizers be applied from one to four weeks ahead of the recommended schedule for soluble fertilizers. This allows additional time for the decomposition processes to make nutrients available. Applications after mid-July are discouraged, as they tend to promote late growth that is particularly sensitive to freeze damage. Table 2 shows natural materials used by organic growers for supplementary fertilization.

Maces Pond: Agrisolar Wild Blueberries

A new field of endeavor, agrisolar, combines agricultural and solar production on the same land. On a wild blueberry farm in Rockport, Maine, a solar array has been installed over 11 acres of blueberry plants in a first-of-its-kind project. The shade of the panels may reduce harvests, but the goal is to find a balance between electricity production and blueberry production. The data collected from research being done on this site and lessons learned from it could inform future projects and open the door for other wild blueberry landowners in Maine to diversify their income with the addition of solar energy production.

Dr. Lily Calderwood, a horticulturalist at the University of Maine, will continue to collect data on shade levels, soil temperatures, plant density, insect and weed pressures, blueberry bud and fruit counts, crop yield, berry size, and more through 2024. That research is funded through a Northeast SARE Novel Approach grant, and more information about the project and Dr. Calderwood's research can be found at the University of Maine Cooperative Extension page, "Dual-use Solar and Wild Blueberry Production" at extension.umaine.edu/blueberries/agrivoltaics/.

Table 2. Natural materials for supplementary fertilization *(Penhallegon, 1992)*

Material	Estimated N-P-K	Characteristics
Alfalfa meal	3-1-2	Slow to medium N release Good micronutrient source
Blood meal	12-1.5-0.6	Medium N release, 6-8 weeks
Cottonseed meal	6-2.5-1.7	Slow N release, 4-6 months
Feather meal	13-0-0	Slow N release, 4-6 months
Fish meal	10-4-0	Slow N release, 4-6 months
Soybean meal	7-1.6-2.3	Slow N release, 4-6 months
Compost	Variable	Analysis depends on feed stock
Fortified compost	Variable	Analysis depends on materials added

The best way to determine whether fertilization rates are "on target" is to test foliar nitrogen levels annually. This testing is done in late July or early August (in Arkansas), by sampling leaves from the mid-shoot area on fruiting canes and sending them to an analytical laboratory. Lab results showing nitrogen levels below 1.6% indicate a nitrogen deficiency; a level above 2.2% indicates excess nitrogen. This service is available through Cooperative Extension in most states.

Potassium for blueberries is often adequately provided through decaying mulches. The need for further supplementation should be determined by soil and/or tissue testing. Where additional potassium is needed, it can be applied in a number of mineral forms—including sulfate-of-potash-magnesia or K-Mag™, granite meal, and greensand. Some forms of potassium sulfate are also allowed in organic production. Consult your certifier before buying fertilizer.

High-quality compost is a good all-around blueberry fertilizer. Depending on the humus condition and biological activity in the soil, compost may provide all the fertility needs of the crop. Where compost is of average quality, it may still function as a good soil conditioner. Using aged animal manures in blueberry production also is possible, but less common. Unlike the roots of grapes and bramble fruits, which grow well into the inter-row area, blueberry roots are not very extensive. As a result, all fertilizers and acid-forming amendments must be applied under the plant canopy to ensure that they reach the roots.

Foliar feeding of blueberries is practiced by some organic growers and is especially helpful when plants are stressed. Foliar fertilization programs usually employ seaweed and fish emulsion.

A steam-weeding device at the Arkansas blueberry farm of Megan and Matt (pictured) Varoz. Photo: Guy Ames, NCAT

Cultural Considerations

Inter-row Management

Blueberries do not have extensive root systems. As a result, clean cultivation of row middles to control weeds and to incorporate cover crops is less damaging to blueberries than it is to bramble fruits. Still, it is wise to till no deeper than three inches. Similarly, inter-row living mulches—also called *sodded middles*—generally are not competitive with the crop unless the inter-row species are aggressive and invade the rows. Fescue is commonly used in the Mid-South for sodded middles, as are several other grass species. Further north, perennial ryegrass or orchard grass would be good choices. The grower should avoid grasses that spread by stolons or rhizomes, like bermudagrass in the South and quackgrass in the North. Such grasses can spread into the blueberry rows and become a competitive nuisance.

Timely mowing—usually three to five times per year—is the common means of controlling weeds and other vegetation in sodded middles. It is most important that weeds not be allowed to produce seed that may be scattered into the rows and germinate later.

In a Texas study, researchers demonstrated that the inter-row area could be used to produce significant quantities of mulch for rabbiteye blueberries. Successful winter crops of rye, ryegrass, and crimson clover, as well as a summer crop of pearl millet, were grown, cut, and windrowed onto the blueberry rows (Patten et al., 1990).

Flame, steam, and infrared thermal weed-control systems are other organically approved weed-management options.

In-row Weed Management and Mulching

Weeds are considered by many growers to be the number-one problem in organic blueberry culture. It is especially important to control aggressive perennial weeds such as johnsongrass, bermudagrass, and quackgrass prior to crop establishment. Sites with these grasses should generally be avoided for blueberry establishment. For more information on weed-control options, see ATTRA's *Tree Fruits: Organic Production Overview.* Some techniques, however, deserve additional elaboration.

In much of the country, blueberries are grown on mulched, raised beds. Rabbiteyes and older highbush plantings are sometimes grown without mulch. Raised beds reduce the incidence of soil- and water-borne diseases (e.g., phytophthora root rot). Thick organic mulches provide weed and disease suppression, soil temperature regulation, slow-release nutrients, organic matter, and moisture conservation. This last is especially important because blueberry roots lack root hairs—the primary sites for water and mineral absorption on most plants.

Given the limitations of blueberry roots, researchers determined that an optimum vegetation-free zone during the first two to three years of growth extends roughly 1.5 to 2.5 feet from the plant. This translates to a 3- to 5-foot-wide, weed-free row bed.

Current recommendations suggest mulching a 3- to 4-foot-wide strip under the plants with three to five inches of sawdust, bark, wood chips, or wood shavings. Organic growers often prefer a deeper mulch: up to six inches over a strip at least four feet wide. Ideally, the mulch should be sufficiently coarse to minimize crusting and allow for air exchange and the surface relatively flat to encourage water penetration.

Although the mulch suppresses many weeds, the moist organic medium can also become a haven for annual weeds (annual ryegrass, stinging nettle, crabgrass), as well as perennial weeds (dandelion, horsetail, sheep sorrel) that find a niche in perennial plantings. Strategic attention to weed control, even in mulched fields, is a major cultural consideration. Tractor-drawn cultivation implements are impractical for in-row weed control on deep-mulched blueberries because blueberry roots often grow into the mulch, and significant plant damage can result from tillage. Shallow hoeing or hand-pulling weeds are two traditional options practiced by many organic growers.

One alternative to organic mulching is the use of fabric weed barriers. While fabric mulches may not provide all the benefits of deep organic mulch, they are highly effective for weed control and allow water to pass through. And, though the initial cost is high, it may prove reasonable when amortized over the fabric's expected lifetime of 10 to 12 years. However, by organic rules, all fabric mulches must be removed before they deteriorate and decompose into the soil. Have a plan in place to deal with this eventuality.

Pollination

Pollination will be the same for organic and conventional growers; therefore, it won't be much discussed in detail here. However, because honeybees are not the most effective pollinators for blueberries, having a variety of pollinators like horn-faced bees, mason bees, carpenter bees, bumblebees, orchard bees, and others is important for good fruit set. See the NC State Extension post "Which Bees Are the Best Blueberry Pollinators" for more information.

Managing nearby vegetation for a variety of pollinators can be helpful in ensuring good pollination. Additional information on using various bees as pollinators can be found in ATTRA's publication *Alternative Pollinators: Native Bees.*

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Insect Pests

Although insect damage in blueberry plantings rarely reaches economic thresholds, regular monitoring by scouting and use of insect traps is advisable. In general, rabbiteye blueberries seem more tolerant of insect damage than highbush varieties.

As discussed in the previous section, the use of beneficial insect habitats along crop field borders increases the presence of beneficial insects. If you are releasing purchased beneficial insects, these field-edge habitats will encourage them to remain and continue their life cycle in that location, helping reduce the pest populations. However, pests may also inhabit the field-edge habitats; therefore, these habitats should be monitored along with the crop field. For additional information,

see ATTRA's publication *Farmscaping to Enhance Biological Control.*

Depending on the locations of blueberry plantings and the insect pressure on them, sanitation, good cultural practices, vigorous plant growth, and natural biological control will handle most pests. However, when specific pests reach economically damaging levels, additional action is necessary.

Blueberry Maggot

The most common insect pest is the blueberry maggot, *Rhagoletis mendax.* It attacks the fruit in midsummer before harvest and feeds on all varieties of blueberries. It is found throughout the eastern United States and Canada. This pest overwinters in the pupae stage, buried one to two inches in the soil. The adult flies emerge over a period of a month or two during summer. They lay eggs in ripe berries, and the maggots eat the pulp of the fruits, causing many to drop, spoiling the sale of others, and creating difficulties in post-harvest care.

The choice of blueberry varieties can influence the severity of blueberry maggot damage. In a Rhode Island study, the early-ripening varieties Earliblue and Bluetta were found to have fewer maggots than late-maturing varieties whose ripening periods were synchronized with the fly's egg-laying period. Of the mid- to late-season varieties, Northland and Herbert stood out with less damage (Liburd et al., 1998).

Blueberry maggots on fruit (adult fly, top; maggots, bottom). Photos: Jerry A. Payne, USDA Agricultural Research Service

The botanical insecticide pyrethrum can be effective in controlling blueberry maggots, but it can also be toxic to beneficial insects. The spinosad-type insecticide Entrust™ is approved for use on organic crops, including blueberries, and has been reported effective against the blueberry maggot. Additionally, disking, cultivating, and off-season grazing by fowl can reduce pupa populations.

Spotted Wing Drosophila

The spotted wing drosophila (SWD), *Drosophila suzuki,* is a tiny fruit fly or gnat similar and related to the little vinegar flies often found on produce—especially bananas—left on the kitchen counter. The big difference between the common household vinegar fly and the SWD is that the former will only attack overripe and/or fermenting fruit, while the latter readily attacks undamaged fruit in the field. Adult female SWD can lay eggs directly into thin-skinned fruit using a saw-like ovipositor to cut open a slit in the fruit. The eggs then hatch and the young maggots feed inside the fruit, inciting rot and fermentation.

The SWD was accidentally introduced from Japan around 2008, and, like other such exotic, introduced pests, without its natural controls, it spread widely and quickly. It can now be found almost anywhere outside the desert and mountain states. USDA entomologists were quick to begin exploring for natural enemies in the pest's native range, and some have been introduced and released in the United States, but it will be some time before these can spread and effect commercial levels of control.

In the meantime, SWD is somewhat difficult to control organically, but Entrust™, Grandevo™, and Venerate™ are all effective and approved for organic production. It's important to rotate every so often among these biocontrol materials, as the SWD is quick to develop resistance if a single one is overused. Because the SWD is small and could be overlooked, traps have been developed to alert the grower to the pest's presence and indicate if and when to spray. Search online for "spotted wing drosophila traps" to find sources (there are many).

Blueberry Stem Borer

This beetle, *Oberea myops,* causes damage in two ways. First, egg deposits can cause the first three to four inches of the current season's growth

to wilt or die. This is evidenced by girdling in two places, approximately ½ inch apart, on the injured twig. Secondly, grubs can cause canes to die. Leaves will turn from green to yellow and drop off, and the cane will die. Pinholes along the shoot with yellowish strings hanging from them are indicative of this problem.

Cranberry Fruitworm

Particularly troublesome in the northeastern United States, the cranberry fruitworm affects both cranberries and blueberries. It overwinters in the soil as a fully grown larva and completes development in the spring. Adult moths mate and lay eggs from bloom until late green fruit, usually on unripe fruit. The eggs are very small and difficult to see. Young larvae enter the stem end of the fruit and feed on the flesh. They often web berries together with silk.

A Michigan study reports that many parasites attack the cranberry fruitworm. The most common larval parasitoid is *Campoletis patsuiketorum* (Hymenoptera: Ichneumonidae); the most common parasitoid recovered from the fruitworm's hibernating structure was *Villa lateralis* (Diptera: Bombyliidae) (Murray et al., 1996). Therefore, maintaining refugia by enhancing field borders for beneficial insects and practicing proper sanitation are especially important in controlling this pest. Additionally, eliminating weeds and vegetative litter around plants helps cut down on overwintering protection for fruitworm cocoons.

Cranberry fruitworm larva (top). Photo: Natasha Wright, Bugwood.org; Cranberry fruitworm moth (bottom). Photo: Jerry A. Payne, USDA Agricultural Research Service

The biocontrol *Bacillus thuringiensis* (Bt) can effectively control cranberry fruitworm. Make sure to use a Bt product approved for organic production. In addition, the spinosad insecticide Entrust™ is registered for use against the cranberry fruitworm and cherry fruitworm on blueberries.

Cherry Fruitworm

The cherry fruitworm, *Grapholitha packardi,* which bores into the fruit and feeds extensively below the surface, can be very damaging to blueberries. It causes injury within a few days of hatching. This pest overwinters as mature larvae in hibernating structures on the blueberry bushes, with larvae pupating in the spring. The adults appear in about a month (this varies by seasonal conditions). Adult moths mate and lay eggs on unripe fruit. Pruning and burning the cut limbs helps control the cherry fruitworm, because the hibernating larvae are contained in these limbs. The cherry fruitworm is a lepidopteran pest, and organically approved control products include Bt or the spinosad product Entrust™.

Japanese Beetle

The Japanese beetle larvae develop in pastures, lawns, and other types of turf, where they live in the soil. Adults emerge in early summer and feed on blueberry foliage and berries, causing injury to the berries, as well as decay from fruit-rotting pathogens.

Organic growers use a number of methods to control these pests. Hand picking, trapping, milky spore disease, and/or beneficial nematodes have all been used by growers with varying degrees of success. The key practices are the use of milky spore (which provides a long-term approach to larvae reduction), trapping away from the crop, and regular emptying of the traps.

Japanese beetle skeletonizing a leaf. Photo: University of Maryland Cooperative Extension

In a Michigan study, fields with tilled row-middles had significantly fewer larvae than those with permanent sod, and larval abundance was significantly lower on the interiors of the fields compared to the perimeters (Szendrei et al., 2001). Clean row middles may have fewer Japanese beetle larvae, but they also leave the soil open to erosion, so this option should be used only on level fields.

Kaolin clay, available in the product Surround, can be used for suppression of the Japanese beetle only on blueberries that will be processed.

Leafroller

Leafrollers are the caterpillars of a few species of small moths. These pests roll leaves (hence their name) to use as shelter during their metamorphosis. Adults emerge, mate, lay eggs, and then repeat the cycle at least twice each year. Larvae feed on green berries, ripe berries, and leaves. Small numbers of leafrollers (fewer than 15 per plant) usually will not cause significant losses, unless they are feeding on blossoms (Elsner and Whalon, 1985).

The pesticide Bt var. kurstaki can be applied when insects are feeding. Additional organically accepted strains of Bt can be effective at egg hatch, becoming less effective as larval size increases.

Neem products act as an insecticide and insect growth regulator affecting young caterpillar pests like leafrollers.

Leafhopper

Leafhoppers are small, mobile insects that are often found on stems or the undersides of leaves. They feed by piercing the plant surface to suck plant juices. Leafhoppers transmit a microorganism that causes blueberry stunt disease. In areas where stunt disease is a known problem, leafhopper control is suggested. Insecticidal soap and diatomaceous earth are reported to be effective against these pests. Surround (for processing blueberries) and neem are registered for leafhopper control on blueberries. Kaolin clay in Surround can be used for suppression of leafhoppers on processing blueberries only.

Aphids

Aphids, or plant lice, are related to the leafhopper. They feed on the undersides of the youngest leaves and on tender shoots, and they reproduce very rapidly. Aphids can transmit blueberry shoestring virus, which can be very damaging to commercial blueberry producers. Aphids have many natural enemies, like ladybugs, lacewings, and parasitic wasps. Encouraging these natural enemies with habitat plantings can keep aphids and other pests on blueberries below economic thresholds. Remove the virus-infected plants, which will have bright red streaks or straplike leaves. Avoid overfertilization of the crop. Organic growers can also use insecticidal soap to control aphids.

Diseases

Diseases in plants occur when a pathogen is present, the host is susceptible, and the environment is favorable for the disease to develop. Changing one of these three factors may prevent the disease from occurring. Pathogens responsible for blueberry diseases include fungi, bacteria, nematodes, and viruses. If these pathogens are present, manipulation of the environment and the host—to make it less susceptible—help to manage diseases on blueberries in a more sustainable manner.

Managing soil health is key for successful control of soil-borne diseases. A soil with adequate organic matter can house large numbers of organisms (e.g., beneficial bacteria, fungi, amoebas, nematodes, protozoa, arthropods, and earthworms) that, in conjunction, deter pathogenic fungi, bacteria, nematodes, and arthropods from attacking plants. These beneficial organisms also help foster a healthy plant that is able to resist pest attack. For more information, see the ATTRA publication *Sustainable Management of Soil-borne Plant Diseases.*

A soil with adequate organic matter can house large numbers of organisms (e.g., beneficial bacteria, fungi, amoebas, nematodes, protozoa, arthropods, and earthworms) that, in conjunction, deter pathogenic fungi, bacteria, nematodes, and arthropods from attacking plants.

Botrytis Blight-infected flower clusters. Photo: Caleb Slemmons, Bugwood.org

A blueberry diagnostic tool from Cornell University has a step-by-step exercise that can aid a blueberry grower in determining what diseases may be affecting the crop.

Diseases common to blueberries include mummy berry, Botrytis blight (gray mold), stem blight, stem canker, phytophthora root rot, blueberry stunt, and several viral diseases. For proper disease identification, consult Cooperative Extension Service publications and related literature. Many states also have plant pathology laboratories associated with their land-grant university that can provide diagnosis.

Foliar diseases

Mummy Berry

(Monilinia vacinii-corymbosi)

This fungus overwinters in mummified berries that have fallen to the ground. Sod or moss directly under the plant contributes to spore production. To control this fungus, remove infested fruit ("mummies") from the plant, rake and burn mummified berries, or cover the fallen berries with at least two inches of mulch. Cultivation during moist spring weather will destroy the spore-forming bodies. Strategies that lead to early pollination of newly open flowers may be useful in managing mummy berry disease in the field, since studies show that newly opened flowers are the most susceptible to infection and that fruit disease incidence is reduced if pollination occurs at least one day before infection (Ngugi et al., 2002).

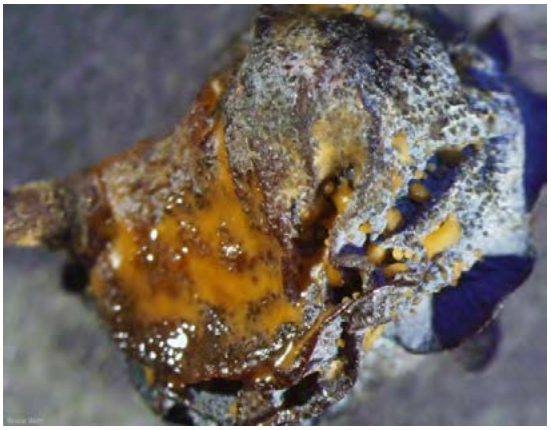
The fungus survives the winter on dead twigs and in organic matter in the soil. The disease is more severe when excessive nitrogen has been used, where air circulation is poor, or when frost has injured blossoms. Varieties possessing tight fruit clusters are particularly susceptible to this disease. Remove dead berries, debris, and mulch from infected plants during the winter and compost or destroy it. Replace with new mulch, and do not place mulch against the trunk of the plant.

Highbush blueberry varieties are more resistant to mummy berry than are rabbiteye. Rabbiteye varieties that showed lower levels of infection were Coastal, Delite, Centurion, Walker, Callaway, and Garden Blue (Ehlenfeldt et al., 2000). Highbush varieties that exhibited constant resistance to mummy berry were Northsky, Reka, Northblue, Cape Fear, Bluegold, Puru, and Bluejay (Stretch and Ehlenfeldt, 2000).

Anthracnose

(Collectotrichum acutatum and *C. gloeosporioides)*

This fungus overwinters in dead or diseased twigs, fruit spurs, and cankers. Spores are released in the spring and are spread by rain and wind. Varieties in which the ripe fruit hangs for a long time on the bush prior to picking are especially susceptible. Removal of infected twigs by pruning and frequent harvesting is beneficial to control. Old canes and small twiggy wood should be removed in order to increase air circulation around the fruit clusters. Immediate postharvest cooling significantly reduces the incidence of this disease.



Anthracnose-infected fruit, oozing out of berry. Photo: Bruce Watt, Bugwood.org

Stem Blight

(Botryosphaeria dothidea)

Stem blight shows up as a wilting, browning, or reddening of the infected leaves, which frequently

Mummy berry (left). Mummy berry with apothecia (center). Infected leaves and flower bud (right). Photos: Gerald Holmes, Bugwood.org

precedes the death of the plant. This is a vascular disease that most often starts from a wound infection site. The most typical symptom would be a flag (limbs killed by the disease that do not drop their leaves). The stems can be cut open to reveal a light-brown discoloration.

Removal of infected wood, pruning about 12 inches below the discolored part of the limb, is the only practical control for *Botryosphaeria* stem blight. Because infection can spread throughout the growing season, growers should prune during dormancy. Fertilizer management is necessary to prevent the formation of succulent shoots late in the season. Infection of cold-injured shoots around the base of the bush is a primary way for this fungus to enter the plant. The worst cases of stem blight occur on soils that are extremely sandy or on heavy peat soils that promote excessive growth. Clove oil inhibits fungal growth and spore germination of *Botryosphaeria dothidea* and could be effective in controlling this disease on several woody plant species, such as blueberry (Jacobs et al., 1995). Be certain any clove-oil product you use is allowed in organic production.

Rust

(Pucciniastrum vaccinii)`

Rust is a serious leaf-defoliating problem for southern highbush blueberry varieties. The first yellow leaf-spot symptoms appear in late spring to early summer. The yellow spots turn reddish-brown as yellow to orange pustules show up on the bottom sides of leaves. Finally, the infected leaves turn brown and drop off prematurely. Remedial action includes removing and burning infected vegetation. Multiple reinfestations are possible during one growing season. Native evergreen berries (but not hemlock) are suspected as the overwintering source and a necessary alternative host for completion of the fungus life cycle. It may be beneficial to remove native species in the *Vaccinium* genus—which include sparkleberry, huckleberry, gooseberry, and bearberry—from areas adjacent to cultivated bushes.

Phytophthora Root Rot

(Phytophthora cinnamomi)

Root rot occurs more often on southern highbush plants than on rabbiteyes. The first symptom is general unthriftiness leading to yellowing and reddening of leaves. Necrosis will appear on small rootlets and progress to a discoloration on the main roots and crowns. Eventually, the plants will drop their leaves and die. Controls include use of clean nursery stock and good field drainage. Heavy soils that become waterlogged or have a high water table should be avoided. Plants can be grown on raised beds to reduce risks. Varieties resistant to *Phytophthora* include the rabbiteyes Premier and Tifblue and the highbush Gulf Coast (Smith and Hepp, 2000).

Blueberries' shallow roots may benefit from the soil-disease suppressive qualities of an organic mulch.

Phomopsis Twig Blight

(Phomopsis species)

Tip browning and dieback are classic symptoms of this disease. Then, elongated brownish cankers up to four inches long appear on stems. The fungus overwinters in infected plant parts. Spores are released from old cankers in the spring; rain is necessary for spore release. Temperatures ranging from 70 to 80°F encourage infections, and moisture stress predisposes the plant to infection. The disease is most severe after winters in which mild spells are interspersed with cold periods. Growers should prune and destroy infected plant parts. Avoid mechanical damage such as that caused by careless pruning and cultivating. Avoid moisture stress by using irrigation during dry periods. A fall application of lime sulfur after the leaves have dropped helps reduce disease spores. Spring application of lime sulfur should be made early, before warm weather occurs, to avoid injury to plants. Refer to your state's spray guide for recommended rates and timing. Careful variety selection can greatly reduce the severity of twig blight. For instance, the varieties Elliott and Bluetta have proved resistant to *Phomopsis* twig blight (Baker et al., 1995).

Fusicoccum Canker

(Fusicoccum species)

Fusicoccum is a stem disease that causes dieback and general plant decline. This fungus overwinters in cankers. Spores are largely disseminated by rainwater, and cold stress may play a part in increasing disease damage. Removal of infected plant parts is essential for control. Varieties differ in their resistance to this disease.

Viral Diseases

Control of vectors, like aphids and leafhoppers, and sanitation of pruning and propagating materials are important steps in controlling viral

diseases. Once a plant is infected, diagnosing it and culling it from the field is critical to prevent the virus from spreading.

Shoestring Disease

Symptoms appear as red discoloration in the mid-vein of a leaf, which then develops abnormally into wavy, distorted, or crescent shapes. Other than buying disease-free plants, destroying wild plants near the planting, and removing diseased plants, control does not exist.

Stunt

With this disease, plants lose vigor and become yellowish and dwarfed. The yellow-tipped leaves remain small, rounded, and often puckered. The only known carrier is the sharp-nosed leafhopper, though other vectors probably exist. Diseased bushes cannot be cured. They must be removed from the field as soon as they are diagnosed. Agitation of the bush during removal will dislodge the leafhoppers, causing them to move to a neighboring healthy bush.

If stunt has occurred in a planting, after removing affected plants, targeting the leafhoppers with an organic pesticide like insecticidal soap and/or neem is the best (and only) preventative. If you have a known problem with stunt and leafhoppers, employing both soap and neem would be indicated because the soap will kill leafhoppers at application but has little to no residual effects, while the neem is slow to work but can provide longer-lasting suppression.

Scorch Virus

This virus causes severe dieback, blossom blighting, and significant yield reduction on susceptible varieties, eventually killing its host. First, the flowers turn brown and fade to a greyish color before they fall off, though with the West Coast strain of the virus, the dried flowers can be retained on the bush for more than a year. Production drops off and the plants do not recover. The virus is spread by aphids or by planting infected stock. The first line of defense is to plant virus-free stock obtained from a nursery that undergoes regular virus testing. Otherwise, remove infected plants when symptoms appear and after the disease has been diagnosed by testing. Also, control aphids in the blueberry field. Replant with virus-free stock. Most university Extension Service state offices have a disease-diagnostic service for plant samples.

Bird and Rodent Control

Birds are a very common pest of blueberries. There are no synthetic chemical controls registered for birds, so controls in both organic and conventional blueberry are the same. Consult any blueberry production manual. Cornell University's *Highbush Blueberry Production Guide* provides a good overview of bird management.

For details on options for bird and rodent control, please refer to ATTRA's *Tree Fruits: Organic Production Overview* and ATTRA's *Vertebrate IPM Tipsheet Series.* Cooperative Extension and the U.S. Fish and Wildlife Service also have information on rodent and bird control.

Marketing

There are a number of marketing options for organic blueberries. Fresh blueberries can be marketed directly through roadside stands, U-Pick operations, on-farm sales, and farmers markets. There are also well-established wholesale markets for both fresh and frozen blueberries.

Although highbush blueberries are grown for both fresh fruit and processing markets, more than half of the cultivated blueberries grown in the United States are sold as fresh blueberries. Because returns to the grower usually are higher for fresh berries, most organic growers choose that option.

As local retail markets become saturated, many growers also sell their berries wholesale, through growers' cooperatives. This is a common option

A clever and memorable logo on all its merchandise enhances a farm's sales in the community. Photo: Ryan Neal, Neal Family Farm

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for organic growers, especially where organic collectives have helped to identify premium markets. Some value-added processing options include frozen berries, jams, and juice.

A breakthrough in value-added marketing came in the late 1990s, when scientific research indicated special health benefits associated with blueberry consumption. More farmers are now looking at marketing blueberries as a healthy "functional" food that contains flavonoids, vitamin C, anthocyanins, antioxidants, and phenolic acids.

For more information about marketing options, see the ATTRA publications *Direct Marketing, Farmers Markets: Marketing and Business Guide,* and *Adding Value to Farm Products: An Overview.* On-farm, value-added blueberry products usually require setting up a rural enterprise besides farming and may entail considerable additional planning, management, and start-up expense. Co-packers are an alternative to doing your own processing.

Blueberries are expensive to establish and maintain, so growers might not realize a return on their capital investment until the fifth year or even later. However, well-maintained blueberry bushes can remain productive for at least 15 to 20 years and possibly as many as 40 to 50 years with good management.

Blueberries are a popular "U-Pick" crop. When acreage exceeds the capacity of U-Pick customers, whether five or 15 acres, hired labor becomes necessary. One rule of thumb suggests that 10 to 15 pickers per acre are required during the height of the harvest season.

Additionally, the Wild Blueberry Association of North America (WBANA) promotes marketing and is an excellent source of information on production practices.

Economics

Organic blueberries typically sell for about 15 to 20% more than conventionally grown blueberries.

Highbush blueberries usually start producing in the third season, and yields increase annually for the next four years. At full capacity, blueberries yield about three tons per acre. As blueberries are expensive to establish and maintain, growers might not realize a return on their capital investment until the fifth year or even later. However, well-maintained blueberry bushes can remain productive for at least 15 to 20 years and possibly as many as 40 to 50 years with good management.

Blueberries ripen fairly predictably, according to the region in which they are grown. In heavy bearing years, wholesale market prices can drop dramatically, with early-bearing regions faring well and late-bearing regions doing poorly. Harvest patterns follow a sequence, beginning with rabbiteyes from Georgia and Texas, followed by highbush berries from North Carolina and the Southern Interior Highlands (Arkansas, Tennessee, Kentucky, and Missouri). These are followed by the Northern Interior Highlands, New Jersey, and so on. Washington state, now the national leader in blueberry production, begins harvesting in mid-late July, about the same time that Michigan blueberries are ripe. In years of overproduction, harvest prices do not even cover the cost of picking. Therefore, factors affecting local supply (such as late spring frost and the number of blueberry farms in your area) can play a major role in profitability.

Blueberries are a highly perishable crop, and efficient post-harvest handling is critical. Berry flats should be quickly refrigerated following harvest. For the commercial grower, a walk-in cooler is a must.

Because cost and return estimates vary by producer, by state, and from year to year, developing a budget is best done using an interactive template that allows the operator to plug in their own numbers, such as those provided by Penn State University and listed in the Further Resources section.

Conclusion

Blueberries are a viable cash crop for organic growers. Diseases and pests are few, but as a marsh plant in its native environment, any blueberry planting needs an acidic, high organic matter soil and lots of available water. Weeds can be problematic for the organic grower, but heavy mulch on raised beds with non-creeping grasses in the row middles simplifies weed control considerably. Fertility demands are not high, but pH must be kept low and will likely require applications of sulfur in accordance with periodic soil tests.

Blueberries are in high demand, but fruit is perishable, so must be marketed quickly. Post-harvest refrigeration should be available.

Like other perennial fruit crops, blueberries don't start bearing until a few years after planting, so there is a corresponding gap between initial investment and returns on that investment.

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Further Resources

Print and Electronic

2022 Organic Production and IPM Guide for Blueberries
New York State Integrated Pest Management Program
ecommons.cornell.edu/items/feb3e6a8-1d7d-4977-95cf-8fe75fc1d633

This published guide for organic blueberry production is an outline of cultural and pest management practices is available online in PDF.

The Berry Diagnostic Tool
Cornell University, blogs.cornell.edu/berries

A pictorial aid to diagnosing physiological disorders and pest problems of berry crops.

Blueberries Database
Michigan State University Extension
canr.msu.edu/blueberries/index

An extensive online collection of information resources, sorted by topic. Topics include weed management, insect management, disease management, horticulture, economics, and more.

The Blueberry Bulletin, Rutgers Cooperative Extension
njaes.rutgers.edu/blueberry-bulletin

The Blueberry Bulletin is produced on a weekly basis during the growing season and contains information on all aspects of highbush blueberry production and marketing. Archives are available online.

Blueberry Gall Midge, Featured Creatures
University of Florida IFAS
entnemdept.ufl.edu/creatures/fruit/blueberry_gall_midge.htm

A detailed introduction to a recently discovered pest of rabbiteye blueberries in the southeastern United States.

The Blueberry News
Florida Blueberry Growers Association
floridablueberrygrowers.org/newsletter

This is the free, quarterly newsletter of the Florida Blueberry Growers Association.

Blueberry Pest Management
University of Michigan
isaacslab.ent.msu.edu/blueberries

Reports on current pest management research on blueberry pests.

The Changing Landscape of U.S. Strawberry and Blueberry Markets: Production, Trade, and Challenges from 2000 to 2020, USDA Economic Research Service
ers.usda.gov/webdocs/publications/107358/eib-257.pdf?v=8855.1

A report on changes in domestic production, consumption, prices, and trade for strawberries and blueberries over two decades, with a section specifically on organic blueberries.

Disease Resistance in Blueberry Cultivars Commonly Grown in Kentucky
University of Kentucky Cooperative Extension
uky.edu/Ag/kpn/kpn_02/pn020128.htm#fruit

A chart that summarizes resistance to seven common diseases among 34 blueberry cultivars.

Florida's Commercial Blueberry Industry
University of Florida IFAS Extension
edis.ifas.ufl.edu/publication/AC031

This publication takes a look at cultivars, profitability, and trends for blueberry production in Florida.

Fruit and Nut Review: Blueberries
Mississippi State University Extension
extension.msstate.edu/sites/default/files/publications/information-sheets/is1448_0.pdf

This publication on blueberry production contains helpful descriptions of different varieties of rabbiteye blueberries.

Highbush Blueberry Production
Penn State Extension
extension.psu.edu/highbush-blueberry-production

A good general reference that offers sample budgets and budget worksheets.

Massachusetts Berry Notes
University of Massachusetts Amherst
ag.umass.edu/fruit/berry-notes-archive

This website contains the back-issue archives of UMass Extension Fruit Program's monthly Massachusetts Berry Notes newsletter.

Midwest Small Fruit Pest Management Handbook
The Ohio State University
extensionpubs.osu.edu/midwest-small-fruit-pest-management-handbook

This handbook for Midwestern fruit growers contains information on small fruit production methods and pest management practices.

National Integrated Pest Management (IPM) Database
USDA Ag Data Commons
data.nal.usda.gov/dataset/national-integrated-pest-management-ipm-database-ipmdata

This database offers science-based, decision-making process that identifies and reduces risks from pests and pest management-related strategies.

Opportunities and Challenges of Highbush Blueberry Production in Washington State
HortTechnology, Vol. 25, No. 6
journals.ashs.org/horttech/view/journals/horttech/25/6/article-p796.xml

This published study explores opportunities and challenges related to organic blueberry production and marketing and describes trends in organic highbush blueberry production using Washington State as a case study.

Organic Blueberries
University of Kentucky Cooperative Extension
uky.edu/ccd/sites/www.uky.edu.ccd/files/organicblueberries.pdf

In addition to production considerations, this publication addresses marketing, labor, and economic considerations for organic blueberries.

Organic Wild Blueberry Production
University of Maine Cooperative Extension
extension.umaine.edu/blueberries/factsheets/organic/304-organic-wild-blueberry-production

Reports on the results of a study on pruning, soil management, and organic fertilizer application for wild, or lowbush, blueberries.

Organic Blueberry Production in Florida
University of Florida IFAS Extension
edis.ifas.ufl.edu/publication/HS1400

Detailed information on organic production, including listings of cultural and organically approved chemical controls for weeds, pests, and diseases.

Organic Production Systems in Northern Highbush Blueberry (Oregon State University)
HortScience, Vol. 52, No. 9
horticulture.oregonstate.edu/sites/agscid7/files/horticulture/attachments/114_strik_et_al_organic_blueberry_i_hs_25_1201-1213_2017.pdf

A published study that examined the impact of planting method, cultivar, fertilizer, and mulch on yield and fruit quality of organic blueberries from planting through maturity.

Suggestions for Establishing a Blueberry Planting in Western North Carolina, North Carolina State Extension
content.ces.ncsu.edu/suggestions-for-establishing-a-blueberry-planting-in-western-north-carolina

Blueberry production information specific to Western North Carolina, with a chart overview of characteristics of highbush cultivars.

U.C. Fruit & Nut Research and Information Center: Blueberry, University of California, Davis
fruitsandnuts.ucdavis.edu/crops/blueberry

A collection of resources links on blueberries, addressing topics such as production, economics, and current research and issues.

Which Bees Are the "Best" Blueberry Pollinators, North Carolina State Extension
entomology.ces.ncsu.edu/2013/12/which-bees-are-the-best-blueberry-pollinators

A post on blueberry pollination that compares their abundance and efficiency, based on research in North Carolina.

Wild Blueberry Publications
The University of Maine Cooperative Extension
extension.umaine.edu/blueberries/factsheets

A collection of educational materials created by the University of Maine for wild blueberry producers, including fact sheets on management practices, summaries of research reports, and conference presentation archives.

Organizations

U.S. Highbush Blueberry Council
ushbc.blueberry.org

Maine Organic Farmers and Gardeners Association (MOFGA)
mofga.org

Michigan Blueberry Growers Association
blueberries.com

North American Blueberry Council
blueberry.org

The Southern Region Small Fruit Consortium
smallfruits.org

Wild Blueberry Association of North America
wildblueberries.com

Notes

Notes

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