

# Establishment and Maintenance of Blueberries

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The rabbiteye blueberry (*Vaccinium ashei*) is native to the southeastern United States. Its native habitat ranges northward from central Florida to eastern North Carolina and westward to eastern Texas and southern Arkansas. The highbush blueberry (*Vaccinium corymbosum*) is native to the East Coast and is the type grown commercially in New Jersey, Michigan, and other northern states as far south as North Carolina and northern Arkansas. Southern highbush types result from crosses between the highbush blueberry and native Southern blueberries. Rabbiteye and southern highbush are the two types that can be grown in Mississippi.

The Mississippi blueberry industry consists mostly of rabbiteye blueberries, with most new acreage being planted in southern highbush varieties. The industry began in the mid-1970s with small acreage and has grown to more than 1,700 acres in 1999. The potential for further growth of the blueberry industry in Mississippi is promising.

The rabbiteye blueberry differs in several ways from the highbush blueberries grown in northern states. The berries themselves, however, closely resemble those of the highbush, and the two are essentially the same in the marketplace. Rabbiteye plants are vigorous, and yields are high in comparison with northern varieties.

Blueberry plantings are expensive to establish compared to short-term crops, and they generally remain productive for a long period of time. Plan carefully when preparing to establish a blueberry

planting. Consider site selection, varieties, water sources and quality, harvesting, and marketing.

## Establishment

### *Site Selection and Preparation*

Rabbiteye blueberries require acidic, well-drained soils with a pH of 4.0 to 5.5; the optimum pH is about 4.8. Get a soil sample analysis to determine the pH and the nutrient content of the soil. Plants on land with an improper pH may become yellow and grow poorly. As a general rule, blueberries grow best on land recently cleared or that has never been planted in crops. Blueberries do not grow well in soils high in calcium.

Avoid planting blueberries in soil containing large amounts of wood ash as found in windrows burned on newly cleared land. Burned wood deposits minerals and salts that raise the pH above the acceptable range for good blueberry growth. If windrows have been burned, sample such areas separately, and apply sulfur as indicated by soil test results.

Soils with a native pH above 5.5 are difficult to adapt to blueberry culture and should be avoided. On the other hand, cultivated land that has been limed in the past may have an artificially high pH, which can be lowered by adding sulfur. Work the recommended amount of sulfur into the soil 6 months before the blueberries are planted.

Low-lying areas with a high water table are not recommended for blueberry

ries, but growers can use such sites if the water table stays at least 2 feet below the soil surface year-round. If you plant blueberries on poorly drained soils where the water table is less than 2 feet deep, form raised planting beds 8 to 12 inches high. Blueberries do not tolerate standing water or grow well in excessively wet areas.

Kill perennial weeds in the summer before planting; this usually requires cultivating and using a systemic herbicide. Weed control is difficult in blueberries for the first 2 years after planting. Eliminating perennial weeds before planting greatly reduces later problems.

### Irrigation

Blueberry plants require from 1 to 2 inches of water per week. Newly established plants have the most critical water needs and can be damaged by too much or too little water. Upland soils in the Gulf States region are well drained but have low water-holding capacity. Short periods (1 to 3 weeks) without rain can stress blueberry plants severely; therefore, irrigation during such periods is required for optimum plant performance.

Irrigation of producing blueberry plants during dry periods before harvest results in larger berries and higher yields. Also, irrigation in August and September stimulates growth and fruit bud formation, thus increasing the potential yield for the next blueberry season.

A rapid decrease in soil moisture during dry periods increases the concentration of fertilizer nutrients in the soil solution, which may damage roots. Irrigation lowers the concentration of nutrients in the soil solution and reduces the risk of fertilizer damage.

Trickle irrigation is the most common system growers use. This is the most efficient way to distribute water to blueberry plants. The trickle irrigation system operates on low water pressure and consists of polyethylene tubing laid down the row with an emitter placed under each plant. The emitter discharges a calculated amount of water on the soil surface beneath each plant. The recommended rate is 8 to 12 gallons per week per plant, which may be divided into three applications. Water requirements increase as plants age and grow and vary due to soil type, organic matter, and natural climatic conditions. Most trickle irrigation systems are buried to eliminate deterioration from ultraviolet light and to protect them from damage by animals or equipment.

The water source may be groundwater or impounded water. Regardless of the source, test the water to determine suitability for blueberry irriga-

tion. Filter impounded water to prevent the emitters from clogging. Check water quality before planting to see if it is suitable for blueberry production. The Mississippi State University Extension Service Soil Testing Laboratory or the State Chemical Laboratory can test the water. Specify that the water will be used for irrigation of blueberries.

### Rabbiteye Varieties

Proper variety selection determines, to a large extent, the profitability of the blueberry operation. Select varieties based on the targeted market, desired harvest interval, and location (Tables 1 and 2). Certain varieties are not adapted to machine-harvest or fresh-market sales, but these same varieties may be excellent choices for pick-your-own operations. Among rabbiteye varieties, Climax, Premier, Brightwell, Tifblue, and Powderblue are the ones best suited for mechanical harvesting for the fresh-fruit market. Recommended varieties are listed in ripening categories. Many other varieties are available but are obsolete or no longer recommended. Because most rabbiteye blueberries require cross-pollination for maximum fruit set, plant two or more varieties in each field.

**Table 1. Percent of total yield harvested at various intervals; 8-year average of 11 rabbiteye blueberries planted in 1979 at Poplarville, Mississippi, by variety and harvest intervals**

| Variety    | Harvest intervals |            |     |
|------------|-------------------|------------|-----|
|            | 5/20 - 6/15       | 6/16 - 7/8 | 7/9 |
|            | %                 |            |     |
| Bluebelle  | 6                 | 66         | 28  |
| Briteblue  | 8                 | 68         | 24  |
| Centurion  | 1                 | 51         | 48  |
| Climax     | 49                | 45         | 6   |
| Delite     | 8                 | 83         | 9   |
| Powderblue | 11                | 61         | 28  |
| Premier    | 61                | 36         | 3   |
| Southland  | 13                | 60         | 27  |
| Tifblue    | 10                | 74         | 16  |
| Woodard    | 21                | 63         | 16  |

### Early Season

**Bonita**—A pick-your-own and fresh-shipping variety from Florida that growers can harvest mechanically for the fresh market. The bushes are moderately vigorous and ripen about 3 days after Climax. The fruit has good color, size, and firmness with a dry picking scar; 350 to 400 chill hours (Florida release, 1985).

**Climax**—These are upright, open blueberry plants. Berries are medium in size, medium to dark blue in color, and have a small scar and good flavor; early season, ripening 3 to 5 days before Woodard. Concentrated ripening, excellent for machine harvest and fresh market; 450 to 500 chill hours (Georgia release, 1976).

**Woodard**—Ripens early, 7 to 10 days before Tifblue. Bush size shortest and the most spreading of Georgia's varieties. Produces many suckers. Berries are light blue, firm, large, and have excellent quality when fully ripe but tart until ripe; has wet scar and is not well suited for shipping; 350 to 400 chill hours (Georgia, 1960).

**Brightwell**—Berries are medium in size and blue in color, with small, dry scars and good flavor. Plant growth is vigorous, upright, and produces enough new canes to renew the plant. Plants may be mechanically harvested for the fresh market. Fruit ripens over a relatively long period beginning after Climax; 350 to 400 chill hours (Georgia, 1981).

**Premier**—Matures earlier (2 to 3 weeks) than Tifblue. Large fruit with good flavor. Vigorous, disease resistant, and productive; 550 chill hours (North Carolina release, 1978).

### *Midseason*

**Briteblue**—This blueberry bush is moderately vigorous; grows upright and open; generally ripening before Tifblue. Berry firmness, heavy bloom, and small dry scar combine to make this a good shipper. Fruit has good flavor when fully ripe. Berries are easily handpicked because they grow in clusters. Mature berries have a long retention on the plant, making it attractive for pick-your-own operations; 500 to 600 chill hours (Georgia, 1969).

**Bluebelle**—Excellent pick-your-own cultivar. Berries are large, round, light blue with excellent flavor; berries size well throughout the season. Plants are moderately vigorous with upright growth. Scar tends to tear, so this cultivar is not recommended for shipping. Ripe fruit tends to float with green fruit on a wet line when processed, so it is difficult to grade and pack for the frozen market; 450 to 500 chill hours (Georgia, 1976).

### *Mid- to Late-Season Varieties*

**Tifblue**—Leading rabbiteye variety because of its excellent appearance, productivity, and shipping quality. Bush is vigorous, upright, and widely adapted. A mid- to late-season cultivar usually ripening after fresh prices have moderated. Fruit is large, round, light blue, sweet, very firm with small dry scar. Berries appear to be ripe several days

before full flavor develops. Berries remain on plant several days after fully ripe; 550 to 650 chill hours (Georgia, 1955).

**Powderblue**—Vigorous, disease resistant, and productive. Same season as Tifblue with better fruit color and more foliage-disease resistance. Powderblue usually cracks less in wet weather and hangs on the bush better than Tifblue. It can be mechanically harvested for the fresh market; 550 to 600 chill hours (North Carolina, 1978).

### *Late Season*

**Centurion**—This blueberry variety is later than Tifblue. Adds at least 1 week to the rabbiteye ripening season. Bush is vigorous, upright, and has limited suckering. It blooms late, and the flowers are self-fertile. Ripening season begins in late July and extends through August into September. Fruit is medium size, medium to dark blue, and has good quality with aromatic flavor. Recommended for pick-your-own operations; 550 to 650 chill hours (North Carolina, 1978).

**Baldwin**—A productive, late-ripening variety with good flavor and firm dark-blue fruit. Has lengthy ripening period; adapted to pick-your-own and backyard plantings. It is not recommended for mechanical fresh-market harvest; 500 chill hours (Georgia, 1985).

## **Southern Highbush Varieties**

Several new varieties show promise of producing early ripening blueberries. Rabbiteye varieties ripen in June or July. The new southern highbush varieties should produce ripe blueberries in May.

Southern highbush varieties require somewhat different cultural practices from rabbiteye blueberries and are more specific in their requirements. Southern highbush blueberries need well-drained soil and irrigation. Growth is poor in wet fields, and plant losses are high from root rots. You will need to use raised beds or drainage if you have wet conditions. You will also need to practice annual winter pruning to reduce the number of flower buds per plant. Some varieties will be stunted if you do not remove flower buds when the plants are young.

Space the southern highbush blueberries closer than the rabbiteye plants are spaced because the highbush varieties are not as vigorous as the rabbiteye plants. For most varieties of southern highbush, a spacing of 4 feet by 10 feet or 4 feet by 12 feet is about ideal. Most southern highbush varieties are self-fertile, but cross-pollination will improve production.

The following is a list of some recent southern highbush varieties available for planting in Mississippi.

**Biloxi**—A relatively low-chilling cultivar recommended for the southern areas of the Mississippi blueberry-growing region. Plants of Biloxi are upright, vigorous, and productive. Fruit is medium in size, has good color, flavor, and firmness, with a small picking scar. Fruit ripens early, late April in south Mississippi; but the bloom period is also early, which puts it at risk in years of late-spring freezes. Plant Biloxi in with other southern highbush cultivars to facilitate fruit set, early ripening, and maximum yield (Mississippi release, 1998).

**Bladen**—Fruit is medium in size, light blue, firm, crisp texture with a pleasant flavor, and is resistant to cracking in wet weather. Bushes are upright and vigorous. Interplanting with a compatible variety ensures adequate cross-pollination. Ripening is early, mid-May in central Mississippi. Leafing is poor on bushes with excess flowers. Topping or late pruning should increase fruit size and reduce bush damage. Requires 600 to 800 chill hours (North Carolina, 1994).

**Bluecrisp**—The flesh of the ripe fruit is so firm it is described as "crunchy." Bluecrisp flowers later than rabbiteye varieties and ripens from late April to early May in south Mississippi. Bluecrisp produces a moderately vigorous plant that is more spreading than upright. Berry color is light blue, the scar is dry but medium deep, and the skin tears on some berries when they are picked. The scar has not caused problems with fresh shipments. Unusually high fruit firmness is the most notable characteristic that may enhance consumer appeal and contribute to the shelf life of the fresh berry. Interplant Bluecrisp with other southern highbush varieties for cross-pollination. Bluecrisp is a patented variety and requires 400 to 600 chill hours (Florida release, 1998).

**Blue Ridge**—Blue Ridge produces medium to large fruit with excellent color, firmness, and flavor. Picking scar is fair with occasional tearing. It was originally released for the home garden, but a few North Carolina growers are considering small plantings for commercial picking, most likely only by hand. Blue Ridge is a midseason, low-chilling variety that has field tolerance to stem blight. Requires 500 to 600 chill hours (North Carolina, 1987).

**Duplin**—A southern highbush blueberry with high fruit quality. The fruit is large, blue, and firm, with good picking scar and good flavor. The plant is

vigorous, high-yielding, and semi-upright. Interplant with one or more southern highbush varieties for cross-pollination (North Carolina, 1998).

**Georgiagem**—Ripens in mid-May in south Mississippi. Moderately vigorous, upright, and productive with firm, medium-sized fruit that has good color and a small scar. Resistant to diseases. Requires 350 chill hours (Georgia, 1987).

**Gulfcoast**—Ripens in mid-May in south Mississippi. Vigorous, semi-upright, medium productivity; fruit size medium, firm, small stem scar, and good flavor. The fruit retains the stem when picked, which reduces its attractiveness for commercial production. Requires 300 to 400 chill hours (Mississippi, 1987).

**Jubilee**—Jubilee plants grow upright and are vigorous and productive. Fruit of Jubilee is medium in size and has good color, flavor, firmness, and a small picking scar. Plants of Jubilee bloom later and ripen their fruit almost 2 weeks earlier than the earliest rabbiteye varieties. Fruit on Jubilee plants retains good quality over an extended period of time and can be 95 percent commercially harvested in one or two pickings (Mississippi, 1995).

**Magnolia**—Plants have a spreading growth habit and are medium in height; productive and vigorous after field establishment. Small plants require good planting management to ensure good survivability. Fruit of Magnolia is medium in size, has good flavor, color, firmness, and a small picking scar; blooms later and ripen their fruit about 2 weeks before the earliest rabbiteye varieties (Mississippi, 1995).

**Misty**—Misty plants flower and ripen about the same time as Sharpblue and Biloxi. Berries are light in color with a good scar and firmness. Misty is upright in growth habit. It appears to be relatively disease resistant. Cross-pollination is beneficial to Misty, which should be interplanted with a compatible southern highbush variety such as Biloxi or Sharpblue. Misty tends to produce excessive flower buds and may require winter pruning to reduce flowering potential. Requires 300 chill hours (Florida, 1992).

**O'Neal**—Is very early ripening, large fruit, medium blue, good picking scar, and flavor. Bloom often begins in the fall and continues during warm periods until the normal bloom time. O'Neal is more susceptible to stem canker than most other North Carolina cultivars; however, it seems to have adequate field tolerance. Requires 400 chill hours (North Carolina, 1987).



**Ozarkblue**—Exceptional yields with good fruit size and quality. Plants have grown well in variety trials in three areas of Arkansas. Ozarkblue has consistently fruited when most other southern highbush and rabbiteye cultivars have had partial to total crop losses to spring freezes and frost. Ozarkblue is suggested for planting in the upper part of the South because it requires a period of 800 to 1000 chill hours (Arkansas, 1997).

**Pearl River**—Plants of Pearl River are vigorous, productive, and grow upright. Pearl River fruit is firm, medium in size, has good flavor and a small scar. The fruit is darker blue than other southern highbush cultivars but is commercially acceptable. Pearl River plants bloom almost 2 weeks later than the earliest rabbiteye varieties, and the fruit ripens about 1 week before the same (Mississippi, 1995).

**Reveille**—Firmness, color, and the ability to hold up in storage have been favorable with hand or machine harvested Reveille fruit. Fruit size is medium, light blue, very firm, and crisp textured with a pleasant flavor. The bush is upright with a narrow base. Fruit is easily detached during mechanical harvest. Rapid growth in early years allows for high yields from young bushes, and older bushes are also very productive. Early bloom makes freeze protection desirable. Fruit cracking occurs during wet periods. Many berries remain red or green at the stem end after the blossom end is blue. Requires 600 to 800 chill hours (North Carolina, 1990).

**Sampson**—A southern highbush blueberry with large fruit and a sturdy plant. The fruit is large with excellent picking scar, firmness, and flavor. The color is average. The plant is self-fruitful, sturdy, vigorous, and has a semi-upright growth habit (North Carolina, 1998).

**Santa Fe**—This blueberry produces a vigorous, upright bush, flowers later than rabbiteye blueberry varieties, and ripens late April in south Mississippi. The fruit is medium size; the scar, firmness, and flavor of Santa Fe are excellent, and the color is blue to black blue. The branches are stout rather than twiggy, and the plants are easy to prune. Santa Fe plants show good disease resistance. Santa Fe should be interplanted with one or more other southern highbush blueberry varieties for cross-pollination. Santa Fe is a patented variety; requires 300 to 500 chill hours (Florida, 1998).

**Sharpblue**—This blueberry accounts for more than half of the southern highbush plants in Florida. It is vigorous, easy to propagate and has a low chilling requirement. Cross-pollination is important. It has medium resistance to phytophthora root rot and Botryosphaeria stem blight, but both diseases can be severe on Sharpblue if growing conditions are marginal. Fungal leaf diseases can be severe on Sharpblue, and fungicide applications are needed for good production. Sharpblue is a strong early leafer, its berries are large, has excellent flavor, and is medium to dark in color. Scar and firmness are marginal but satisfactory. A disadvantage is the long harvest season (Florida, 1976).

**Southmoon**—This plant has a desirable, upright growth habit and an excellent berry that is large and firm. The berry has a good scar, medium color, and good flavor. Southmoon flowers the same time as Star, which is about 10 days later than Sharpblue. Southmoon is a good pollinator for Star; requires 400 chilling hours. Southmoon is a patented variety (Florida, 1996).

**Table 2. Fruit yields of 11 rabbiteye blueberry varieties planted in 1979 at Poplarville, Mississippi, by variety and year**

| Variety    | Total yield (lb/a) |       |       |       |        |        |        |        |        | Average   |
|------------|--------------------|-------|-------|-------|--------|--------|--------|--------|--------|-----------|
|            | 1981               | 1982  | 1983  | 1984  | 1985   | 1986   | 1987   | 1989   | 1990   | 1985-1990 |
| Bluebelle  | 900                | 1,100 | 1,500 | 4,100 | 4,800  | 4,600  | 7,100  | 7,300  | 3,500  | 5,500     |
| Briteblue  | 900                | 3,900 | 3,500 | 6,600 | 9,800  | 6,900  | 12,700 | 10,000 | 8,300  | 9,500     |
| Centurion  | 1,100              | 2,600 | 3,300 | 6,200 | 9,100  | 9,500  | 15,100 | 4,400  | 7,000  | 9,000     |
| Climax     | 800                | 1,200 | 3,500 | 5,700 | 8,500  | 4,100  | 12,000 | 12,900 | 13,400 | 10,200    |
| Delite     | 400                | 1,700 | 2,100 | 3,200 | 4,200  | 4,200  | 5,700  | 4,400  | 1,700  | 4,000     |
| Powderblue | 200                | 2,600 | 3,200 | 6,600 | 7,500  | 8,600  | 15,500 | 11,500 | 12,300 | 11,100    |
| Premier    | 600                | 2,400 | 3,200 | 9,200 | 8,600  | 6,900  | 12,900 | 10,000 | 13,000 | 10,300    |
| Southland  | 1,000              | 2,900 | 3,500 | 7,600 | 9,900  | 8,000  | 22,700 | 6,100  | 13,800 | 12,100    |
| Tifblue    | 100                | 2,300 | 3,200 | 8,200 | 10,700 | 11,700 | 22,900 | 14,000 | 11,560 | 14,200    |
| Woodard    | 900                | 2,500 | 3,800 | 6,300 | 8,200  | 2,300  | 10,800 | 8,400  | 8,600  | 7,700     |

**Star**—This plant flowers 10 days later than Sharpblue but ripens at the same time. The berries are large, easy to harvest, and the plant has a concentrated ripening season. Berries have excellent scar, firmness, good color, and good flavor. The plant leafs strongly before the first flowers open. The recommended pollinator for Star is Southmoon or another southern highbush variety that flowers later than Sharpblue. Requires 400 chill hours. Star is a patented variety (Florida, 1996).

**Summit**—A mid- to late-season southern highbush cultivar. Fruit is firm and large with excellent color, flavor, and picking scar. Resistant to cracking, tearing, and stemming. Excellent performance in postharvest studies. Plant is semi-upright with medium vigor. Flowers are self-fertile but should be cross-pollinated where maximum earliness is important (North Carolina 1997).

## Selecting, Handling, and Setting Plants

Obtain healthy, true-to-name plants from a reputable nursery. Blueberries are propagated from cuttings taken in the spring. Blueberries for commercial use are usually purchased as a 2-year plant or one that has grown through two growing seasons. Blueberry plants can be bought in containers or as bare-root plants.

Buy container plants in a 1-gallon or larger container. Water the plants when you get them, and keep them moist until they are planted. If plants are still in containers when freezing weather arrives, saturate the root media in the containers before each hard freeze. This will help to insulate the roots from freeze damage. When you set container plants in the field, it is important to break up the rootball or make several vertical slashes with a knife. In transplanting blueberries, be careful to keep roots from drying out.

Check bare-root plants when they arrive to see if the roots are still moist. Blueberry roots are naturally brown on the outside and white on the inside. Plant bare-root plants immediately. If you cannot plant them within a few days, heel them in. Before planting, cut plants back to a height of 6 to 12 inches or remove at least 50 percent of the top, including all flower buds. Do not allow newly set plants to flower and fruit the first year.

Plants may be spaced 6 feet apart in rows 12 feet apart; this will require 605 plants per acre. If you are planning to harvest the fruit with an over-

the-row mechanical harvester, setting the plants 5 feet apart in the row may increase harvesting efficiency. The 5-foot by 12-foot planting arrangement will require 726 plants per acre. Southern highbush blueberries grow slower than rabbiteyes and may be planted as close as 4 feet by 10 feet. This spacing requires 1,089 plants per acre.

Plant blueberries during the dormant season, which is mid-November through February in Mississippi. It is generally more desirable to plant before the end of December because that gives the plants more time to establish roots before spring growth begins.

To prepare for planting, disk or work the soil well within the planting row. Use a subsoiler if a hardpan exists. Open a planting furrow with a middle-buster. Studies show that incorporating 2 gallons of moist peat moss into the soil beneath each plant at the time of planting results in faster plant growth. Do not use sawdust or wood chips this way because they take nitrogen from the soil as they decay. If planting on ideal blueberry soil, you may reduce the amount of peat.

If planting where soil conditions are not optimum (high pH, heavy soil, poor sandy soil), you may use more peat. Sometimes you may use fine pink bark as a peat substitute. Mix the moist peat moss well with soil and then place the soil-peat mixture around the blueberry roots.

Set the plants at the same depth they grew in the nursery or one-half of an inch deeper. Do not expose the shoulder of the rootball because this will cause a wicking effect and dry out the rootball. Never put fertilizer in the hole at the time of planting.

Another system of planting is to dig individual holes about 2 feet in diameter and 2 feet deep with a soil auger or shovel and fill the hole with a mixture of soil and peat moss and set the plants as described previously.

## Pollination

Rabbiteye blueberries require cross-pollination between different varieties for good fruit set. Plant varieties in alternating rows so that each row is bordered by a row containing a different variety. Planting the same variety on a row is advantageous for ease of harvesting, so do not mix varieties within the same row, but plant so adjacent rows have different varieties.

Two schemes for a six-row planting are shown below:

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One-half Variety A
One-half Variety B
.....A.....
.....B.....
.....B.....
.....A.....
.....A.....
.....B.....

Two-thirds Variety A
One-third Variety B
.....A.....
.....B.....
.....A.....
.....A.....
.....B.....
.....A.....

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Southern highbush blueberries are self-fertile, but planting with other varieties may increase fruit set and size.

Insects are necessary to pollinate blueberries. Wild bees and honeybees are primarily responsible for blueberry pollination. In plantings of one acre or larger, it is usually beneficial to have one or two hives of honeybees per acre present at flowering.

## Management

### Fertilization

Fertilization of blueberries is important; carefully consider it because excessive or incorrect use of some fertilizers may cause damage. Blueberries have a low tolerance for fertilizer, and young blueberries are often killed by overfertilization or by using the wrong type of fertilizer. For this reason, no fertilizer is recommended the first year. Blueberries prefer the ammonium form of nitrogen instead of the nitrate form. Ammonium sulfate is most often used. Avoid ammonium nitrate and other nitrate-containing fertilizers because nitrate ions are very damaging to blueberries on certain soil types.

Fertilizers of any kind can damage or kill blueberries when applied in excess. Fertilization rates that are ideal for other crops may kill blueberries. A number of factors influence the effect of fertilizer on blueberry plants. These include soil moisture, soil type, plant age, mulching practices, and plant growth status. Because of this, it is hard to give a simple rule for fertilizing blueberries that will work

in every case. General guidelines are listed, but each grower needs to adjust fertilization rate based on the plant response observed on the farm. Mild fertilizer injury is indicated by brown colored leaf chlorosis, particularly around leaf margins. More severe fertilizer burn causes leaf drop and possibly plant death.

The primary goal in fertilizing blueberries is to promote rapid vegetative growth in young plants so they reach maturity as soon as possible. After plant size has been achieved, the primary goal is to maximize fruit yield.

The USDA Small Fruits Laboratory in Poplarville, Mississippi, has developed two blueberry fertilizers that have shown good results:

1. An acid-forming fertilizer, 14-8-8, with a nitrogen source of ammonium sulfate and diammonium phosphate. Use this formulation on soils with a pH above 5.2.
2. Non-acid-forming formulation, 18-10-10, with the nitrogen source being urea. Use this formulation on soils with a pH below 5.0.

The filler material in both formulations is cottonseed meal. Contact the county Extension agent or state Extension specialist for sources.

General recommendations for using these formulations on most plantings are shown in the following table:

| Years plants have been in the field | Recommended rates*               |
|-------------------------------------|----------------------------------|
| 2                                   | 400 lb/acre**<br>2.5 oz/plant*** |
| 3                                   | 680 lb/acre<br>4.0 oz/plant      |
| 4 to 5                              | 1,020 lb/acre<br>6.0 oz/plant    |
| 6 or more                           | 1,361 lb/acre<br>8.0 oz/plant    |

\*Apply recommended rate as split applications—one-half in March, one-half in June.  
 \*\*Fertilizer broadcast evenly over the entire acreage supplies nutrients equally to plants and sod and will help maintain uniform pH and fertility over the entire area.  
 \*\*\*Applied to a 16-square-foot area beneath each plant and is only 22 percent of the per acre recommendation. Spread the recommended amount equally over the 16-square-foot area.

## ***Irrigation***

Blueberry plants require from 1 to 2 inches of water per week in the first year or two of growth. Upland soils in the Gulf States region are well-drained but have low water-holding capacity. Short periods (1 to 3 weeks) without rain can stress blueberry plants severely. Irrigation during such periods is required for optimum plant performance.

The rapid decrease in soil moisture during dry periods increases the concentration of fertilizer nutrients in the soil solution, which may damage plants. Irrigation lowers the concentration of nutrients in the soil solution, and this reduces the risk of fertilizer damage.

The most efficient method of irrigation is a drip or trickle system. This requires a filtering system for water from ponds or lakes. Excellent results have been obtained with in-line swimming pool filters that use a sand medium. Water from most wells can be filtered inexpensively unless it has a high iron content.

The trickle irrigation system operates on low water pressure and consists of polyethylene tubing laid down the row (buried or on top of the ground) with an emitter placed above ground near each plant. A calculated amount of water is discharged on the soil surface beneath each plant. The recommended rate is 8 to 12 gallons per plant per week, which should be in split applications. Water requirements increase as plants increase in age and size.

This system operates under low pressure and requires less water for a given area than an overhead system, thereby increasing efficiency of the pump.

## ***Frost and Freeze Protection***

Most rabbiteye blueberry varieties require 400 to 500 hours of chilling (below 45 degrees Fahrenheit) to break dormancy. Until the cold requirement is achieved, an extended period of warm weather will not usually cause floral bud-break. Once the chilling hour requirement has been satisfied, extended periods of warm temperatures will initiate flower bud growth.

Susceptibility to cold damage in rabbiteye blueberry blooms is directly related to the stage of development. As flower development progresses, blooms become more vulnerable to damage. Flower buds that have visibly swelled but with flowers still completely enclosed can withstand temperatures as low as 21 °F. Buds in which bud scales have abscised and individual flowers are distinguishable are killed at 25 °F. Flowers that are distinctly sepa-

rated with corollas unexpanded and closed are killed at 28 °F. Fully opened flowers and fruit are severely damaged at 29 °F.

Certain varieties seem to be more cold tolerant than others. This is mostly because of the dominant state of floral development at the time freezing temperatures occur. Earlier blooming varieties (those with a low chilling hour requirement) are the most prone to freeze injury because they will have the greatest number of blooms at an advanced stage of development when freezing temperatures are most likely to occur.

The common method of determining if buds have been frost damaged is to cut through the bud several hours after a freeze. This gives time for browning of fruit or flower tissue that may have sustained injury. Sometimes the freeze injury is not severe enough to kill the fruit or flower completely but may affect some individual part such as the pistil, stamen, or seeds, which may result in a reduction of fruit set or size. Blueberry fruits can develop and mature after a portion of the ovaries are damaged; however, because fruit size is highly correlated with seed number, fruits from seed-damaged flowers are usually smaller.

Freeze damage is also the cause of scarring on fruit, which results in reduced quality. The area of the fruit exposed to cold temperatures will desiccate and result in a brown ring around the calyx end. Because this tissue is desiccated, it is more brittle than surrounding tissue and may be the site of splitting during periods of unusually wet weather during harvest. At best, it will cause a discolored ring and possibly some disfigurement of the fruit.

Considerable work has been done to find methods of protecting flowers from freezing. The difficulty in making recommendations about freeze protection is that every freeze is different. Weather conditions, wind, weather, temperature before the freeze, and stage of growth of the plant are a few factors that affect the overall picture.

Overhead sprinkling is the most effective method of frost protection; however, it is also somewhat expensive to install and requires a large volume of water. Water volume is critical. Water must be consistently applied because ice is a poor insulator and the protection comes exclusively from the constant application and freezing of water, which keeps the plant tissue at 31.5 °F. The water must be continuously applied to the plants until the air temperature has risen to 32 °F (34 °F if conditions are windy). If the water is turned off too soon, the entire crop may be lost.



Other methods include creating heat or wind currents or a combination of the two. If windy conditions occur with a freeze, this method will prove ineffective. If an inversion frost situation occurs and a warmer layer of air exists 50, 100, or 200 feet above the ground, creating air currents to mix the air may achieve some protection. Air mixing may be accomplished with helicopters or by building fires throughout the planting. Even though the fires generate some heat, the protection is primarily derived from the air-mixing action that results from the heat-generated air currents.

### **Weed Control**

Weed control during the first 2 years is probably the most difficult problem in establishing a blueberry plantation. Weeds compete with blueberry plants for water, nutrients, and sunlight. Weeds also decrease harvesting efficiency and interfere with maintenance operations such as pruning and fertilization. You begin effective weed control the summer and fall before transplanting using a combination of herbicides and cultivation. Planting rows should be thoroughly disked and weed-free at the time of planting.

Maintain a weed-free strip, 4 feet wide, centered on the plant row, throughout the life of the blueberry planting. Establish a sod in the middles between the rows and maintain it by mowing. Centipedegrass, carpetgrass, or some native grasses are better choices than bahiagrass or bermudagrass, which grow much faster and require more maintenance.

Use herbicides, shallow cultivation, or mulching to control weeds in the weed-free strip. Several herbicides are labeled for use with blueberries. Always follow label instructions carefully when using any herbicide. County Extension agents or state Extension specialists can assist with specific weed control recommendations.

### **Mulching**

Mulching with organic materials such as pine bark, pine needles, leaves, hay, or other organic materials is expensive but beneficial. Mulch helps control weeds and helps keep the soil moist and cool. A good mulch is 4 to 6 inches deep and covers a 4-foot band centered on the plant row. The mulch needs to be replenished as it deteriorates. A deteriorating mulch adds organic matter to the soil and creates a favorable environment for root growth but can cause damage from root exposure if not replenished.

The economic feasibility of mulching large commercial plantings is questionable but is highly recommended for small plantings, pick-your-own operations, and home plantings.

### **Pruning**

Before planting blueberries, prune them back to a height of 6 to 12 inches, removing at least 50 percent of the top, including all weak shoots and flower buds. Additional pruning usually is not needed in the year of establishment.

**Rabbiteyes** -- After the first year, rabbiteyes require very little pruning in comparison to other fruit crops. The objective is to keep the plant properly shaped and of a size that fits a particular harvesting method. If you use mechanical harvesters, the plants should be narrow at the base with excess suckers removed, and plant height should fit the parameters of the harvester. Height control and rejuvenation are generally needed when rabbiteyes become 6 years and older.

Pruning rabbiteyes in the second through fifth years consists mainly of removing the lower twiggy growth, dead or damaged shoots, and weaker growth. In the postharvest season, remove the top one-third of tall shoots to encourage lateral branching and prevent excessive drooping in the next fruiting season. Shape plants for mechanical harvesting by removing all shoots growing outside a 12-inch crown within the row.

Prune plants immediately after harvest. This permits shoot regrowth and flower bud formation before plants become dormant.

When plants become too tall to harvest easily, summer prune immediately after harvest to reduce top height by removal of about one-third of the older canes. This permits better light penetration into the center of the plant. After the plants are mature, annually prune for height reduction by raising the cutting height 6 inches from the year before. This allows new growth to form on previous year's wood, which will be the site of next year's crop. When the plant becomes too large for the desired harvesting program, make a rejuvenation cut at about 4 feet and begin the annual pruning process again as previously described.

**Southern Highbush** -- Pruning methods and principles for southern highbush are similar to those used in northern highbush blueberry production. That is, mature plants are annually pruned to regulate fruit size and quantity plus the growth of new fruiting wood and not to maintain bush size for ease of harvest, as is usually the case in rabbit-

eye blueberries. Unpruned southern highbush plants usually have weak growth and small, later-ripening fruit.

When planting southern highbush blueberries, cut back about one-half of the plant top to remove all flower buds. The next year, remove all flower buds if plants are not growing vigorously. Both years remove all low and weak growth. In older plants, annually prune to produce new vigorous growth and to reduce flower bud numbers. Remove old (4- to 6-year-old) canes near the crown, and on young canes, cut back weak shoots to a strong lateral branch. Southern highbush blueberries are usually pruned when plants are dormant.

### ***Disease Control***

Diseases seldom are a serious problem in rabbiteye blueberries. Rabbiteye blueberries are more resistant to fungal infections than are highbush blueberries.

Root rot can cause problems, especially in wet, poorly drained soils. Stem blotch is characterized by red blotches on the previous season's growth, and anthracnose can cause stem dieback on more susceptible varieties.

These and other reported diseases are found only in isolated situations and are not considered serious problems at present. There is no disease spray program for rabbiteye blueberries.

### ***Insect Control***

Rabbiteye blueberries are more resistant to insect damage than are highbush varieties. Relatively few insect species attack the rabbiteye varieties and, as with diseases, damage occurs only in isolated cases.

Insects known to attack blueberries include stem borers, blueberry gall midge, cranberry fruit worms, leaf rollers, mites, bagworm, orange-striped oak worm, yellow-necked caterpillars, and scales. Fire ants are a major problem; therefore, find ways to eliminate them.

An insecticide spray program is not necessary because insect infestations are infrequent. However, you should monitor the orchard and spray with an approved insecticide if you detect an infestation.

### ***Harvesting***

Rabbiteye blueberries in southern Mississippi normally begin ripening in early June and continue into late July. They continue to ripen into mid-August in northern Mississippi. Southern highbush varieties begin ripening mid-May and are usually finished by early June. Blueberry fruit will continue

to ripen for several days after they turn blue.

Maximum flavor and size are achieved 5 to 7 days after the fruit turns blue. This is the best time to pick for home use or pick-your-own operations. Fresh fruit that will be packed and shipped needs to be picked before the fruit reaches its natural peak in the field. If you leave the fruit until it has reached its peak, it will be too soft to handle and the shelf life will be shortened considerably.

Growers must harvest fruit every 5 to 7 days, and, depending on variety, three to five pickings may be necessary to complete harvest. To reduce field heat in berries, harvest in the early morning hours, late afternoon, or at night. Delay picking each day until after the dew has evaporated to reduce postharvest fruit rots. Some drying of dew-moistened fruit may be done in an air-conditioned, low humidity room.

Excessive rainfall can cause splitting of ripe berries. If heavy rains occur, harvest berries at closer intervals. If rains continue long enough that the harvest intervals are extended to where fruit is over-ripe, you will have to harvest the overripe fruit and sell to the processing market. When you become current with harvesting again and the overripe fruit is out of the field, you can resume harvesting for the fresh market.

Where available, hand harvesting is used for fresh market berries. Roll ripe berries into your hand and place them into gallon buckets or directly into pint containers in which they will be sold on the fresh market. Usually some grading of hand-picked fruit is necessary, but be careful not to handle it any more than necessary during picking, sorting, and packing. Handling removes the "bloom" or surface wax, which gives the fruit its characteristic blue color. This can subject it to bruising and the spread of organisms that cause decay.

You can mechanically harvest blueberries with a catch frame or over-the-row harvester. Because mechanical harvesting removes some leaves, twigs, and immature and overripe fruit during the harvest operation, grading is necessary. A common blueberry grading line consists of a blower unit (removes leaves, small twigs, and immature berries), a tilt belt (removes soft and misshapen berries), and a sorting table. A conveyor belt moves the fruit along the sorting table for visual inspection and hand removal of the remaining undesirable berries. A greater percentage of mechanically harvested berries will go to the processing market, and mechanically harvested fresh market berries have a shorter shelf life than hand-picked berries.

Southern highbush berries are more perishable than rabbiteye berries and should be handled carefully during harvest and grading to assure marketing of high-quality fruit.

Storage life of rabbiteye blueberries is quite good if they are handled properly. Store and transport packed blueberries at temperatures of 32 °F to 35 °F and 85 percent to 90 percent relative humidity. If you handle and refrigerate them properly, blueberries should have 2 weeks of storage and shelf life (measured from the day of harvest).

### ***Propagation***

Blueberries usually are propagated from softwood or hardwood cuttings selected from healthy, disease-free mother plants. Cuttings are placed in a propagation bed in a medium that holds moisture well but allows adequate aeration. Water is delivered with an intermittent misting system.

**Softwood Cuttings**—Take softwood cuttings (4 to 5 inches long) in late spring from the tips of the current season's growth. Collect these when stems are still somewhat flexible and terminal leaves are half-grown to almost mature. Cuttings taken too early (terminal leaves very succulent, stems very flexible) wilt readily. If cuttings are taken too late (mature leaves, second flush of growth initiated), poor rooting will occur. Rooting usually is more successful when you get cuttings from the first blush of spring growth; however, you can collect cuttings from growth flushes occurring later in the growing season.

Take cuttings from the upper part of the mother plant. Use sharp, clean pruning shears or knives disinfected in a solution of one part household bleach to five parts water. Disinfect tools between mother plants. Remove lower leaves by pulling them upward to avoid tearing the bark, leaving the two or three terminal leaves. Don't allow cuttings to dry; keep them moist and cool after collection. Place cuttings in the propagation bed as soon as possible at a depth of one-half to two-thirds of their length. Cuttings are usually planted at a 2-inch by 2-inch spacing. Prepunching holes in media is often advantageous. Firm media around the base of cuttings to avoid air pockets.

**Hardwood Cuttings**—Hardwood cuttings are taken during the dormant season after sufficient chilling, usually late January through February. Collect strong, healthy shoots or "whips" (usually 12 to 36 inches long) that grew the previous summer.

Divide these "whips" into sections 5 to 6 inches long with a sharp knife or a bench saw with a fine blade. If the terminal of the shoot contains flower buds, remove the flower buds or discard the tip.

You can use the same beds and media for softwood propagation and for hardwood cuttings. Insert cuttings into the medium from one-half to two-thirds of their length. Press the medium firmly around the base of cuttings, which are usually spaced 2 inches by 2 inches. Keep the propagation beds moist, but be careful not to use too much water. You can water hardwood cuttings with a sprinkler until they leaf out. Mist-water them while in leaf but not yet rooted.

After cuttings are rooted you can apply a diluted complete liquid fertilizer weekly. Plants can remain in the propagation bed until winter (use little or no fertilizer in this case), when you should transplant them into pots or nursery beds and hold them for 1 year. If plants are strongly rooted by June or July, you can transplant them to pots, place under shade, and fertilize with a slow-release complete fertilizer 2 weeks after transplanting. This method often results in plants large enough for field planting the next winter.

Propagation beds need to be well-drained, under shade cloth (40 percent to 70 percent shade), and have adequate ventilation. Avoid excessive wind movement that may interfere with mist control.

**Propagation Media**—You will need a medium that retains moisture well but allows aeration. Media containing various propagation mixtures of coarse sand, ground pine bark, perlite, sawdust, and peat moss have proven satisfactory. Root development is best when the rooting medium contains at least 25 to 50 percent peat moss. Mixtures of coarse sand, ground pine bark, and peat moss (1:1:1) or perlite and peat moss (1:1) often are used.

**Mist System**—The mist system should keep the media uniformly moist but not soggy. If only a few drops of water can be squeezed from a handful of media, the amount of moisture is probably correct. An intermittent-mist system is needed to keep the humidity around the cutting near 100 percent, to prevent wilting, and to keep the medium moist. Starting with a porous medium that holds moisture well, adjust the mist system to maintain turgid (nonwilted) leaves and high humidity. Frequent (2 to 10 minutes) short misting intervals (2 to 10 seconds) are recommended.

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**Publication 1758**

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Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. VANCE H. WATSON, Director (POD 10-07)