Southeast Regional Blueberry Horticulture and Growth Regulator Guide

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Site Selection

Southern Highbush and Highbush Soils

Desirable southern highbush and highbush blueberry soils are primarily coarse sands with an organic base, open, porous, and with a water table prior to bed formation at least 14 inches deep, but not more than 30 inches below the surface. These sandy soils are characterized by an organic matter content of 2 percent (minimum of 3 percent in Ga.) or greater in the surface layer, underlain with a white sand layer above an organic hardpan (spodic soils). The white sandy layer underneath the topsoil, referred to as the A2 horizon is extremely important. Production, vigor, and livability of bushes are much higher in soils where this A2 horizon is present, compared to soils where it is absent. Plantings are also being grown successfully on peat soils. Addition of acid organic matter to the bed and/or mulching the plants with pine sawdust or pine bark will allow blueberries to be grown in upland mineral soils. In Georgia, southern highbush blueberries are frequently grown in beds of only pine bark about six to eight inches deep.

Rabbiteye Soils

Rabbiteye blueberry plants will grow well in many soil types in the Southeast. However, they grow most rapidly on sandy or loamy sand soils which are well-drained (but moist) and acidic. If the organic matter content of the soil is below two percent, organic matter should be added to the soil at planting. Rabbiteyes can also be grown on sandy clay loams or sandy loam soils in the Piedmont and Mountains. Because the aluminum and manganese content of these soils is higher than in sands, it is desirable to have a pH of 4.5 to 5.2 in these soils. Very low pH's can release excessive amounts of aluminum and manganese. As a general rule, rabbiteye blueberries grow best on land that has been recently cleared or never planted to other crops. Blueberries generally do not grow as well on soils which are high in calcium (greater than 900 pounds per acre), unless accompanied by high organic matter. Also avoid areas extremely high in phosphorus (greater than 200 pounds per acre), as this can tie up iron.

Soil pH

Blueberries require an acid soil pH. Soils with a pH between 4.0 to 5.0 usually promote the best growth, as blueberry plants will likely suffer nutritional problems above or below this range. However, plants have grown well at even lower native pH levels. Lime is seldom needed unless the pH is below 3.6 in NC or 4.0 in Georgia. Nutrient availability may be enhanced by liming to a pH of 4.5-4.8. A soil test will determine the acidity (pH), organic content, phosphorus, and potassium levels. Your local Cooperative Extension Service or Soil Conservation office can advise you concerning this service and offer valuable assistance.

Soil Moisture

Soil moisture is a critical factor in blueberry production. Blueberry bushes are very shallow rooted and will not tolerate either extreme drought or prolonged periods of excessive water in the root zone. Blueberry roots also lack root hairs. Consequently, they require a well-drained soil but one which has a continuous moisture supply. In some areas this condition can be maintained by regulating the water table at 14 to 30 inches below the surface with ditches, canals, etc. In all other locations, supplemental irrigation is needed.

Blueberry Type

Highbush blueberries grow well in the desirable blueberry soil conditions described above. Rabbiteye and southern highbush blueberries will too; however, rabbiteyes may exhibit excessive vigor in such soils, especially in North Carolina. The rabbiteye blueberry is more widely adapted to different soil conditions than the highbush and southern highbush blueberry. However, poor plant growth of rabbiteye blueberry has been associated with soil pH levels above 5.4. Rabbiteye blueberries will not tolerate the cold climate of the higher mountains in North Carolina, but have performed well in the Georgia mountains. Southern highbush, and to a greater extent rabbiteye, are also more drought and heat resistant than highbush. All of these blueberries may be grown in less desirable soils by the addition of organic matter to the planting hole/bed, supplying supplemental irrigation, and by mulching around the plants with 4 to 6 inches of aged sawdust or pine bark mulch.

Important Cultural Practices

Training Young Plants (1 to 3 Years of Age) – If vigorous, well-rooted two-year-old bed-grown plants are set, they will need cutting back by up to ½ of their total height at or shortly after planting to remove fruit buds and all twiggy growth If container grown plants are used, it may necessary to "beat out" the roots to correct pot binding. Again, plants should be cut back about ½ to balance the top and root system. Pruning should be conducted in the second year in the field to stimulate strong new growth on selected canes and remove flower buds. Do not permit plants younger than three years of age to bear more than a modest amount of fruit, or the onset of the commercially productive period will be delayed. A large bearing area is best established in the shortest possible time by removing all flower buds during the first two years.

Winter Pruning of Bearing Southern Highbush and Highbush Plants (over 3 to 4 years of age) – Using a set sequence with each bush ensures that pruning is uniform across the planting. Normally this type pruning is carried out during the winter since it is easy to see what needs to be removed at this time. However, in South Georgia, this type of pruning can also be conducted immediately after harvest (early June).

1. Sucker and head back -- Remove all low-spreading branches and suckers that have sprouted too far away from the crown of the bush. Cut off (head back) the tallest upright "bull shoots" to the desired height to keep the bush from growing too tall. Summer pinching of excessively vigorous canes can be used to control the height of the bush and turn these canes into productive fruiting shoots. Be sure to leave a few strong, upright basal shoots each year, to replace the older canes you will be removing.

2. Cane Renewal or making large "shaping cuts" — Select and completely remove the oldest canes if they are weak, particularly if in the center of the plant. Remove dead canes and cross-overs. Essentially, you have then automatically selected the remaining, more vigorous canes to bear

your crop next season and the following season. However, do not remove more the 15% of the canopy in this procedure. Depending on the number of canes in the bush this is typically one or two canes removed per bush.

3. Brush Wood Removal. On the remaining canes, systematically "thin out" flower buds by removing the shorter, thinner shoots ("brushwood"), leaving enough of the thick shoots to bear the crop and make new growth. Only experience can tell you how many shoots a particular variety of a particular age can carry and still perform well. It is probably better in most instances to prune too lightly than too heavily. Lighter pruning is usually practiced as the plant grows older because it can carry more "wood" successfully due to a larger root system.

4. If severe summer hedging is conducted, it is not necessary to make large shaping cuts or systematically thin out remaining canes. Summer hedging promotes thick vigorous canes with reduced numbers of flower buds.

Winter Pruning Bearing Rabbiteye Plants – Rabbiteye blueberries over five years old usually benefit from cane renewal pruning. Cane renewal pruning involves removing about 15% of the canopy by cutting one to three of the oldest canes each winter about one or two inches from the crown, with loppers. Also during this process, remove as much dead wood as feasible. If mechanical harvest is being used, try to narrow the crown as much as practical. Attempt to narrow the bush to one foot wide at the 18 inch level. This is where the "fish scales" of the mechanical harvester normally contact the bush. On rabbiteye cultivars such as Climax, that have few canes, remove only a portion of a cane each year. Flower bud numbers and fruit set on rabbiteye blueberries is often lower than on highbush. For this reason, it is seldom necessary to do detailed hand pruning on rabbiteyes.

Post Harvest or Summer Hedging – Post-harvest hedging is an optional practice that can be used to reduce winter pruning costs, adjust crop load and timing, and manage leaf spot diseases. Sickle bar or flail mowers can be used. Flail mowers are preferred because they are faster, have a wider range of cutting angles and heights, and serve to both remove and chop (mulch) the prunings in a single pass. Flail mowers tend to shatter more canes, but this has not resulted in more disease in North Carolina, and actually seems to stimulate more new shoots. **Severe flail mowing of southern highbush in Georgia is not recommended, as this has resulted in severe disease problems.** For small operations, or in high density beds, hedging can be done with heavy-duty, hand-held gasoline shrub hedgers. A roof-top cut down each side of the row at about 45 to 55 degrees from the horizontal is recommended over a flat top cut.

With rabbiteye blueberries the growing season remaining after harvest is relatively short, so it is important that hedging be conducted as soon after harvest as possible. Mid to late July is best for hedging, but the procedure should be finished no later than the first week in August in North Carolina and mid-August in south Georgia. Normally only about 6 inches of regrowth occurs on rabbiteyes in the year of hedging, so the hedging cut should be very moderate. No more than about 18 inches of bush height should be removed in one year. Avoid cutting into the main bearing area of the canopy when possible. Ideally, start hedging in the year the bushes reach a height of seven feet if hand harvested and 7-9 feet if machine harvested. Remove cut debris from the bush after hedging to avoid disease problems. Fertilize and water well after hedging. Flowers on new growth produced after hedging will bloom later than the rest of the bush and may require treatment for thrips in south Georgia.

For highbush blueberries, most cultivars finish ripening in late May or early June in south Georgia and southeast North Carolina, therefore, a more severe hedging can be conducted. If plants are growing in single rows in the field at 9 to 12 feet between rows, mature bushes can be "roof-top" hedged back immediately after harvest with the top of the "roof" cut at 4 to 5 feet. Select pruning height based on bush vigor and the length of the growing season remaining. Normally about 1.5 to 2.5 feet of regrowth occurs after harvest if the bushes have good vigor and are well fertilized and watered. In North Carolina, yields may be reduced the year following hedging on most cultivars except 'O'Neal' and 'Reveille'. However, bud mite and fruit rot problems are reduced by hedging. Many growers in North Carolina summer roof-top hedge one year followed by winter cane renewal

the next (18 months later). The post-harvest growing season in south Georgia is about one month longer than North Carolina, so annual post-harvest hedging of mature vigorous southern highbush growing in single rows may be feasible in some situations. Do not hedge highbush in single rows excessively, as a large canopy (about six feet in height after regrowth) is needed for high production.

For southern highbush growing in south Georgia in high density pine bark beds (typical spacing of 5 feet between rows), hedging should be conducted in late May. A roof-top cut with the top at 2.5 to 3.5 feet is recommended. Select pruning height based on bush vigor and the length of the growing season remaining. Normally about 2 to 3 feet of regrowth occurs after harvest if the bushes have good vigor and are well fertilized and watered. If a cultivar has marginally low numbers of flower buds ('Star' for example), a second hedging or tipping can be conducted when the new growth is 12 to 18 inches in length. This should be conducted no later than August in south Georgia. This normally promotes more branching and increases the number of flowers. It is also important on 'Star' to leave sufficient numbers of "spring" shoots. These shoots will have a much higher flower bud density than fall shoots.

Fertilizer recommendations for Georgia:

Rabbiteyes

Bearing rabbiteye blueberries growing in loamy sand soils with moderate amounts of organic matter (1-2%) usually require about 60 pounds of nitrogen per year. Apply about 30 pounds of nitrogen per acre near bud break and 30 pounds after harvest. Additional nitrogen may be needed on very poor soils, but less on high organic matter soil (over 3%). Phosphorus and potassium should be applied according to soil tests. In general, 10-10-10 has been a good blend for rabbiteyes in Georgia. DAP (18-46-0) is a good source of phosphorus in situations where phosphorus is low.

Highbush in Soil or Amended Strips

Bearing southern highbush in soil or pine bark amended strips usually need between 80 and 120 pounds of nitrogen per year in south Georgia, split into a minimum of four to five applications. Make a minimum of two applications in the spring and others after harvest. Typical times of application in south Georgia are mid to late Feb., late March or early April , early June, mid-July, and late Aug. Apply 30 to 40 pounds of nitrogen pre-harvest as follows: 20 pounds of nitrogen at bud break and 10-20 pounds 4 to 6 weeks later. Avoid fertilizing with nitrogen during harvest in most situations. After harvest about 50 to 80 pounds of nitrogen should be applied, at the rate of 15-20 pounds per acre for each application. Typically about 50 pounds of phosphate and potassium are applied per year, but this should be monitored by soil and leaf analysis.

Highbush in Bark Beds

Bearing southern highbush in pine bark beds usually need 120 to 200 pounds of nitrogen per year depending on many factors such as the age of the bark, irrigation practices, type of fertilizer used (regular, slow release or controlled release) and severity of summer hedging. In south Georgia, apply a minimum of three applications in the spring and four applications after harvest if a slow release fertilizer is not used. Typical times of application are mid-Feb., mid-March, early April, early June, early July, early Aug. and early Sept. using about 20 pounds of nitrogen per acre at each application. Avoid fertilizing with nitrogen during harvest in most situations. Pine bark does not hold phosphorus and potassium well. Phosphorus and potassium requirements are estimated to be about 50-100 pounds per acre per year, but adjust based on media and leaf analysis. **Watch for excessive boron and manganese levels.** Do not apply premium grade fertilizer (contains micronutrients) if these are too high. In Georgia, send in pine bark samples to the UGA Lab as a "Greenhouse /Nursery" Test.

Plant Tissue Analysis

In order to monitor plant nutrient status, tissue can be sent to the UGA Lab for analysis. Just after harvest, collect 50 to 100 leaves per sample from the mid-portion of the shoot. Collect samples from across the field, pulling off just a few leaves at a time. Sample varieties separately. To prepare samples, leaves should be washed in clear water to remove most pesticides and dust, air dried and placed in a clean paper bag. Send leaves in as soon after sampling as possible. Values for nutrient level needs are listed in the table below:

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)	0.12	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

Fertilizer recommendations for North Carolina:

Propagation beds

Apply 1 lb. diammonium phosphate (18-46-0) dissolved in 4 gallons water per 100 sq. ft. of bed beginning when cuttings are well-rooted (July 1-15) and repeat every 2 weeks until mid-August.

First year

After the first flush of growth apply 40 to 80 lbs. of 14-28-14 per acre and repeat every 4 to 6 weeks until mid-August. Extend application interval during dry periods until rainfall has totaled 4 inches. Based on 1360 plants per acre.

Second year

Double first year amount when new growth begins in the spring. Follow the first year timing and rate schedule for the rest of the season.

Bearing plants

Apply 100 to 150 lbs of 14-28-14 prior to blossoming and an additional 50 to 75 pounds 4 to 6 weeks later (early May). On sandy soils or if more growth is desired, apply 50 pounds ammonium nitrate after harvest. Apply 50 pounds per acre of diammonium phosphate 18-46-0 in mid-August to maintain plant vigor if phosphorus is low or leaching has been severe.

Adjustments for rabbiteye blueberries

The above recommendations are based on tests and responses of highbush blueberries. Rabbiteye blueberries require less fertilizer, especially nitrogen. For the first 3 years, rabbiteye can be fertilized the same as highbush in order to get maximum growth. Once plants reach about 5 feet tall, the rates should be reduced. On soils with more than 2% organic content, little or no nitrogen is required. When bushes reach 5 feet tall on soils with more than 2% organic content, apply 50 to 100 pounds per acre of 14-28-14 prior to blossoming. Make additional applications only if more growth or better bush color is desired. Rabbiteye bushes with foliage that is a medium green (slightly yellow-green) are often more productive than bushes that are a deep green. The deep-green bushes produce excessive vegetative growth (shoots) and fewer flower buds. Rabbiteye bushes respond rapidly to nitrogen fertilization if the leaf color gets too yellow. Green color will often return within 10 to 14 days after applying 50 pounds per acre of ammonium nitrate. The mid-August application of diammonium phosphate is generally beneficial also for rabbiteye in order to stimulate a healthy root system for the winter. Rabbiteye bushes require more adjustments in fertilization depending upon soil organic content and rainfall than do

highbush plants. In some tests, on soils with more than 2% organic content, production has been equal or greater with no fertilization than with any fertilizer combination.

NOTE: The 14-28-14 fertilizer is a blend of diammonium phosphate, ammonium nitrate (33-0-0) and potassium chloride (0-0-60). Other formulations are available but this one is probably the most desirable since no filler is required. The same ingredients can be blended into a 14-14-14 analysis if soil phosphorus is in the medium or high range. Use proportionally more fertilizer if an analysis lower than 14-14-14 or 14-28-14 is used. Apply actual copper at the rate of 1 pound each year or 5 pounds once every 5 years. Take soil samples at least once each year to determine phosphorus level and changes in pH.

Lime at the rate of 500 lbs/acre (about ½ lb/bush) has given a positive response on soils when the pH was below 3.6. Avoid excessively liming since 1000 lbs/acre has been detrimental in all cases.

Overview of Blueberry Growth Regulators

(Read detailed information before purchase or use)

Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness (+) or Importance (*)**	REI	PHI	**Comments**
Poor Spring leaf development and delayed flowering of some southern highbush and rabbiteyes, delayed harvest	Dormex (50% hydrogen cyanamide)	Typically 1 ½% Dormex plus 1 pint per acre of non-ionic surfactant in 50 gallons of water	++++ certain cultivars	72 hours	NA	**Not recommended for use in North Carolina.** This is a material that must be used with caution. Enclosed cab tractor required for application. Will kill flower buds if applied after bud swell. Application must be based on bud development. Typical application dates for southern highbush in south Georgia are late Dec. or early Jan. Rabbiteyes applications are usually in late Jan. or early Feb. Use only on a small scale until you gain experience with the material. Do not apply within 14 days of oil application or within 30 days of copper fungicide application.
Poor fruit set of rabbiteye blueberries in poor pollination situations or years; Poor fruit set following partial freeze damage of rabbiteye flowers	Gibberellic acid - ProGibb 4% liquid concentrate or GibGro 4 LS or Gibbex 4%	24-32 oz./acre (4% gibberellic acid) or 24-32 grams gibberellic acid/acre applied twice (total of 48-64 oz./acre in most cases)	++++	12 hours	40 days	First application: When at least 40-50% of the blooms are open. About 10% of the flower petals should have fallen. Second application: 10-18 days later. 1. min. of 40 gal. water/acre. 2. Add surfactant. 3. If solution is alkaline (pH greater than 8.0), lower the pH with a buffering agent. 4. Apply at night or during slow drying conditions

Problem	**Management Options**	**Amount of Formulation per Acre**	**Effectiveness (+) or Importance (*)**	**REI**	**PHI**	Comments
Cultivars blooming too early and suffering freeze damage, two cultivars not blooming at the same time for cross pollination	Super Boll, 55.4% ethephon	400 ppm solution; 9.2 ounces per 100 gallons plus 1 pint per acre of non-ionic surfactant	++++ some cultivars such as Climax	48 hours	NA	**For use only in Georgia.** Test on a limited basis before wide spread use. May delay harvest. Applied in the Fall for bloom delay the next Spring to help avoid Spring freeze damage. Can also be used on an early-blooming cultivar to help synchronize its bloom with a later blooming cultivar (i.e. Climax treated in a Climax / Tifblue field will help improve bloom overlap.) First application in S. Ga.: mid October. Second application: early November Good coverage is necessary, apply 50-100 gallons per acre.

Dormex to Enhance Fruit Ripening of Certain Southern Highbush and Rabbiteye Blueberries

Response: If properly used, Dormex can stimulate more rapid leaf development in the spring, resulting in more concentrated ripening on the first two harvests **on blueberry cultivars with poor spring leaf development in south Georgia.** Both increased number of leaf bud breaks and earlier leaf emergence occurs on poor leafing blueberry cultivars in response to Dormex. Dormex also promotes defoliation of old leaves, reducing leaf disease carry over.

Flower buds at stage 3 of bud development or beyond (see gibberellic acid bud stage section) are extremely vulnerable to chemical burn and/or injury when using Dormex. Normally advances bloom by a few days, slightly increasing the risk of freeze injury. Most commonly used by southern highbush growers with overhead irrigation for freeze protection.

Material: Dormex -50% hydrogen cyanamide

Timing: Timing of Dormex applications is **extremely important** in order to achieve the desired response and **to avoid flower bud injury**. Apply during the dormant season after significant winter chilling has been received, but before significant flower bud swelling occurs. Apply before a significant number of flower buds reach stage 3 (see flower bud chart in gibberellic acid recommendations). Timing **must** be based on flower development, however, generally optimum time of application in lower south Georgia has been early January on low chilling requirement southern highbush. Generally, the best timing for rabbiteyes such as 'Climax' has been late January or early February. But again, plants must be examined for their stage of development. If excess floral bud swell and floral bud break has occurred, chemical injury to buds is highly possible.

Rate of Material: Typically 1.5%to 2% Dormex with 0.25% non-ionic surfactant in a minimum 50 gallons of water per acre. The 1 ½% rate is three quarts of Dormex plus one pint of surfactant in 50 gallons of water. The 2% rate is ½ gallon of Dormex plus one pint of surfactant in 50 gallons of water. Most growers in Georgia use 1 ½%. On some cultivars with very tight flower buds and where more complete defoliation of old leaves is desired, 2% can be used. Read the label carefully before use.

Additional Remarks: Dormex is a moderately toxic material and is registered for application only with closed cab tractors. Read the label carefully before use.

Do not consume alcohol the day before or after application, as this makes your body more sensitive to Dormex (cyanamide "flush"-rapid heart beat and skin reddening). Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 72 hours.

Dormex is highly corrosive to equipment. Clean up thoroughly after application.

Avoid drift. Dormex may be toxic to green plants such as winter vegetable crops and shrubs; it is also toxic to pets, wild animals and livestock. Use a spray pressure of 50 psi to reduce drift.

Flower buds sprayed at stage three or beyond may be killed by Dormex, especially at concentrations of 1.5% to 2%. However, when applied in the correct "window" of bud development (bud stage 1 and 2), 1.5% to 2% usually gives a much better response than 1%.

Direct spray nozzles to the area with flower buds.

Do not apply within 14 days of an oil spray or within 30 days of a copper fungicide spray.

Apply during dry weather. Slow drying may enhance Dormex activity and cause more phytotoxicity if the buds are swelling.

Dormex may advance flowering by several days, slightly increasing the risk of freeze damage.

Dormex is not needed on cultivars with good leaf development such as 'Sharpblue', 'Emerald' and 'Brightwell'. Dormex reponse has been erratic on 'O'Neal'.

Do not apply to cultivars with "puffy" flower buds such as 'Sharpblue'. Dormex may wick between the bud scales and kill even dormant flower buds.

Gibberellic Acid as an Aid for Fruit Set of Rabbiteye Blueberries

Additional considerations and precautions for using Gibberellic Acid:

1. Gibberellic acid is expensive, but has been effective in improving fruit set on bushes affected by poor pollination. Poor pollination can be the result of cultivars not blooming together, cultivars which have low pollen compatibility, low bee activity, high night temperatures during bloom, low temperatures during bloom, excessively rainy weather during bloom, and damage to the blooms from insects such as thrips. **Many large fields in south Georgia will benefit from gibberellic acid application in most years.**

2. Good results can be obtained with two applications of 24-32 oz./acre (48-64 oz./acre total) in 40 gallons of water per acre, spraying both sides of the bush each time. Another successful method is cultivar directed treatment (CDT). Where two varieties with different bloom dates are planted together (i.e. 'Climax' with 'Tifblue') this is the best method. Using CDT, the first and second application of gibberellic acid are directed toward the first variety to bloom (i.e. 'Woodard' or 'Climax'). Some gibberellic acid will also reach the adjacent variety (i.e. 'Tifblue'), helping the early

flowers to set. The third and fourth sprays are directed toward the later blooming variety (i.e. 'Tifblue'). The last 'Woodard' or 'Climax' flowers to open will benefit from spray drift from 'Tifblue'. The total applied during the season is normally 48-64 oz. acre.

3. Apply gibberellic acid in about 40 gals. of water per acre. Since gibberellic acid activity is concentration-dependent (150 p.p.m. or greater active ingredient is best) at least 0.6 oz.of ProGibb should be used per gallon of finished spray (i.e. 24 oz. in 40 gal., 30 oz. in 50 gal., or 36 oz.in 60 gal.).
4. Although common non-ionic surfactants can be used, it is recommended that X-77, Silwet L-77, Kinetic, or Flood be used with gibberellic acid. Follow label rates carefully. Silwet L-77 is used at the rate of only 3.2 oz./100 gal. of spray. Caution should be used in trying other surfactants, because they could burn blueberry blooms.

5. In past years, only night applications of gibberellic acid were recommended. However, several experiments in 1995 showed comparable fruit set occurred for both early day and night applications. In any case, it is best to apply gibberellic acid during periods of slow drying such as at night, in the late evening or very early in the morning.

6. Gibberellic acid should be compatible with most fungicides, but a small-scale trial is recommended to make sure settling or clabbering is not a problem. The spray solution pH should be checked to make sure the pH is not too alkaline (pH 8.0 or above). If the pH is 8.0 or above, add a buffering agent.

7. Do not apply within 40 days of harvest.

8. If possible, do not apply if rain is forecast within 12 hours.

9. Do not apply to bushes in a low state of vigor.

10. Excessive applications may reduce flowering the following year by setting more fruit than the bush can properly mature. This is especially true if the bushes are in a low state of vigor. Do not apply to young bushes (i.e. 3 years old or less) since heavy fruiting may delay establishment.

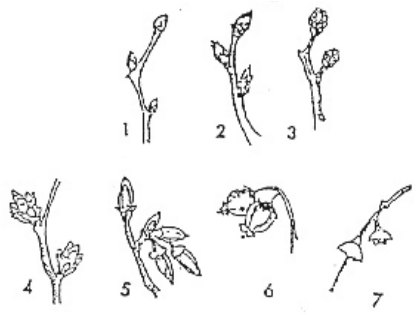
11. Some cultivars such as 'Alapaha', 'Brightwell' and 'Powderblue' usually set a good crop if planted with compatible cultivars for cross pollination. They seldom need applications of gibberellic acid unless bee activity is low or the blooms are damaged by spring freezes.

12. Southern highbush blueberries often set more fruit than they can properly mature. Gibberellic acid can increase this problem.

13. Part of the yield increase often seen with gibberellic acid is from smaller-sized, seedless or nearly seedless berries which ripen later in the season. If you are mechanically harvesting for the frozen market, this is not a problem, but it could pose a problem for hand picking of fresh fruit.

14. Blueberry fruit set and fruit size under natural conditions is determined in large part by number of seeds in the fruit. Low seed counts result in smaller, later ripening fruit. Gibberellic acid can set fruit, but will not fully substitute for total lack of seeds. Fruit set with a combination of gibberellic acid and some seeds develop better fruit size, so bee pollination is important even in fields treated with gibberellic acid. Growers should use honey bees (min. 2 strong hives per acre) if there are not large numbers of honeybees and wild bees such as bumble bees and southeastern blueberry bees present in the blueberry field. Most large fields do not have enough bees, so honeybees should be imported.

15. Although flowers are most receptive to fruit set with gibberellic acid at stage 5 (elongated but not yet open) and 6 (open), seedless fruit set just with gibberellic acid are smaller in size than partially seeded fruit set with the help of gibberellic acid. Allow at least 40 to 50% of the flowers to open and be worked by bees before gibberellic acid application. About 10% of the petals (corollas) should have fallen. Apply a second application of gibberellic acid 10 to 18 days later.



1 = no visible swelling, bud scales completely enclose the flowers;
2 = visible swelling of bud, scales separating, flowers still completely enclosed;
3 = bud scales separated, apices of flowers visible;
4 = individual flowers distinguishable, bud scales abscised;
5 = individual flowers distinctly separated, corollas elongated but closed;
6 = corollas completely expanded and open;
7 = corollas dropped. Adapted from J. M. Spiers, 1978, J. Amer. Soc. Hort. Sci. 103 (4): 452-454.

Fig. 1. Stages of flower bud development in rabbiteye blueberries:

Gibberellic acid as an Aid for Fruit Set of Rabbiteye Blueberries Following Slight Freeze Injury

Response: Increase fruit set of flowers with slight freeze damage.

Material: Gibberellic acid -- ProGibb 4% liquid concentrate or GibGro 4 LS

Situations and timing: The use of gibberellic acid for fruit set following freeze damage to rabbiteye blueberries is a fairly recent discovery. Field and laboratory experiments indicate it may be used in several situations. **Actual damage suffered during a freeze depends on many factors**

including stage of bloom, cultivar, wind, low temperature, and duration of low temperature. Blossom temperatures during radiation freezes can be 2-3^{o}F lower than protected thermometer temperatures.

As a general rule, blossom temperatures in the range of 26-32F will cause partial flower damage to rabbiteye flowers at stage 5 and 6. If the freeze occurs during full bloom, this calls for the first gibberellic acid application soon after the freeze event. Apply a second application of gibberellic acid 10 to 18 days later.

Temperatures below 26^{o}F are likely to cause total death of flowers at stage 5 and 6. In this case, application of gibberellic acid starts when the slightly freeze damaged stage 3 and 4 flowers develop into stage 5 and 6. Note that freeze damaged flowers may never open properly or be receptive to bee pollination, so an application of gibberellic acid should be applied when a large percentage of the damaged blooms reach stage 5 and a stage equivalent to 6 in age. If the weather is warm after a freeze this is often about one week after the freeze. Apply a second application of gibberellic acid 10 to 18 days later.

Ethephon for Bloom Delay on ' Climax' and Certain other Blueberry Cultivars in Georgia

Response: Spring bloom delay if applied the previous Fall. Length of delay will vary with cultivar, number of applications and rate of ethephon applied. Delays of seven to 14 days are likely to occur with 'Climax', with **seven** to ten days being typical. Response has been variable on some sites. Trial on a small scale on your farm with your own cultivars before adopting widespread use.

Material: ethephon: Superboll (55.4% a.i.)

Timing: First application: mid-October

Second application: early November

If possible, apply when temperatures are in the range of 60 to 80 degrees F. One application will provide most of the bloom delay, a second application will lengthen the bloom delay.

Rate of Material: Use 4.6 ounces per 50 gallons or 9.2 ounces per 100 gallon of finished spray solution. This will produce a 400 ppm solution of ethephon. Add a non-ionic surfactant at the rate of one pint per acre. Good coverage is needed for this material to work. Apply a minimum of 50 to 100 gallons of water per acre depending on bush size.

Remarks: Fruit ripening will be delayed. Length of delay of fruit ripening is related to improved crop load and delayed flowering.

Ethephon has been tested for a number of years on a number of bluerberry cultivars in Georgia. No plant damage or flower bud damage has been observed, but growers are cautioned to mix the material at the proper rate. **Only healthy plants should be sprayed.**

In several trials, flower bud numbers have been increased. If a cultivar sets excessive flower buds already, use only a trial basis. Cultivars which have demonstrated appreciable bloom delay with ethephon are:

'Climax', FL86-19("V1"), 'O'Neal','Sharpblue', and 'Woodard'. Cultivars which have exhibited minimal bloom delay with ethephon are: 'Bluebelle' and 'Tifblue' (zero to two days delay in bloom).

To improve bloom synchronization of 'Climax' planted with 'Tifblue' or 'Brightwell', spray only the 'Climax'. In a trial with an airblast sprayer, drift of ethephon spray from the treated rows of 'Climax' had minimal effect on bloom of 'Brightwell' where a good stand (solid row) of 'Climax' was present. Adjust spray nozzles so primarily 'Climax' is sprayed.