

# **BLUEBERRY FERTILIZATION IN SOIL**

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## Introduction

Blueberry fertilization has been a subject of much debate. Since blueberries evolved in areas with low nutrient content they can survive with a surprising low level of fertilization. However, over the test of time, it has been clearly shown that for rapid growth of young plants and high yields of older plants a good fertilization program is necessary. This is especially true for southern highbush blueberries.

Since blueberries are a salt sensitive plant, proper placement and amount of fertilizer applied should be carefully monitored. For instance only 1.15 ounces of 10-10-10 applied to a circle 24 inches in diameter is equivalent to 1000 pounds per acre on a broadcast basis. This is a significant amount of fertilizer and tripling this amount would probably result in some root injury. In order to properly use fertilizer, a general knowledge of the types needed in Georgia is required.

## General information on blueberry fertility and fertilizers

### Nitrogen

Nitrogen is an important element in protein formation. It is one of the primary limiting elements in most Georgia soils. However, bear in mind that each 1% organic matter content releases about 15 pounds of nitrogen per year. On high organic matter soils (4-6%) you may receive a significant amount of nitrogen from the soil and in certain situations of high plant vigor (esp. with mature rabbiteyes), little additional nitrogen may be needed. However, most rabbiteye fields in the state have a organic matter content of only one to two percent and one or two applications of nitrogen are needed each year.

Nitrogen deficiency often occurs when fertilizer is leached out of the root zone by excessive rains or irrigation. Leaves will be small, pale, and may have tiny red spots. Young blueberries are often killed by over fertilization with nitrogen or the use of the wrong type of fertilizer since they are a salt sensitive plant. This is especially true under non-irrigated conditions. Blueberries prefer most of their nitrogen in ammonium form of nitrogen instead of the nitrate form, but ammonium nitrate can be used in fertilizer mixes where the nitrate portion of the mix constitutes a minor part of the total nitrogen in the mix and the soil pH is below 5.3. Ammonium nitrate can also be used for **very light** (20 pounds per acre or less) applications of nitrogen where a small amount of nitrogen is needed. On soils where the pH is on the high end of the range for blueberries (above 5.0), use more acid forming fertilizer such as ammonium sulfate.

Blueberries also respond well to fertilizers containing urea and slow release type nitrogen fertilizer. Urea is a good blueberry fertilizer which rapidly converts to the ammonium form of nitrogen in the soil. However, up to 20% can be lost from volatilization if rain is not received in a timely fashion. Use of fertilizers containing slow release nitrogen allows for less frequent fertilizer applications. In fact, some types can be applied just once a year. The price per pound is expensive, but labor costs are greatly reduced.

### Phosphorus

Phosphorus is an important element for good root growth and energy transfer in the plant. Phosphorus is an element which is low in many blueberry fields. This is due to the very low levels of phosphorus in virgin blueberry fields, the lower availability of phosphorus in very

acid soils, and possible leaching of phosphorus in very sandy soils.

Many virgin fields would benefit from a preplant application of phosphorus. It takes eight pounds of phosphate (fertilizer type phosphorus) to increase the phosphorus level in the soil one pound. Therefore, 240 pounds of phosphate are needed to increase the level of soil phosphorus by 30 pounds. If concentrated superphosphate is used (45% phosphate) then 533 pounds are required per acre. UGA Extension considers 31-60 pounds of phosphorus per acre to be a medium soil test level for blueberries, and many virgin blueberry fields have levels of only 4 to 8 pounds per acre.

In established blueberry fields, where growers have very low levels of phosphorus, it is advisable to apply a fertilizer with a higher analysis of phosphorus such as 14-28-14. Your fertilizer distributor can probably custom mix such a blend for you from ammonium nitrate, diammonium phosphate (DAP), and potassium chloride. The nitrate form of nitrogen forms just a small percentage of the mix. DAP alone is an excellent blueberry fertilizer where just nitrogen and phosphorus is needed. It contains 16% nitrogen and 48% phosphorus. An application of 50 pounds per acre will contain 8 pounds of nitrogen and 24 pounds of phosphorus.

Most Georgia soils can accumulate phosphorus given time. Areas where a lot of chicken litter has been applied often have high phosphorus levels. On sites with high soil phosphorus levels, it is advisable to apply little or no phosphorus. High levels of phosphorus in the soil can tie up iron, making it unavailable to the blueberry plant. Pure pine bark has poor phosphorus holding capacity. In pine bark bed culture it may be necessary to apply phosphorus three or four times a year.

## Potassium

Potassium is an important element in photosynthesis and water regulation. It is usually applied annually in most Georgia blueberry fields. Most Georgia soils can hold some potassium, but a significant amount leaches out and is used by the plant. Typically one or two applications of potassium are needed per year on bearing plants.

## Secondary elements

The secondary elements are calcium and magnesium. Blueberry plants have a low calcium requirement, and in fact too much calcium creates problems with iron deficiency. Blueberry soils are normally only limed when the pH is below 3.6. Lime application rate if the pH is below 3.6 is only 500 pounds per acre. Do not exceed this rate even if the pH is below 3.6.

Magnesium deficiency is occasionally seen in Georgia. On highbush blueberries, classic magnesium deficiency is a green "Christmas tree" in the center of a chlorotic leaf. It usually occurs on the older leaves. Based on our observations, on young rabbiteye plants the most common symptom of magnesium deficiency is leaves that are pink on the edges and yellowish between the veins. Calcium and magnesium are elements which should be in balance with each other. Normally a ratio of 8 to 10 pounds of calcium to 1 pound of magnesium is desired in the soil. If calcium levels of the soil are too high this will create magnesium deficiency. Since most virgin blueberry soils are low in magnesium, it is often included in small amounts in balanced blueberry fertilizer. Magnesium deficiency can be corrected by applying 15 pounds per acre of magnesium as magnesium sulfate (agricultural grade epsom salts). Since magnesium sulfate contains 10% magnesium, 150 pounds per acre of magnesium sulfate is required.

## Micronutrients

Micronutrients such as manganese, iron, boron, copper and zinc are needed by the plant in only small quantities, but they are very important. Micronutrient levels in the plant are determined by leaf analysis. The test is a reliable indicator except for iron. Annual use of a premium grade fertilizer which contains small amounts of micronutrients is a good insurance policy on most Georgia blueberry soils. On rare occasions, certain micronutrients are found to be excessively high and premium grade fertilizer should not be applied.

Iron deficiency is characterized by a yellowing of the young leaves between the veins. Plants deficient in iron may show adequate levels of iron in the leaves, but this iron is in an unavailable form. Iron deficiency often occurs when the pH is above 5.3 or when calcium or phosphorus levels are too high in the soil. Plants irrigated with water from deep wells in lime rock

may exhibit temporary iron deficiency during dry periods when they are surviving on alkaline water. Lower the soil pH with a post plant application of **no more than** 300 pounds of sulfur per acre (broad cast rate). It is only necessary to apply sulfur to the root zone area and not the entire field. It is generally much better to lower the soil pH by applying sulfur at least six months before planting (see sulfur chart in blueberry bulletin). Post plant applications will also work, but do not apply too much at one time.

Iron chelate applied to the soil can also be used help reduce iron problems. Follow directions on the label since there are many different formulation of iron chelate. Iron sulfate can also be used. It lowers the pH and supplies iron This material is commonly used in the nursery industry at the rate of 1 teaspoon per gallon nursery container. It can also be used in field situations. A suggested rate is one teaspoon per foot of bush height. Spread the iron sulfate evenly under the bush. Foliar applications of iron chelate may be used if a good surfactant is used to help move the iron chelate into the plant through the waxy blueberry leaves.

Copper deficiency has been reported on high organic blueberry soils in North Carolina. In North Carolina 5 pounds of actual copper is applied before planting on these soils and repeated every five years. Low copper leaf levels (below 2 ppm for rabbiteye and 5 ppm for highbush) are occasionally seen in Georgia and may need treatment.

## Leaf and Soil Sampling

Leaf and soil samples are very useful tools in blueberry fertilization. Leaf samples should be collected from mature leaves in the mid-portion of current season's growth the first two weeks after harvest. A double fist full of leaves should be harvested from across the field, washed in tap water, dried and taken to your county extension office. The computer print out you will receive from your county agent is based on what nutrient levels should be during this time period (Table 1). Generally highbush blueberries have a higher nutrient sufficiency range than rabbiteye blueberries. Currently, all University of Georgia computer printout leaf sample recommendations are for rabbiteye blueberries. At this time, highbush blueberry leaf analysis results should be shared with your county agent for interpretation.

Soil and leaf samples will not always have perfectly matching results. An element may be medium in the soil and low in the leaves, etc. Nevertheless they are useful in gaining a picture of what is happening in your fields and where the fertility program may need to be changed. One element that produces unreliable leaf results is iron. Plants growing at a pH above 5.3 will show iron deficiency but still have normal iron levels in the leaves. The iron is in an unavailable form in the leaf.

Table 1: Suggested critical nutrient levels in highbush and rabbiteye blueberry leaves

ELEMENT	DEFICIENCY BELOW	STANDARD RANGE FOR HIGHBUSH AND (RABBITEYE)		
		Minimum	Maximum	EXCESS ABOVE
Nitrogen(N)	1.70 %	1.80(1.20)	2.10(1.70)	2.50
Phosphorus(P)	0.10	0.12(0.08)	0.40(0.17)	0.80
Potassium(K)	0.30	0.35(0.28)	0.65(0.60)	0.95
Calcium(Ca)	0.13	0.40(0.24)	0.80(0.70)	1.00
Magnesium(Mg)	0.08	0.12(0.14)	0.25(0.20)	0.45
Sulfur(S)	0.10	0.12(NA)	0.20(NA)	NA
Manganese(Mn)	23 ppm	50(25)	350(100)	450
Iron(Fe)	60	60(25)	200(70)	400
Zinc(Zn)	8	8(10)	30(25)	80
Copper(Cu)	5	5(2)	20(10)	100
Boron(B)	20	30(12)	70(35)	200

NA = not available

Soil test levels can change with the season so sample each field at the same time of the year, if possible, so results from year to year can be compared. Generally, pH will be lower in

the summer than the winter. Soil samples should be collected using a soil tube if possible or shovel if necessary. Sample depth for blueberries should be eight inches. A composite soil sample should be collected from each field or each five acre block of blueberries. If the field has variation in soil type or history sample these areas separately.

The samples or cores should be taken at random from the entire sampling area, and should be representative of the entire area. When all the cores have been collected they should be thoroughly mixed together. Samples bags are available at no charge from your county extension office.

### **Selecting a fertilizer mix to use**

Selection of a fertilizer should be based on existing levels of phosphorus and potassium in the soil. The nitrogen required is usually about the same for most Georgia soils (unless you have a high organic matter soil) but phosphorus and potassium requirements vary widely. When you pull a soil sample and send it to the University of Georgia Soil Test Lab via your county agent or to a private lab, a report will come back telling you if your soil is low, medium, high or very high in phosphorus or potassium. Soils low or medium in phosphorus should be fertilized with annual applications of phosphorus. Soils high or very high in phosphorus generally do not need phosphorus in the fertilizer that year. Soils low, medium or high in potassium should be fertilized with annual applications potassium. Soils very high in potassium generally do not need potassium that year. The least expensive way to purchase fertilizer is a custom blend. The fertilizer can be custom blended based on soil test recommendations or one of the common blueberry fertilizers can be selected to match your soil test results.

On most sandy Georgia soils, it is a good insurance policy to ask the fertilizer dealer to include a micronutrient package and 1 to 2% magnesium. If you are buying prebagged fertilizer, get a premium grade fertilizer, it contains micronutrients and magnesium.

### **Selecting a common blueberry fertilizer preblended and packaged**

If your soil is very low in phosphorus and low or medium in potassium a good choice would be 14-28-14.

If your soil is low to medium in phosphorus and low to medium in potassium a good choice would be 10-10-10. This is also a good choice if you are not sure of your nutrient levels.

If your soil is high in phosphorus and medium or high in potassium a good choice would be 12-4-8 or 16-4-8.

### **Differences in rabbiteye versus highbush blueberries**

The objective of blueberry production is to rapidly bring the plants into heavy bearing. Generally, begin by frequently fertilizing with small amounts of fertilizer when the bushes are young. Young rabbiteyes will grow fairly well with just two to four fertilizations per year (Table 2 and 3), but will probably grow faster with light doses of fertilizer six to eight times per year (Table 4). In non-irrigated young fields fertilize modestly. Fertilizer salts can increase drought stress. Apply fertilizer only when the bushes are not under drought stress. Mature rabbiteyes generally need only two fertilizations per year. Once rabbiteyes reach maximum yield size (about six feet), the amount of fertilizer (especially nitrogen) is stabilized or reduced to help control bush vigor. It is important that mature rabbiteyes not be over fertilized. Over fertilization results in excessive bush height, additional pruning, poorer fruit quality, and excessive shading of the bush interior. Four to five inches of new growth on lateral bearing twigs should be adequate for good production.

Southern highbush and highbush blueberries generally need more frequent fertilization than rabbiteyes to keep both the young bushes and mature bushes healthy. Young bushes should be fertilized every 4 to 6 weeks (five to eight times per year) and mature bushes about four (north Georgia) or five times (south Georgia) per year.

## **Standard program for fertilizing young rabbiteyes on a per plant basis**

Many growers prefer to fertilize young plants on a per plant basis. Generally it requires less fertilizer and allows the weeds to receive less fertilizer. When plants are three years and older, the root system is extensive enough that most growers band the fertilizer under the drip line of the plants. The entire root system should receive fertilizer, since the roots on one side of the plant supply the top directly above those roots.

**Standard hand applied rabbiteye fertilization program with two to four applications per year. This assumes that one size gallon plants have been set in winter and allowed to settle in with rain or overhead irrigation.**

First Year) Non-Irrigated Field (Generally irrigation is recommended)

Apply 1 ounce of 10-10-10 per plant at bud break and repeat in July or August. Spread the fertilizer evenly in a circle 24 inches in diameter with the plant in the center. **Do not pile the fertilizer around the base of the bush. If the plants are in drought condition, do not fertilize.**

First Year) Irrigated Field

Apply 1 ounce of 10-10-10 per plant at bud break. Repeat in May, July and September (skip September in north Georgia). Spread the fertilizer evenly in a circle 24 inches in diameter with the plant in the center. **Do not pile the fertilizer around the base of the bush.** At a plant spacing of 5 by 12 feet (726 plant per acre) this will require 45 pounds of fertilizer per acre.

## **Succeeding Years-Standard hand applied rabbiteye fertilizer program with two to four applications per year**

If you are obtaining good growth (a foot or more per year) increase your fertilizer amount in accordance with Table 2. However, base your application on plant size, not age. It is very important not to over fertilize small size plants. On second year plants fertilize at bud break, May, July, and September (skip Sept. in North Georgia). On bushes three years and four years old which are in production, fertilize at bud break, May (optional) and after harvest in August. On bushes five years old and older, fertilize at bud break and after harvest in August. Diameter of the fertilized area should be increased by about one foot in diameter for each additional year of age. By the fifth year, apply the fertilizer in a large circle or continuously in the row (banded application).

When the plants are six years old, or six feet high, they are considered to be mature and you should be at your peak fertilization rate. Note: Fertilizers low in phosphorus (12-4-8, 16-4-8 or ammonium sulfate) should be used only on fields with high phosphorus levels already.



**Table 2. Rabbiteye blueberry hand applied fertilization with 10-10-10, 12-4-8, 16-4-8 or ammonium sulfate. Years two through six.**

Age of Plant	Plant Height	Plant Diameter	Amount of fertilizer per plant per application- use soil test to determine which material to use				Applications Per Year
1st Year	) 1 foot		(See previous recommendations)				
			10-10-10	12-4-8	16-4-8	Ammonium sulfate (summer application if no P and K needed)	
2nd year	) 2 feet	24"	1.5 oz	1.2 oz.	.93 oz.	.71 oz.	3 or 4
3rd year	) 3 feet	30"	3.0 oz.	2.5 oz.	1.9 oz.	1.4 oz.	2 or 3
4th year	) 4 feet	36"	4.5 oz.	3.7 oz.	2.8 oz.	2.1 oz.	2 or 3
5th year	) 5 feet	42"	6 oz.	5 oz.	3.75 oz.	2.9 oz.	2
6th year	) 6 feet	48"	8 oz.	6.7 oz.	5 oz.	3.8 oz.	2

**Fertilizing rabbiteye blueberries with banded applications in years four through six (four to six feet tall) based on row spacing and plant density**

Based on soil samples select the common type of fertilizer that best suits your plant needs or have a custom blend prepared. If you want to fertilizer without a soil test, the suggested analysis is 10-10-10.

Multiply the ounces per plant in Table Two with the number of plants per acre. (If the field is planted 5 by 12 = 726 plants per acre, if the field is planted 6 by 12 = 608 plants per acre). Divide by 16 ounces per pound to obtain pounds of fertilizer per acre. For example 6 ounces times 726 plants per acre = 4356 divided by 16 = 272 pounds of fertilizer per acre. Spread the fertilizer in a band four feet in diameter centered on the plant row. Banded applications can also be use in years two and three but double the amount of fertilizer recommended for hand applications since much of the fertilizer will be lost.

**Fertilizing mature rabbiteye blueberries (usually six years old and older)**

Once rabbiteyes are six to eight feet tall sunlight becomes limiting and the bearing canopy has reached it's maximum depth. The bushes will grow taller, but the bearing canopy will remain only five to six feet deep no matter how tall the bushes grow. Fruiting wood on the lower part of a tall bush dies out from too much shade. The objective now is to fertilize enough to keep the bushes healthy, but reduce the bush vigor. Rabbiteye bushes with medium green foliage are often more productive than bushes that are dark green. Dark green bushes produce excessive vegetative growth and fewer flower buds. Leaf analysis in July can be used to determine the nutritional status of the bushes. Generally July leaf nitrogen levels should not exceed 2%.

On typical rabbiteye soils low in organic matter about 30 pounds of nitrogen plus phosphorus and potassium should be applied at about the time of bud break. Make phosphorus and potassium applications based on soil tests. A typical program is 300 pounds per acre of 10-10-10 per acre on soils low to medium in phosphorus and potassium. On soils very low in phosphorus and low to medium in potassium a typical program is 214 pounds per acre of 14-28-14. Just after harvest another 15-30 pounds of nitrogen plus phosphorus and potassium (if

needed) should be applied based on leaf samples, plant color or growth. On soils high in organic matter (over 4 %), the amount of nitrogen applied can often be reduced. Each 1% organic matter releases about 15 pounds of nitrogen per year. Follow soil test results for phosphorus and potassium. Soils high in organic matter can still be low in phosphorus or potassium.

### **Maximum growth program with six to eight applications per season**

### **Maximum growth program for fertilizing young rabbiteye and southern highbush blueberries**

A maximum growth program has been used by several Georgia growers with great success. The key is frequent applications of small amounts of fertilizer and plenty of water via overhead sprinklers or natural rainfall.

If you are willing to spend the extra time and money **and you have a very good overhead irrigation system**, frequent fertilization can be used to accelerate the growth of young blueberry plants and bring them into production earlier. Plant in the early or mid winter if possible. After planting wait until several inches of rain or irrigation has settled the soil around the root system before starting to fertilize.

The first application is applied at bud break and subsequent applications should be made every 4 to 6 weeks during the growing season **when a total of at least four inches of rainfall or overhead irrigation has been received. It is extremely important that the fertilizer not be dumped at the base of the plant. This will kill the plant since blueberries are salt sensitive. It should be thrown at the plant so it scatters evenly in a circle of the desired diameter with the plant in the center.**

**IMPORTANT: If you see any sign of salt injury (wilting, browning leaves) cut the rate in half or stop fertilizing**

Fertilize until September or early October in south Georgia and August in north Georgia, about six weeks before the normal first frost date in your area. Bear in mind that occasionally, about every 50 years, there is a bad freeze in the fall before the plants have hardened off. Overly vigorous plants will suffer more injury during a fall freeze.

### **Maximum growth program for summer rooted cuttings (very small plants)**

If you are using tiny summer rooted cuttings (generally not recommended because of their small size) use about one-half teaspoon of premium grade (contains micronutrients) 10-10-10 applied evenly in a circle 12 inches in diameter starting at bud break and continuing during the early part of the summer. As the cuttings grow to about a foot in height, the rate can be increased to a teaspoon per application and the diameter of the circle increased to 18 inches. At a spacing of 5 by 12 feet (plant population of 726 per acre) this will require about 8 pounds of fertilizer per acre per application.

### **Maximum growth program for first year hardwood rooted cuttings**

Starting at bud break make the first fertilizer application. Large one year old hardwood rooted cuttings (North Carolina bed grown type) should receive a teaspoon of premium grade 10-10-10 applied to a circle 18 inches in diameter at each application.

### **Maximum growth program for first year one gallon plants**

One gallon plants should receive two teaspoons of premium grade 10-10-10 applied to a circle 24 inches in diameter. At a plant population of 726 per acre, this will require about 16 pounds of fertilizer per acre. If you want to band the fertilizer with a spreader consider the

distance between rows and the distance between plants. Rabbiteyes are typically planted 12 feet between rows and 5 or 6 feet in the row. This is plant density of 608 or 726 plants per acre. Southern highbush and highbush are typically planted 8 to 10 feet between rows and four feet in the row, so the fertilizer rate per acre is correspondingly higher. Banded fertilizer applications also require more fertilizer per acre since more of the fertilizer falls in the band area not occupied by blueberry roots. Banded fertilizer applications are listed in Table 3.

### Maximum growth program for second year and third year plants

If the plants have made **at least 18 inches of growth the first year**, increase the amount of fertilizer the second year to two teaspoons per application for rooted cuttings and 1 ounce for the one gallon size plants at each application. Increase the area in which the fertilizer is applied to **at least a 24 inch circle with the plant in the center for rooted cuttings and 30 inches for one gallon plants**. Make the first application at bud break. Apply every 4 to 6 weeks during the growing season in which a total of at least four inches of rainfall or overhead irrigation has been received. Fertilize until September or early October in south Georgia and August in north Georgia, about six weeks before normal first frost date in your area. Banded applications of fertilizer can also be used and are listed in Table 3. By year three plants should be large enough for a banded application of fertilizer with minimum waste of fertilizer.

**Table 3. Maximum growth program with banded fertilizer application on young rabbiteyes, southern highbush and highbush (pounds per acre),(note: eight foot between row spacing is generally not recommended for rabbiteyes and 10 feet is a bit tight), base fertilizer type on soil tests.**

#### Fertilizer type

Year in field	Between row spacing	10-10-10	12-4-8	14-28-14	Comments
1	8	112	94	80	<b>Every 4-6 weeks from bud break to six weeks before normal first frost date</b>
	10	90	75	64	
	12	74	62	53	
2 and 3	8	225	187	160	
	10	180	150	128	
	12	149	124	106	

### Fertilizing southern highbush and highbush in soil, year four and after

**Bearing southern highbush and highbush** growing in soil require about 76-113 pounds of nitrogen per acre per year split into at least four to five applications beginning at bud break and ending in August or September about six weeks before the normal first frost date in year area. Apply about 25 to 38 pounds of nitrogen at the spring depending upon distance between the rows (Table 4). It is best to apply one-half the spring fertilizer at early bud break and the second half of the spring fertilizer four weeks later. Starting immediately after harvest, apply about 17 to 25 pounds of nitrogen per acre (depending upon row spacing) every six

weeks if you have received at least four inches of rain or irrigation between applications of fertilizer (Table 4). Apply phosphorus and potassium based on soil samples and leaf analysis. Have the fertilizer custom blended or select a common blueberry fertilizer for your fertilizer needs. On soils very high in organic matter (6% or more-rare in Georgia), significant nitrogen is released from the decomposition of the organic matter. On these soils, it may be necessary to reduce the amount of nitrogen applied to 60-80 pounds per year to control excessive plant vigor.

**Table 4: Banded fertilizer application of bearing highbush blueberries (pounds/acre)**

Between row spacing	10-10-10	12-4-8	14-28-14	Time of application
8	375	311	268	<b>Bud break- It is best to apply one-half at bud break and one-half four weeks later</b>
10	300	250	214	
12	249	207	178	
8	250	208	179	<b>Postharvest application every six weeks until six weeks before normal first frost date (three applications in s. Georgia)</b>
10	200	167	143	
12	166	138	118	

### **Fertigation through drip systems- Another management option**

Fertigation, or injection of fertilizer into the irrigation system, works well on blueberries if you have an irrigation system which applies water uniformly. Fertigation through the drip system is quite useful for keeping bushes growing during drought periods when dry fertilizer is not being washed into the root zone. It is probably not a good idea to depend solely on fertigation, since irrigation systems are rarely uniform enough and areas outside the wetted zone will not receive fertilizer. However, it can be an extremely useful tool to keep bushes growing during dry periods and provide fertilizer with very little expenditure of labor. General recommendations for drip irrigated blueberries are one-half to one gram (1/28th ounce) of nitrogen per foot of bush diameter per week. Phosphorus and potassium can also be applied through fertigation, but normally a dry fertilizer application of these elements will last several months or more in Georgia soils, hence only nitrogen may be needed in many cases. Information developed in

Texas can be used as a guideline for growers experimenting with fertigation (Table 5).

Table 5. Texas fertigation schedule for drip irrigated blueberries

Plant size (diameter in feet)	grams*/ plant / week		
	Nitrogen	Phosphate	Potash
1	1	0.5	0.5
2	1.5	.75	.75
3	2.0	1.0	1.0
4 and up	2.5	1.2	1.2

\* 28.35 grams per ounce

Example of how to calculate fertigation amounts:

For instance, if there are 726 bushes per acre and bush diameter is two feet, then  $726 \times 1.5$  grams of nitrogen are needed per week = 1089 grams divided by 454 grams per pound = 2.4 pound of nitrogen per acre per week.

If 21% dry ammonium sulfate is used, then 4.76 pounds of ammonium sulfate are needed to = one pound of nitrogen.  $4.76 \text{ pounds} \times 2.4 \text{ pounds of nitrogen required} = 11.4 \text{ pounds of ammonium sulfate per acre per acre per week.}$

If 32% liquid nitrogen is used, it contains 3.5 pounds of nitrogen per gallon.  $2.4 \text{ pounds of nitrogen needed divided by } 3.5 \text{ pounds of nitrogen per gallon} = 0.68 \text{ gallons of nitrogen per acre per week. (or about a half-gallon plus one pint)}$

The fertilizer should be diluted so that no more than 200 ppm of nitrogen is applied in the irrigation water at one time. This is calculated by the following equation:

$$\text{pounds of fertilizer mixture to add to 100 gallons of water} = \frac{100 \times \text{desired ppm (usually 200 ppm)}}{(\% \text{ nitrogen concentration of fertilizer}) \times 1205}$$

for instance, if a 32% liquid nitrogen solution is used:

$$\frac{100 \times 200 \text{ ppm}}{32\% \times 1205} = \frac{20,000}{38,560} = 0.52 \text{ pounds of 32\% liquid fertilizer per 100 gallons of irrigation water}$$

Since 32% weights 10.5 pounds per gallon, then  $.52 \text{ divided by } 10.5 = 0.05 \text{ gallons per 100 gallons of irrigation water to equal 200 ppm of nitrogen.}$

If the rows of blueberries are 12 feet apart then there are 3629 feet of row per acre (208.7 feet per acre divided by 12 = 17.39 rows per acre  $\times 208.7 = 3629.8 \text{ feet of row per acre}$ ). Let's imagine the drip system is applying .3 gallons per 100 feet per minute.  $3629.8 \text{ feet per acre}$

divided by 100 feet = 36.3 one hundred foot units per acre.  $36.3 \times .3 = 10.9$  gallons of water per minute per acre.

From previous calculations we know we need 0.68 gallons of 32% nitrogen per acre per week and we can inject the nitrogen solution at the rate of 0.05 gallons per 100 gallons of irrigation water.  $0.68$  divided by  $0.05 = 136$  minutes or 2.3 hours injection time to produce a 200 ppm solution of nitrogen in the irrigation water.

Now we know the amount of fertilizer to be injected and the duration of the injection. During the fertigation process, normally the drip system is first filled with water, then irrigation without fertilizer is applied, then at the end of the irrigation cycle the fertilizer is injected. After injection the system is flushed with clean water.

Contact your county agent if you would like some help with the calculations. We will be glad to assist you.