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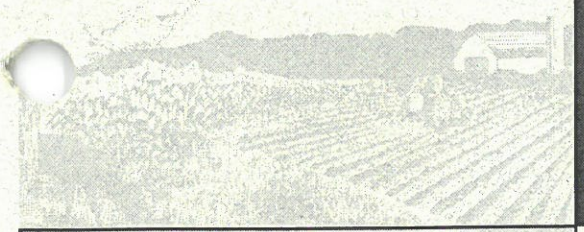
North Carolina Crop Profile
Blueberries



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College of Agriculture and Life Sciences, NC State University
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PRODUCTION FACTS

- North Carolina ranks fourth nationally in production of highbush blueberries.
- Two blueberry species are grown commercially in North Carolina: *Vaccinium corymbosum* (highbush blueberry) and *Vaccinium ashei* (rabbiteye blueberry).
- Nearly 4,000 acres of blueberries are grown in North Carolina, and highbush blueberries account for about 75 percent of the acreage (3,100 acres).
- North Carolina's annual blueberry production includes 10 million to 12 million pounds of fruit for the fresh market and 2 million to 3 million pounds for processing.
- The annual cost of blueberry production averages $6,184.92 per acre.
- Annual revenue from blueberry production totals $12 million to $14 million.

PRODUCTION REGIONS

More than 90 percent of highbush production is located in Bladen, Sampson, Pender, and Duplin counties (southeastern coastal plain) where the soil type favors growth and productivity of this species. Rabbiteye production is more scattered throughout the state because these plants tolerate a broader range of soil conditions.

CULTURAL PRACTICES

In order to achieve optimum growth and productivity, blueberries must be grown in acidic soils (pH range from 3.5 to 5) and fertilized with materials that supply nitrogen in the form of ammonium ions (e.g., ammonium nitrate or diammonium phosphate). Many blueberry varieties bloom in early spring; they must be protected from freezing temperatures once the blossoms open. Insect pollination (honey bees and bumblebees) is critical to fruit set—most rabbiteye cultivars are self-sterile and require cross-pollination between varieties. Irrigation promotes maximum fruit yield and will relieve drought stress (or bush mortality) in dry seasons. Overhead irrigation can also be used for frost protection in early spring. Annual pruning of deadwood and older canes maintains plant vigor, eliminates disease inoculum, and reduces populations of bud mites and scale insects.

INSECTS AND MITES

Arthropods that attack blueberries may be classified into three groups: direct pests (those that reduce yield by feeding on flowers, buds, and/or fruit), indirect pests (those that feed on leaves, stems, or roots), and husbandry pests (those that interfere with production). Direct pests cause

the most severe economic losses because they reduce the yield of marketable fruit. Indirect pests may also reduce yield, but their impact is upon the vigor and longevity of a field planting. Husbandry pests affect the health or safety of workers who tend and harvest the blueberries.

Direct pests

In late winter and early spring (before bloom), the buds of blueberry plants are often attacked and destroyed by blueberry bud mites (*Acalitis vaccinii*), cutworms (Lepidoptera: Noctuidae), and spanworms (Lepidoptera: Geometridae). The extent of damage varies from year to year and site to site. Bud mites are most effectively controlled by oil sprays applied in late summer or fall. Cutworms and spanworms are suppressed with a prebloom spray of azinphosmethyl, malathion, fenvalerate, or a formulation of *Bacillis thuringiensis* (*Bt*).

Insecticide applications must be avoided during bloom to allow bee pollination, but as soon as possible thereafter, fenvalerate or azinphosmethyl are needed to prevent infestations of cranberry fruitworm (*Acrobasis vaccinii*), cherry fruitworm (*Grapholita packardi*), and plum curculio (*Conotrachelus nenuphar*). These fruitworm species are key pests that require control every year in nearly all parts of the state.

Another direct pest, the blueberry maggot (*Rhagoletis mendax*), occurs in "hot spots" throughout North Carolina's piedmont and coastal plain. Adult flies emerge just before harvest and lay eggs in ripening fruit. This insect can be controlled only by pre-harvest sprays of a short-residual insecticide (malathion) applied before the females begin oviposition. Timing of applications is determined by monitoring adult emergence with yellow sticky traps.

Japanese beetles (*Popillia japonica*) can be a problem as frugivores in late-maturing blueberries (rabbiteye) planted on upland soils. Larval stages of this insect feed on grass roots. If larval populations are not suppressed by ecological or biological factors, an application of carbaryl may be needed to protect ripening fruit.

Indirect pests

Sharpnosed leafhoppers (*Scaphytopius magdalensis*), terrapin scale (*Mesolecanium nigrofasciatum*), datana caterpillars (*Datana* spp.), and stem borers (*Oberea* spp.) are the most common indirect pests. The sharpnosed leafhopper is regarded as the most serious of these pests because it transmits a phytoplasma that is presumed to be the pathogen of blueberry stunt disease. Leafhoppers are abundant in the woods where they feed on wild blueberries and other Ericaceae. They complete three generations per year in North Carolina. The first generation is usually controlled by fruitworm sprays after petal-fall; the second generation is controlled by maggot sprays before harvest. An application of malathion is recommended in late September or early October to control the third generation. Natural host-plant resistance to the leafhopper has been found in several commercial cultivars of the rabbiteye blueberry and in selections from four other *Vaccinium* species that are not grown commercially. Efforts are currently under way to transfer this resistance into commercial highbush blueberries.

Three species of endemic Hymenoptera have been discovered as parasites of terrapin scale in southeastern North Carolina. All three of these species as well as several predators (lacewings and lady beetles) represent potential biological control agents for local infestations of terrapin scale. Further work is needed to develop cultural management strategies and mass rearing techniques for augmentative releases of these beneficial insects.

Husbandry pests

Fire ants are the most significant husbandry pest in North Carolina. Populations are spreading throughout the coastal plain, where they are a threat to people who prune, cultivate, and harvest blueberries. Diazinon, used as a mound drench, is currently recommended for fire ant control. This practice gives about four to six months of protection.

Principal insecticides and miticides

Superior Oil

A 70-second superior oil is used on 20 percent of acreage as either a summer oil to suppress blueberry bud mites or a winter (dormant) oil for controlling scale insects. It is usually applied once or twice per season at 2 to 3 gallons per acre.

Malathion

This product is used on 95 percent of acreage as a short-residual, pre-harvest spray to control blueberry maggots. It is applied by air (ULV @ 10 oz/acre) or by ground (25WP @ 2 lb/acre or 57EC @ 1 pt/acre). Malathion may also be used in the early season for fruitworm control, but it is not effective against plum curculio.

Azinphosmethyl (Guthion)

This is very effective at petal-fall for fruitworm control and tends to be more active than other materials at low temperatures. It gives good control of plum curculio (50WP formulation applied to 60 percent of the acreage 2-3 times/year @ 0.5-0.75 lb/acre).

***Carbaryl** (Sevin)*

This short-residual preharvest spray is used to control Japanese beetles. It may also be used at petal-fall for fruitworm control, but it is not effective against plum curculio. Apply by ground to 10 percent of the acreage (50WP @ 1 lb/acre) 1 to 2 times per season.

***Esfenvalerate** (Asana)*

Used on 50 percent of the acreage, it is very effective at petal-fall for fruitworm control and is a good alternative to azinphosmethyl for resistance management (0.66EC formulation applied 2-3 times per season @ 4.8-9.6 oz/acre).

***Endosulfan** (Thiodan, Phaser)*

This product is sometimes tank-mixed with superior oil to give better control of blueberry bud mites (3EC formulation used on 20 percent of acreage, applied @ 1 pt/acre once or twice per season).

Diazinon

This is used as a mound drench to control fire ants on about 5 percent of acreage. One gallon of dilute material (50W @ 1 lb/100 gallons or AG500 @ 1 pt/100 gallons) is poured into each active nest site.

WEEDS

Although blueberries benefit from mulching for weed control, the process may not be economically feasible on commercial-size plantings in the coastal plain. Here, chemical control has been widely adopted to reduce weed competition for water, nutrients, and sunlight. Herbicides may be applied to both rows and middles; but more typically, they are applied only to the rows, while middles are cultivated with a tapered disk. All newly planted blueberries are hand-hoed. The selection of a given herbicide is based on specific weeds present in the field. These include annual or perennial grasses and broadleaf weeds such as goldenrod, greenbriar, red sorrel, broomsedge, red root, and smilax. A number of these problem weed species is not commonly found in other crops.

Organic matter is often highly variable within blueberry fields (from less than 1 percent to more than 8 percent). This complicates the selection of herbicide (and application rate) because many compounds lose effectiveness when applied on high-organic-matter soils. Enough herbicide to give satisfactory control in 6 percent organic matter on one end of a row is likely to damage or kill bushes on the other end of the row where organic matter may be only 1.5 percent. As a result, growers must use repeated applications or adjust tractor speed to compensate for differences in organic content of their soil.

Principal preemergence herbicides

***Hexazinone** (Velpar 2S)*

Applications of 1 to 2 pounds of active ingredient per acre are currently used for preemergence weed control on approximately 95 percent of the blueberry acreage in eastern North Carolina. This material offers broad-spectrum activity.

***Terbacil** (Sinbar 80WP)*

Applications of 0.4 to 1.6 pounds of active ingredient per acre are currently used on approximately 30 percent of the acreage in eastern North Carolina primarily for preemergence control of annual grasses and broadleaf and broomsedge. Broomsedge is not controlled adequately by hexazinone.

***Simazine** (Princep 90WDG)*

This material is used at 2 to 4 pounds of active ingredient per acre. Each of the following three herbicides is applied to approximately 5 percent of blueberry acreage for preemergence control of annual grasses and broadleaf weeds. They are used primarily on young blueberry fields the first few years after establishment, a period when hexazinone and terbacil cannot be used due to potential crop injury. Simazine is used primarily on established blueberries in the piedmont where organic matter content is less than 2 percent.

***Oryzalin** (Surflan 4AS)*

This is used at 2 to 4 pounds of active ingredient per acre.

***Napropamide** (Devrinol 50DF)*

This is used at 4 pounds of active ingredient per acre.

***Norflurazon** (Solicam 80DF)*

This is used at 2 to 4 pounds of active ingredient per acre.

Principal postemergence herbicides

***Glyphosate** (Roundup 4L)*

This material is used at 1 to 5 pounds per acre as a directed application to control emerged weeds in blueberries. It is currently used on 95 percent of blueberry acreage to kill escaped weeds.

***Paraquat** (Gramoxone 2.5L)*

Used at 0.6 to 0.9 pound per acre as a directed application to control emerged weeds, paraquat is applied to 5 to 10 percent of blueberry acreage.

***Sethoxydim** (Poast 1.53 EC)*

This material is used at 0.3 to 0.5 pound per acre as

a postemergence application to control emerged grasses in blueberries. It is currently used on 20 to 30 percent of blueberry acreage and is especially important in young blueberries.

DISEASES

Three major techniques are available to growers for controlling blueberry diseases: use of disease-resistant cultivars, pruning and field sanitation, and chemical control. All three tactics must be used together to successfully produce a crop.

Stem canker (*Botryosphaeria corticis*) and stem blight (*B. dothidea*) are best controlled by planting resistant cultivars and using disease-free cutting wood in the establishment of new fields. Selective pruning of old and diseased wood can reduce inoculum for twig blight (*Phomopsis vaccinii*), stem blight, and stem canker. Clean cultivation inhibits the spread of mummy berry (*Monilinia vaccinii-corymbosi*).

Blueberry stunt disease (an insect-vectored phytoplasma) is controlled by insecticide sprays for vector control and by roguing to remove infected plants. Phytophthora root rot (*Phytophthora cinnamomi*) occurs in excessively wet areas and is controlled by improving drainage. Metalaxyl (Ridomil) is labeled but not recommended.

The first few weeks following bud break are critical in the infection cycles of mummy berry and twig blight. *Phomopsis* blight can be controlled with two or three applications of benomyl at 7- to 10-day intervals from bud swell through full bloom. Benomyl also controls Botrytis blossom blight (*Botrytis cinerea*), which can be severe under cool, wet conditions, especially following freeze damage to blossoms. Both primary (leaf stage) and secondary (fruit stage) infections of mummy berry can be controlled with triforine. Benomyl will suppress secondary infections, but it is totally ineffective against primary infections.

Additional fungicide sprays are needed at bloom and petal-fall to protect developing fruit from infection by fruit rot fungi, especially ripe rot (Anthracnose fruit rot), caused by the fungus *Colletotrichum acutatum*. Since benomyl and triforine are ineffective against ripe rot, 2 to 3 applications of captan are recommended at 7- to 10-day intervals beginning just after full bloom.

Finally, several species of fungi cause leaf spots that develop in mid summer. Light infestations are generally inconsequential, but severe ones can cause premature defoliation, weaken the plant, and reduce fruiting potential for the following year. Biweekly applications of fungicide (usually benomyl plus captan) starting before harvest will give satisfactory protection from Alternaria leaf spot (*Alternaria tenuissima*), Gloeosporium leaf spot (*Gloeosporium minus*), Septoria leaf spot (*Septoria albopunctata*), and double spot (*Dothichiza caroliniana*). A tank mix is advised in order to prevent development of resistance due to overuse of benomyl. Summer mowing (topping) has become a common practice in North Carolina as a means of maintaining proper bush height. An added benefit of this technique is the reduction of leaf diseases by removing older, infected leaves. New mid-summer foliage produced after topping persists well into fall.

Principal fungicides

Benomyl *(Benlate)*

This material is used on 90 percent of acreage at 0.5 pound of active ingredient per acre for control of twig blight, blossom blight, mummy berry (secondary infection), and leaf spots. No alternatives are currently available.

Captan

This material is used on 60 percent of the acreage at 2 pounds of active ingredient per acre for controlling fruit rots and in combination with benomyl as an aid in controlling leafspot diseases.

Ziram

No use data is available, as it was recently re-labeled for use at 2 pounds of active ingredient per acre, comparable to captan.

Triforine *(Funginex)*

This material is used on 90 percent of acreage at 0.3 pound of active ingredient per acre to control mummy berry disease. It is no longer manufactured. In 1998, an EPA Section 18 Emergency Exemption was issued for fenbuconazole (Indar) as a replacement for triforine. This emergency registration was requested again in 1999.

Fenbuconazole *(Indar)*

Use data is unavailable. It is labeled for use at 1.5 ounces of active ingredient per acre for control of mummy berry disease (EPA Section 18 Emergency Exemption).

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NOTES

NOTES

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