Container blueberries as an "ornamental edible"©

P.R. Fisher[a]

University of Florida IFAS Extension, Environmental Horticulture Department, PO Box 110670, Gainesville, Florida 32611-0670, USA.

INTRODUCTION

Blueberries are a great candidate for container production by nursery growers. They fit into the "ornamental edibles" market niche and combine consumer interest in edible gardening, sustainability, and low-care perennials. Blueberry cultivars selected for local conditions can be planted out into the environment as a perennial landscape plant, enjoyed as patio potted plants, and have multi-season interest with spring to summer blooming, fruiting, and foliage, and fall color.

FLOWERING AND FRUITING CYCLE

Flower initiation, dormancy and chilling processes in blueberry (*Vaccinium*) are similar to florists' azalea (*Rhododendron*, also in the *Ericaceae*). Blueberries initiate flowering naturally in the autumn under short days and cool night temperatures (Figure 1). In most locations, this is followed by a "dormant" cycle with cool winter temperatures. During the dormant period in late autumn, active growth ceases, leaves turn red and may then fall off. After the plant becomes dormant, a cultivar-dependent chilling period (between 0 and 8°C) of roughly 200 h (southern USA cultivars) to 1000 h (northern USA cultivars) is required to break dormancy.

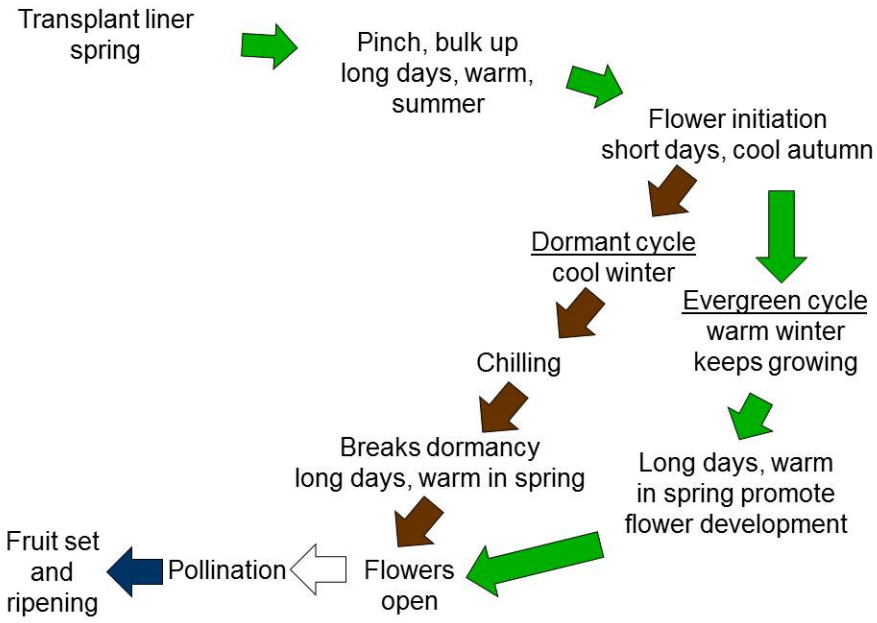

Figure 1. Production steps for blueberries in containers, showing the dormant and evergreen cycles.

After chilling and under the longer days and warming temperatures of spring, the plant begins to grow actively again, with a flush of leaves and vegetative shoots, and development of flowers. Fruit set occurs following pollination by insects such as honey bees.

[a]E-mail: pfisher@ufl.edu

Green fruit typically appear 4 weeks after flowering, and ripe fruit 9 weeks after flowering, but this varies considerably with cultivar and temperature. Flowers contain both male and female organs, but growing a mix of cultivars for cross-pollination significantly increases fruit set. Flowering tends to be variable between plants, meaning that if marketing plants in bud or fruit, they need to be hand-selected from the bench.

Plants can also be grown under warm conditions without dormancy or chilling requirement (termed "evergreen" or "non-dormant" production, Figure 1). The flowering period for evergreen production tends to be more extended and less intense than for plants grown with a dormancy cycle. In Florida, this evergreen cycle naturally occurs during warm winters with southern USA highbush cultivars.

However, evergreen production is unlikely to be useful for growers in cool winter climates with heated greenhouses, because evergreen flowering on most northern USA cultivars tends to be weak, flowering occurs too early in the spring, and without pollinating insects the flowers will mostly senesce and fall off without fruiting unless gibberellic acid sprays are applied during flowering. An exception is 'Top Hat' (a hybrid of northern USA highbush (*V. corymbosum*) and lowbush (*V. angustifolium*)) which is the only northern USA cultivar where we have seen strong flowering in response to day length changes (short days to initiate flowering followed by long days to develop flowers) in the absence of chilling.

CULTIVAR SELECTION

Grow cultivars that are suitable for local conditions, so that your customer will have success in their landscape (and will return next year to buy more!). Young plant suppliers, breeders, farm advisers, and blueberry grower associations can suggest cultivars matched to your climate. Many excellent and free university extension bulletins are available online from the USA, although most of the information is oriented towards field or homeowner use. Search the internet for a "chill-hour map" for your location. The most common mistake is not matching chilling requirement to the local climate—plants with too low a chilling requirement may flower too early, resulting in low fruit set or cold damage. Plants that have too high a chilling requirement will not break dormancy for an extended period and may not fruit.

When trialing blueberries as a new crop, select cultivars that are recommended for your location and provide a range of flowering dates and plant vigor. Based on this experience, you can fine tune the planting and marketing schedule under your conditions, and narrow down to a few high-performing cultivars.

For container production, important features are strong and even branching, attractive foliage (typically small to medium leaves), resistance to disease, and profuse flowering. For landscape use and large containers, higher plant vigor is desirable. For warmer locations such as northern Florida, we use southern USA highbush (*V. corymbosum*) cultivars. Based on a multi-site trial and several years of trialing at UF in Gainesville Florida, recommendations for container-grown cultivars in Florida include:

- 'Emerald' (University of Florida patent) is a vigorous, full plant loaded with large fruit for landscape use and large containers
- 'Sunshine Blue' is a well-branched, non-patented compact plant with attractive foliage, and very high number of flowers which develop from deep pink to white, especially in smaller containers

For colder locations, 'Top Hat' has excellent characteristics, with compact growth, profuse branching, small leaves, abundant flowers and small fruit, and good fall color. The downside of 'Top Hat' is that it can be late to set fruit under natural chilling conditions. Northern USA lowbush cultivars can work well in small containers. Other highbush/lowbush hybrids such as 'Northcountry' and 'Northblue' provide more vigorous growth than 'Top Hat' for larger containers.

MARKET SPECIFICATIONS AND FOOD SAFETY

Plants are more likely to have consumer interest in flower or fruit. The peak marketing window therefore occurs from mid-spring to early summer. The season can be extended if a

mix of cultivars is grown, and research at UF is also focusing on plant culture (light, temperature, pinching) to program flowering. Consider large photo tags or printed pots for off-season sales. Aim to produce finished plants with many branches and a full canopy, with a well-established root system throughout the growing medium, free of leaf spots and other disease and pest problems, and at a similar height to other potted flowering crops (for example, 35 to 40 cm including the pot for a 3 L container).

For food safety reasons (with potential liability ramifications, and also challenges in shipping), use caution if marketing with ripe fruit at retail. It is essential to follow regulations on food safety, for example avoiding contamination with *Escherichia coli* or *Salmonella* in irrigation water, which you might not consider when growing purely ornamental crops. For more information, refer to UF IFAS Extension guidelines at edis.ifas.ufl.edu, and other food safety guidelines available through your local regulatory agencies or farm advisory service.

PEST MANAGEMENT

Only apply pesticides registered for use on greenhouse/nursery blueberry plants intended for food consumption. Blueberry is susceptible to a number of leaf spot, stem and crown rot diseases, plus the usual root diseases for ornamental crops, including *Pythium* and *Phytophthora*. Typical insect issues such as fungus gnats, mites, and whitefly, along with blueberry bud mite, and gall midge. Carefully check the permitted use of pesticides recommended for field production of blueberries, or for ornamental production in greenhouses. Table 1 includes some insect control strategies that are acceptable in greenhouse blueberry production in Florida. Insecticides should not impact pollinators, and biological control is both effective and desirable. For more info, refer to UF IFAS Extension document HS1156 "Florida Blueberry Integrated Pest Management Guide" by J.G. Williamson, P.F. Harmon, and O.E. Liburd, available at: edis.ifas.ufl.edu.

PRODUCTION SCHEDULE

Blueberries are propagated from tissue culture, stem, or tip cuttings. Most growers producing container blueberries in significant numbers purchase rooted liners from an experienced, specialist propagator. Many cultivars are patented, for which propagation is restricted to licensed propagators. Non-patented options such as 'Sunshine Blue', 'Gulf Coast', and 'Top Hat' are available if planning to propagate your own cuttings. If propagating from tip cuttings, at least 10 weeks is needed to produce a well-rooted, pinched liner. Ensure that the tip cutting is vegetative by taking cuttings from stock grown under long days (which typically means the previous summer). Tissue culture plants branch more readily than stem or tip cuttings, resulting in a more attractive plant and reducing production time in the finished container. If using non-tissue cultured cuttings, multiple cuttings per pot may be required to have a well-branched appearance. We have not observed juvenility (resulting in delayed flowering) to be an issue for tissue culture or tip cuttings propagated in the spring and initiating flowering in the fall for fruiting the following spring-summer.

Plant from a 72-count or larger liner in early summer to finish in a 3 L pot the following spring. For larger pot sizes, plant in late spring with a vigorous cultivar. One plant per pot is sufficient if adequate time is allowed for pinching and establishment during the summer, but multiple plants per pot can provide a fuller canopy. Large containers may require a second year of production to develop a large, well-branched plant if planting is late or with a low-vigor cultivar. Grow at 30 cm on center between 3 L pots during bulking up in the summer and blooming in the spring.

Alternatively, if purchasing a "fast crop" large liner in the spring to finish in early summer, it should have a strong root system, and be pre-chilled, well-branched, and near the final market height. I have seen "pre-chilled" liners sold in the spring to northern growers as a fast spring crop, where the problem was that liners had been pruned to about 10 to 15 cm. Flower buds form on wood in the fall, so pruning liners during the winter also removes flower buds, and another year of growth would be needed for acceptable flowering.

Table 1. Suggested arthropod pest management strategies for greenhouse ornamental blueberries. Paul Fisher and Lance Osborne, UF IFAS. Be sure to follow label directions, and test applications on a small number of plants before applying to the entire crop. No endorsement or criticism of any product is implied, and check pesticide regulations in your area before application.

Pest	Product	Application notes
White fly	Neonicitinoid systemic insecticide labeled for edibles and greenhouses	One soil drench application per crop after roots are well established—avoid leaching and apply to moist soil. Do not apply pre-bloom, during bloom, or when bees are actively foraging. Neonicitinoid use is increasingly restricted in many locations and markets
	Parasitic fungus *Beauvaria bassiana* biological control	Spray as needed. Most effective against whitefly nymphs
	Azadirachtin (neem plant extract) spray	Spray as needed. Insect growth regulator
	Amblyseius swirskii biological control (predatory mite)	Whitefly eggs and larvae. Monthly releases
	Other biocontrols available (e.g. predatory wasps)	
Caterpillars	*Bacillus thuringiensis* (Bt) biological control spray	Repeat spray applications usually necessary after 3 to 14 days
Aphids	Neonicitinoid systemic insecticide	See above for whitefly
	Other biocontrols available (parasitic wasps, predatory midges and beetles, lacewings)	
	Insecticidal soap spray	Spray as needed, but not on blooms. Be careful to avoid phytotoxicity
Fungus gnats	Azadirachtin (neem plant extract) drench	Somewhat effective against immature gnats
	Steinernema feltiae entomopathogenic nematodes for biological control	Soil drenches, at least two per crop, 2-4 weeks apart. Most effective when soil temperatures below 30°C
	Other biocontrols available (e.g. *Hypoaspis miles* and *Atheta coriara*)	
Thrips	*Amblyseius swirskii* biological control (predatory mite)	Thrips larvae. Monthly releases
	Other biocontrols available (e.g. other mites, pirate bugs)	
Spider mites	*Phytoseiulus persimilis* predatory mite biological control	Performs best under humid conditions and moderate temperatures. Needs prey presence to survive. Corrective
	Neoseiulus californicus predatory mite biological control	Slower acting, survives longer in absence of prey than *Phytoseiulus*. Preventative
	Other biocontrols available (predatory mites, predatory midge)	

During the bulk up phase in the summer, pinch for height control and branching approximately every 6 weeks as new leaves flush out, starting 10 cm above the media in a 3 L container (15 cm for large pot sizes) and with each pinch 2.5 to 5 cm above the previous pinch. When pinching, use clean clippers including a dip in sanitizing agent between each bench or cultivar. Pinching cuts serve as an entry point for many stem (and leaf) pathogens and a broad-spectrum fungicide may be needed at the end of each day that pruning occurs. Do not overwater after pruning, and keep foliage dry over the following week. Maintain air circulation with fans, especially before and after pruning. Ensure foliage is dry when pruning, and avoid bruising leaves. Avoid pinching shoots after flower initiation (short days) in the late autumn. One final pinch can be made as plants enter dormancy to shape the plants for the spring flush, but beware of removing shoots that will potentially form flower buds.

A typical soilless substrate with moderate to high porosity (for example, peat and/or bark with 30 to 40% coarse perlite) is important to avoid *Phytophthora* and other root rot diseases. Blueberries are susceptible to iron deficiency and should be grown at pH 3.5 to 5.5 (i.e., with minimal or no limestone), typically in a substrate with little or no lime added. Do not use your regular limed mix—if pH is 6 or above, plant vigor will be greatly reduced and you are likely to struggle with iron deficiency and pale color throughout the crop. Avoid overwatering while plant is getting established and during the winter dormancy and slow-growth periods. Allow media to dry between watering, but do not allow plants to severely wilt or leaf damage will occur, increasing labor needed to clean up the crop. Keep plants well hydrated under high air temperature and light. Nutrients can be supplied either in water-soluble form, with 100 to 150 ppm nitrogen with each irrigation from an acid-reaction (high ammonium) peat-lite fertilizer including chelated micronutrients during the active growing period, **or** a moderate rate of controlled release fertilizer incorporated or surface applied to the growing medium.

Growing under cover from the rain helps to reduce leaf foliar diseases. During the winter, provide protection from rodents and deer—in one of our trials we discovered blueberry plants provide tasty winter food for rabbits! Air movement with fans or natural ventilation are needed to avoid powdery mildew in a greenhouse. Shade is not desirable except to avoid high temperature stress, because blueberries are full-sun plants with increased flower count at high light level.

Greenhouse temperature during the establishment period (spring to summer) should be 21°C or higher average temperature. This bulking up can occur in available greenhouse space after spring crops are sold, or outdoors with careful attention to diseases. Blueberries accumulate chilling hours between 0 to 8°C, and plants can be moved to a high tunnel or outdoors in the autumn. Plants overwinter with sub-freezing temperatures so long as plant root systems are well established and the cultivar is suited to your area. Following chilling, plants can be grown under ambient temperatures for a slower, natural flowering time, or brought into a heated greenhouse (18 to 21°F) under long days for more rapid flowering.

FRUIT SET

With artificially early flowering, remember that naturally strong fruit set only occurs in the presence of insect pollinators (such as bees), and young developing buds are susceptible to freezing damage.

We have found that two applications of gibberellic acid can greatly increase fruit set inside greenhouses where pollinator numbers are low. In our trials, we have used ProGibb™ (4% GA_3) at 250 ppm at full bloom and 2 weeks later (which is an acceptable label use in the USA). The resulting “parthenocarpic” fruit is seedless, so texture is slightly different, but our initial tests indicate plants have fruit similar in size and flavor as naturally pollinated fruit.

CONCLUSION

Blueberries provide a niche crop that fits with market trends. Retail prices is likely to be highest with well-branched, blooming plants in 3 L or similar containers. Consider adding container blueberries to your line of ornamental edible crops.

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