

COMMERCIAL BRAMBLE CULTURE

by

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1. INTRODUCTION

Brambles (which include blackberries, raspberries and dewberries) produce their fruit on canes. When harvested the “core” or receptical tissue of the fruit is removed with the blackberry fruit, but retained on the bush with the raspberry fruit. Dewberries are a running form of blackberry. Brambles have tremendous potential for pick-your-own and local sales in much of Georgia. With sufficient cooling and careful handling, there is the potential for shipment of some cultivars to regional and distant markets. Yields of blackberries usually range between 4,000 and 8,000 pounds per acre. Most of the information on brambles in Georgia collected in recent years has been from grower observations. A cultivar trial is now underway (2001) at the Georgia Experiment Station at Griffin (Dr. D. Scott NeSmith) and a trellising experiment at the Vidalia Research Station, however it will be a few years before these UGA trials are completed. Since research information is limited at this time, start with a small trial planting and expand it if you are successful.



Figure 1.1: Blackberries have good potential in many areas of Georgia.

Types of brambles

Brambles are divided into three basic growth habit groups: **erect**, **semi-erect**, and **trailing**. Growth habit determines what type of trellis (if any) will be required. Some cultivars such as ‘Kiowa’ are trailing the first year after planting and then become erect. However,



Figure 1.2: Field of erect type blackberries which do not require a trellis.

cultivars vary in the degree of erectness. Base trellis decisions on the growth habit of each cultivar (see cultivar section).

General blackberries groups 1) thorny, erect blackberries (example: thorny, Arkansas “Indian tribe” cultivars such as ‘Chickasaw’, ‘Kiowa’, and ‘Shawnee’, 2) thornless, erect blackberries (examples: Arkansas “Indian tribe” cultivars such as ‘Arapaho’ and ‘Navaho’, 3) thornless, semi-

erect blackberries (examples: USDA cultivars such as 'Chester' and 'Hull'), 4) thorny, trailing blackberries or dew berries (example: UGA cultivar 'Gem'). There are three groups of **Raspberries** 1) erect, primocane (fall) fruiting raspberries (example: "Northern type" raspberries such as 'Heritage', 2) erect florican (spring) fruiting raspberries (example: "Northern type" raspberries such as 'Latham'), and 3) trailing, florican (spring) fruiting, red raspberries (example: 'Dormanred' from Mississippi)



Figure 1.3: Row of semi-erect blackberries which require a trellis.

Blackberry groups

Thorny or thornless, erect "Indian tribe" named cultivars of blackberries from Arkansas (Groups 1 and 2) are the least expensive to grow since no trellis or a light weight trellis is required. Generally, they are the type of bramble commonly grown in Georgia. **In south Georgia, the thorny, erect blackberries (Group 1) have performed better than the thornless as a group. They are more disease resistant and have a lower winter chilling requirement than the thornless.** Thornless, semi-erect blackberries (Group 3) can be grown in north and middle Georgia and ripen after thorny, erect types, so they may be useful in extending the marketing season. Unfortunately, thornless semi-erect brambles require a substantial trellis for good production, and their flavor is sometimes considered inferior to the thorny, erect types. Information on Group 3 types is very limited in Georgia, so make small trial plantings before you plant significant acreage. Their performance in south Georgia has generally not been favorable because of cane diseases and insufficient winter chilling. Thornless blackberries do offer another important advantage, they are usually much more resistant to rosette disease than erect thorny cultivars.

Trailing blackberries (Group 4) can be grown in all areas of Georgia, but they require trellising. Only 'Gem' and 'Flint' are recommended for commercial trial in Georgia. Both were released by the Georgia Experiment Station in the 1960s. The fruit quality is excellent but because of required trellising and the large thorns, interest in these cultivars has been limited. It does appear that these varieties, especially 'Gem', have resistance to many diseases including rosette. For these reasons they may have a place in commercial production. It may be difficult to obtain large numbers of plants from commercial nurseries so home propagation of plants may be necessary.

Raspberry groups

Erect raspberries (Groups 1 and 2) can be grown in north Georgia, but only a few erect raspberries produce well in Georgia. Heat tolerance has been a problem. Raspberries appear to be best adapted to the area of Georgia north of a line running from Athens to Atlanta. A spray program is necessary for leaf and fruit diseases in most years. Since raspberries are not grown extensively in Georgia, this bulletin does not cover raspberry culture in great depth. If you are interested in growing raspberries commercially obtain a copy of Growing Raspberries in North

Carolina (www.smallfruits.org) and the Bramble Production Guide. The addresses are listed in the reference section.

'Dormanred' trailing raspberry (Group 3) can be grown in all areas of Georgia. It produces attractive fruit, but it requires trellising and its fresh flavor is usually poor. Cooking greatly improves the flavor and it makes delightful pies and jam. Currently, Dormanred is the only raspberry which produces fairly well in south Georgia and is commercially available at this time. However, yields are low compared to blackberries. A similar trailing cultivar from North Carolina named 'Mandrin' has better fruit quality and has performed fairly well in middle and north Georgia. Contact Dr. Jim Ballington at NCSU for information on current availability of Mandrin plants.

Life cycle of brambles

The life cycle of a bramble is as follows: The first year, the canes grow but do not produce fruit (except in the case of primocane fruiting raspberries). These are called primocanes. The second year these same canes produce fruit and then die. In the second year of their life the canes are called floricanes. New canes (primocanes) are produced each year to replace the ones that died. Some cultivars of erect raspberries (primocane raspberries) produce fruit on new canes in the fall of the first year, as well as on two-year-old canes in the spring (floricanes). However, they are normally managed by mowing to ground level in winter, so only a fall (primocane) crop is produced.

2. CULTIVARS

Breeding programs in Maryland, Texas, and Arkansas have released a number of new cultivars in the last 20 years. These cultivars are proving superior to old cultivars grown in Georgia. **Cultivars thought to be the best are marked with an asterisk(*)**. The "good" cultivars for each area are marked with a (G). Cultivars with potential in an area but either too new for general recommendation or know to possess a flaw which should be considered are marked with a (T) for trial. Cultivars thought not to be adapted are marked with an (N).

BLACKBERRIES

In approximate order of ripening. Ripening dates based on south Georgia observations, add about 10 days for middle Georgia and 20 days for north Georgia.

EARLY TO LATE MAY

*'Choctaw') (S GA[T], M GA[T], N GA[T])) is a 1989 patented release from the University of Arkansas with erect canes and medium size fruit. Its outstanding characteristics are very early ripening and small size seeds. 'Choctaw' blooms early and has very sharp thorns. It may also have thorns on the mid rib under the leaf. For this reason it is not recommended except where an early season berry is needed. In Arkansas it bridges the gap between the strawberry and blackberry season. It is a major shipping cultivar in Mexico, but must be picked daily for distant shipping. On some farms there has been a problem with the primocanes dieing. The problem may be raspberry crown borer. Thrips attacked the flowers just before bloom in 1999 and 2000 at Tifton and it was necessary to spray an insecticide to control them.



Figure 2.1: 'Choctaw' is a small berry that can be used to start the season.

'Brazos') (S.GA [T], M.GA [T], N.GA [N])) is a 1959 release from Texas A and M with thorny erect canes and large fruit. Fruit are relatively acid and are used primarily in jams, jellies and baking. The fruit are soft, but yields are generally good in south Georgia. 'Brazos' and other Texas A&M varieties are vulnerable to freeze damage at temperatures below 5°F. Therefore, do not plant in the high mountain areas of Georgia. Rosette disease can cause serious problems for 'Brazos' in south Georgia. Now rarely seen with the advent of the Arkansas Indian Tribe cultivars. Still widely grown in Mexico for shipment to the US.

'Rosborough') (S.GA [G], M.GA [G], N.GA [N])) has thorny erect canes and large fruit. Production is as good or better than 'Brazos'. 'Rosborough', a 1977 Texas A&M release, has been one of the best early season cultivars in east Texas and appears to be productive in south Georgia. It has the longest ripening season of the early varieties, often extending well into early June. The flavor is slightly sweeter than 'Brazos'. Spring freeze damage has been a production problem in middle and north Georgia since it blooms early.

'Brisson') (S.GA [G], M.GA [T], N.GA [T])) has thorny erect canes and very large fruit. 'Brisson' is a 1977 release from Texas A&M. Its berry quality is very similar to 'Rosborough'. 'Brisson'

was the most productive berry in tests at Yoakum in south Texas and has produced well in south Georgia.

'Womack') (S.GA [G], M.GA [G], N.GA [T])) has thorny, erect canes, and medium-size fruit. 'Womack' is also a 1977 Texas A&M release and has yielded particularly well in central Texas. Berry quality is good, very similar to 'Rosborough', but the smaller size of 'Womack' gives it a noted disadvantage for both harvesting and marketing.

'Gem') (S.GA [T], M.GA [T], N.GA [T])) was released by Dr. Fry at the Georgia Experiment Station in 1967. It has trailing canes and large- size fruit of excellent quality. A trellis is required. Vines are vigorous and resistant to anthracnose and leaf spot. It is reported to have resistance to rosette also. The thorns are troublesome.



Figure 2.2: 'Flint' and 'Gem' blackberries. 'Gem' may be a "sleeper" worthy of trial.

LATE MAY TO MID JUNE

'Cheyenne') (S.GA [G], M.GA [G], N.GA [G])) has thorny erect canes and medium- large, firm fruit that are moderately acid with a good flavor. Production is good in all areas of Georgia in most years, but spring freeze damage has been a problem in some years. 'Cheyenne' is a 1977 release from the University of Arkansas. 'Cheyenne' and most other thorny Arkansas varieties are susceptible to rosette disease.



Figure 2.3: A tri-pack of raspberries, blueberries, and 'Cherokee' blackberries grown in Chile.

'Cherokee') (S.GA [T], M.GA [G], N.GA [G])) has thorny very erect canes, and medium-size, firm fruit that are similar in flavor to 'Cheyenne'. 'Cherokee' is productive in middle and north Georgia. 'Cherokee' was released by the University of Arkansas in 1974. Rarely seen in Georgia now, but the upright canes lend themselves to mechanical harvest. Currently being shipped from Chile to the US. Deserves trial on farms interested in distant shipping.

'Comanche') (S.GA [N], M.GA [T], N.GA [T])) has thorny erect canes and large, firm fruit. 'Comanche' is a 1974 release of the University of Arkansas. Its quality characteristics are very similar to 'Cheyenne', but it has softer fruit. 'Comanche' is very susceptible to rosette disease.

'Humble') (S.GA [T], M.GA [T], N.GA [T])) has thorny erect canes and medium size, low-acid, soft fruit and moderate production. 'Humble' is a wild selection from Tyler, Texas found about 1942. It was an important part of the old canning blackberry industry in east Texas. 'Humble'

appears to be immune to rosette. For this reason, you may want to experiment with 'Humble' in areas where rosette has been a severe problem. 'Humble' is susceptible to orange rust.

*(For shipping purposes statewide) 'Arapaho' - (S.GA [T], M.GA [G], N.GA [G]) -is a 1994 patented release from the University of Arkansas with thornless, moderately vigorous, erect canes and medium size, very firm fruit. It has a chilling requirement of 500-600 hours so it should received sufficient winter chilling in most areas of south Georgia except in extremely mild winters such as 1998-99. It has good flavor and small seed size. 'Arapaho' has good refrigerated storage characteristics for a blackberry. 'Arapaho' is more prolific in producing primocanes from root cuttings than 'Navaho' so this method can be used for propagation. However, it appears that primocane production from established plants is poorer than most thorny, erect types. Setting plants about two feet apart should increase yields, since primocane production has not been very prolific. It has not been widely tested in Georgia yet. In recent years a cane blight has been very serve in fields not being sprayed with fungicide. 'Arapaho' is tolerant to rosette. The erect canes appear to be prone to falling over and a light string trellis may be needed to help support the canes in some situations.

EARLY JUNE TO EARLY JULY

'Shawnee') (S.GA [G], M.GA [G], N.GA [G])) is a 1984 patented release from the University of Arkansas with very erect canes and medium- large fruit. It has good flavor similar to Cheyenne and Cherokee and is very productive. 'Shawnee' is noted for its long ripening period and high yields. Most other blackberry varieties hit a peak yield soon after ripening begins and then quickly decline in both yield and fruit size. It is very susceptible to both rosette disease and spider mites. It was the best pick-your-own cultivar before 'Kiowa' was released.



Figure 2.4: 'Shawnee' was one of the best pick-your-own cultivars before 'Kiowa' was released.



Figure 2.5: 'Chicksaw' appears to have excellent potential except for the disturbing amount of sterile blossoms or rosette.

*(note comments) 'Chickasaw'- (S. GA [T], M.GA [T], N.GA [T])-is a 1999 patented release from the University of Arkansas with thorny, erect canes and very large fruit size. Bloom date is mid-season between 'Choctaw' and 'Kiowa' so it probably has a low enough chilling requirement for south Georgia. Fruit flavor is good. Fruit firmness is fairly good, but some drupelet reddening has been noted in storage tests. First year canes are much more erect that 'Kiowa', so it may be possible to grow it without a trellis. 'Chickasaw' has not been well tested in Georgia, but is highly recommended for trial plantings based on the preliminary observations. Sterile blossoms (rosette??) have been noted on some young plantings in South Georgia.

* 'Kiowa' - (S.GA [G], M.GA.[G], N.GA [G?]- is a 1996 patented release from the University of Arkansas with thorny, erect canes and very large fruit size. Plant vigor is excellent and the plants are nearly evergreen in south Georgia. Bloom date is just after 'Choctaw' and 'Shawnee', but plants performed well in the low chilling year of 1998-99 in south Georgia (about 400 chill hours received). The fruit ripen in mid-season, starting three days after 'Shawnee' and extending for six weeks. Fruit flavor is good. Fruit are fairly firm, but not as firm as 'Navaho'. So far, 'Kiowa' has been the best performing variety in south Georgia and good reports have been received from middle Georgia. The very large fruit size makes it excellent for pick-your-own. The primary drawback is the trailing habit the first year. This makes a trellis necessary for contact herbicide use the first year and elevation of the fruit off the ground in the second year. As the plants age the canes become more erect. However, a light trellis is still advisable to hold the fruit off the ground. Splashing sand after heavy rains can be a serious problem in many areas of Georgia. Fruit within 12 to 18 inches of the ground may be unsaleable in some situations.



Fig. 2.6: The huge fruit of 'Kiowa' blackberry makes pick-your-own quick and fun.

'Navaho' (S.GA [N], M. GA [T], N.GA [T]) is a 1989 patented released from the University of Arkansas with erect, thornless canes and medium size fruit. The fruit have very good firmness for a blackberry. The fruit ripen starting about seven days after 'Shawnee'. The fruit is better quality than other thornless cultivars and also cans well. 'Navaho' does not produce many primocanes, but is prone to produce one or two very large primocanes. If provided with a trellis these large primocanes can be supported in fill in a reasonable area. If pruned for a free standing hedge they do not fill in the row space sufficiently for high yields unless planted close together (about 1.5 to 3 feet apart). 'Navaho' is also susceptible to cane diseases during wet seasons, but tolerant to rosette disease. One report from a farm in north Georgia suggests the canes should be tipped while still succulent. If large canes are cut, a fungal disease (*Botryospheria sp.??*) may enter the pruning wound and kill some of the canes. It has generally not performed well in south Georgia because of diseases and lack of winter chilling. One disorder wide spread on Navaho is Pop drupelet. Many of the individual drupelets forming the fruit fail to fill out. This reduces berry size. At this time, it is not know if this is a virus or physiological problem. Its winter chilling requirement is thought to be 700-800 hours (at or below 45 degrees F received between Oct.1 and Feb. 15th). The long term average winter chilling in the Tifton-Alma area is only 750-800 hours.

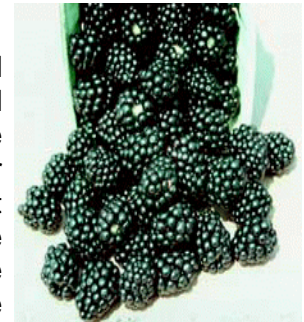


Figure 2.7: 'Navaho' produces firm fruit with ripens late in the season.

'Apache' (S.GA [N], M.GA [T], N.GA [T])- is a 1999 patented release from the University of Arkansas with thornless, erect canes and very large fruit size. Vigor is better than 'Arapaho' and 'Navaho'. 'Apache' blooms late, about 2 to 3 days before 'Navaho', so it may suffer from lack of chilling in some years in south Georgia, but should be less susceptible to spring freeze damage. The fruit starts ripening late, about five days after 'Navaho', but finishes ripening about 11 days before 'Navaho'. Fruit flavor and firmness are good. 'Apache' has been tested on only a limited basis Georgia, but is highly recommended for trial in middle and north



Figure 2.8: 'Apache' is the first thornless with giant size fruit, however, its chilling requirement may be too high for lower south Georgia.

Georgia. Red drupelets and sunburn have been noted as problem in commercial fields in Arkansas in 2001.

Figure 2.8: 'Apache' is the first thornless with giant size fruit, however, its chilling requirement may be too high for lower south Georgia.

'Illini Hardy' - (S.GA [T], M.GA. [T], N.GA. [T]) - is a 1990 release from University of Illinois, has thorny, fairly erect canes. The fruit is medium in size and has a good flavor. This variety has excellent winter hardiness.

LATE JUNE TO EARLY AUGUST

* 'Hull') (S.GA [N?], M.GA [T], N.GA [G])) has semi-erect, thornless canes with large fruit that are somewhat acid if picked before they have reached a fully ripe dull-black color. The fruit are flavorful. 'Hull' is a 1981 Univ. of Ill. and USDA release. It was released as a replacement for 'Black Satin'. 'Hull' has sweeter fruit that does not soften, leak juice or lose color on hot summer days as 'Black Satin' is prone to do.

'Chester') (S.GA [N?], M.GA [T], N.GA [G])) has semi-erect, thornless canes. Although its fruit quality is similar to 'Hull', its fruit is slightly larger. 'Chester' is a 1985 Southern Ill. Univ. and USDA release. Testing in Georgia is limited, but it has good potential for adaptation to middle and north Georgia.

'Black Satin') (S.GA [T], M.GA [T], N.GA [G])) has semi-erect, thornless canes. Its fruit is similar to 'Hull' in size, but it is inferior to 'Hull' in some quality characteristics. 'Black Satin' was released by the USDA in the 1970s. It is recommended in middle and north Georgia as an acceptable garden variety.

RASPBERRIES

'Dormanred') (S.GA [G], M.GA [G], N.GA [G])) has trailing canes and medium- size fruit. Fruit are attractive, but of only fair to poor flavor. They are surprisingly good when cooked. Fruit are produced on two-year-old canes and ripen in late June and early July in Athens.



Figure 2.9: 'Dormanred' is productive and well adapted to Georgia. It is much better cooked than fresh. (Photo courtesy of Dr. Butch Ferree).

'Mandarin'-(S.GA [N], M. GA [T], N GA [T])-has trailing canes and medium-size fruit. Fruit are attractive with good flavor. Fruit are produced on two year old canes in summer. Plants have not survived well in S.Ga., but better reports have come from middle and north Georgia.

'Southland'-(S.GA [N], M.GA [N?], N.GA [T])-has erect canes and light red fruit with acceptable flavor. 'Southland' produces fruit in the spring and summer and can also produce a small crop again in late summer or fall.

'Latham') (S.GA [N], M.GA [N?], N.GA [T])) has erect canes, and medium-size good quality fruit. Fruit are produced on two-year-old canes and ripen in mid-June in Athens.

'Redwing') (S.GA[N], M.GA [N?], N.GA [T]) fruits on current season canes (primocanes) as well as two year old canes (floricanes). Culturally, it is usually handled like 'Heritage' to produce only a fall crop (see 'Heritage' section). It ripens starting two weeks earlier than 'Heritage'. The fruit are soft-medium size and can be soft.

'Autumn Bliss'- (S.GA [N], M.GA [N?], N. GA [T])- fruits on current season canes (primocanes) as well as two year old canes (floricanes). Culturally, it is usually handled like 'Heritage' to produce only a fall crop (see 'Heritage' section). It ripens starting one week earlier than 'Heritage'. The fruit are medium-large size with a pleasant, mild flavor. Does not ship well.

'Ruby'- (S.GA [N], M.GA [N?], N. GA [T])- fruits on current season canes (primocanes) as well as two year old canes (floricanes). Culturally, it is usually handled like 'Heritage'. It ripens starting with 'Heritage'. The fruit are large size and medium to bright red in color.

'Heritage') (S.GA [N], M.GA [N?], N.GA [T])) has erect canes and medium-size, good quality fruit. Fruit are produced on current season (primocanes) and two-year-old canes (floricanes). Yields may be low in Georgia unless management is excellent. 'Heritage' ripens in late June and produces a second crop from August through October. It can also be managed to produce only a fall crop, which may be the best method in Georgia. In this production system, the plants are mowed to the ground (usually with a sickle bar mower) each winter. Since you are growing a plant and cropping it in one year, apply more fertilizer than with other brambles (see fertilization section). It may be advisable to split the summer application. A light trellis may be needed to support a heavy crop of fruit. The fruit are medium size with good to excellent color.

3. SITE SELECTION AND PREPARATION

When selecting a site, consider the soil type, ability to irrigate, air movement and freeze protection. Although blackberries tolerate wet soils better than some fruits, avoid areas with "sour" soil or standing water.

Brambles grow best at a soil pH of 6.0 to 6.5. Use dolomitic limestone, which contains magnesium to raise the pH to 6.5 prior to planting. Incorporate limestone as deeply as possible. Apply enough phosphorus (P) and potassium (K) to the soil to raise the elements at least to the medium range and incorporate them into the soil.

Subsoil as deeply as possible (at least 15 inches) down the row and across the rows at three foot intervals. Subsoil when the soil is relatively dry or glazing may occur. Bottom plow to a depth of nine inches or more and smooth with a harrow or rotovator. **If you are planting blackberries on wet sites or raspberries on sites that are occasionally wet, a raised bed is recommended.**

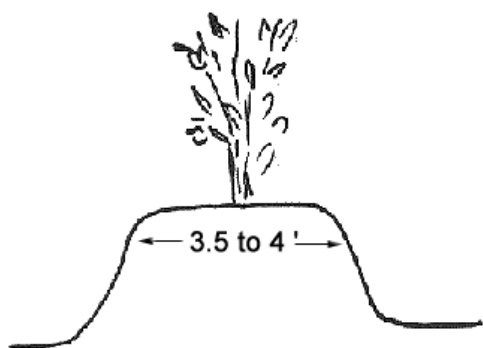


Figure 3.1: Cross section of a properly constructed bed in a wet area. There should be enough well drained soil in the bed for good growth of the plants.

If raised beds are needed for drainage, construct a bed which is three to four feet wide on top and flat on top. This allows rain and fertilizer to enter the bed more easily than a sloping bed. Bed height is determined by the degree of wetness. In the Flatwoods District of southeast Georgia, it is common to construct beds up to 16 inches in height for fruit culture. In areas with slightly poor drainage, a bed six inches in height may be satisfactory. Bed constructed can be accomplished by several methods, but generally the center or core of the bed is created by throwing up soil with a disk plow (aka new ground plow), moldboard plow, pine tree bedder, disk hillers, or back gangs on a harrow. Once the core of the bed is formed, the aisle is broken out and thrown to the bed with the front gangs of a harrow. Adjust the top link on the three point hitch to pull or throw soil with a harrow.

Run the rows down the slope or cut channels through the beds to allow the water to escape. A four inch PVC pipe can also be installed for drainage through the beds in drain pocket between the beds holding water.. Raspberries are not tolerant of "wet feet". **They are very, very susceptible to Phytophthora root rot. Bedding to improve drainage is generally recommended in the South for raspberries.**

Because irrigation greatly increases bramble plant growth and fruit production during dry periods, select a site that can be irrigated. Normally drip irrigation is used. Drip tapes can be purchased which uses .18 to .5 gallons per 100 feet per minute. Set up your irrigation zones based on your water flow. Plan to apply up to 2400-3000 gallons per acre per day under extreme heat and drought conditions. See your county agent or irrigation dealer to plan the zoning of the field.

If possible select an open site since air movement is important for disease prevention and frost protection. **Because cold and damp air settles into low areas, a hilltop site with good elevation minimizes the chance of freeze damage.** For information about frost protection see that section.

Try to eliminate all perennial weeds such as wild brambles, bermuda grass, and johnson grass from the site before you plant. This usually involves spraying a herbicide the fall before planting. Several grass killers (Select, Fusilade, or Poast) which do not damage the brambles are

now cleared for use on non-bearing plants, so grass is less of a problem that it was a few years ago. However it is difficult to remove wild brambles from established brambles, so make a serious effort to eliminate these before planting or during the first growing season.

Consider erosion and contour of the land when you choose a site. Rows oriented in a north-south direction are usually slightly more productive than east-west oriented rows. However, erosion and contour of the land may pose problems. On pick your own farms, consider picker access in the row orientation and length.

Plant spacing

Plant semi-erect thornless and trailing type (trellised) blackberries and trailing (trellised) raspberries four to eight feet apart in the row, erect raspberries three feet apart in the row and erect thornless and thorny blackberries two to four feet apart in the row. When using root cuttings the two foot spacing is most commonly used, since all the root cuttings will not emerge. When using plants, the four foot spacing is most commonly used to save money. After a few years a hedge row should be formed. The distance between rows will vary depending upon the width of your equipment and the trellis system used. Generally, most growers use a spacing of nine to 12 feet. Vigorous, thorny erect blackberries should be spaced 12 feet between rows if you plant to maintain the planting with a five foot wide small farm tractor. If you are using a garden tractor or riding lawn mower, a spacing of nine feet between rows should be satisfactory.

4. PROPAGATION

To propagate patented University of Arkansas releases you must become a licensed propagator. Contact Dr. John Clark, 316 Plant Science, Dept. of Horticulture, University of Arkansas, Fayetteville, AR 72701 (501-575-2810).

Leafy Stem Cuttings

You may produce nursery plants from leaf stem cuttings. Make cuttings from the top four to five inches of new canes when these shoot tips are still succulent but firm. A good cutting should snap cleanly when bent. Stick cuttings in a perlite/ peat, peat/ sand, or pinebark/peat/sand mix to ensure optimum water drainage. Dipping the cutting in rooting hormone may enhance rooting, but information is limited in this area. Commercially, cuttings are propagated under intermittent mist, but you can use a plastic covered propagation frame in the shade with daily watering for small production needs.

Root Cuttings

Root cuttings are effective for propagating erect or semi-erect blackberries planted directly in the field or the nursery. Direct-planted root cuttings are the least expensive and fastest method to plant blackberries. Root cutting can also be planted in a nursery for one year and then the plants transferred to the field. Dig roots one-fifth to one-half inch in diameter and cut each into pieces four to six inches long. Very short or wiry root cuttings do not have enough food reserves to succeed. You can collect roots in the dormant season by plowing a furrow away from the parent plant and picking up the exposed roots. For direct field planting space the cuttings two feet apart in the row. Normally a tobacco or vegetable transplanter is used to plant the root cuttings. If you are planting by hand, scratch a small furrow about three inches deep with subsoiler or middle buster, lay the root cuttings in the furrow, and cover with soil. Plant root cuttings in late winter or early spring.

Root cuttings must form roots and a shoot after transplanting to survive. This requires a great deal of energy. When the plant finally emerges from the soil it is in a weakened condition. After emergence, the plant will remain small for about six weeks while it builds its reserves. After this phase, rapid growth occurs, usually starting in mid-June in South Georgia. Near perfect weed control is needed for root cuttings during the establishment phase.



Figure 4.1: Root cuttings are an economical method of establishing cuttings of excellent weed control can be provided.

Tip Layering

You can propagate erect, semi-erect, and trailing blackberries by tip layering. You can set up a nursery for tip-layering propagation only, or you can tip layer from first-year shoots on producing plants. First-year shoots are vegetative. In a propagation nursery, set plants 4 feet apart and cut them to nine inches when you plant them. "Summer top" new and vigorous canes by cutting off the upper three to four inches of the 18- to 30-inch canes. Pruning encourages lateral shoot growth which produces more shoot tips.

In the fall you can soil layer these shoot tips to produce more plants. To layer, dig a three-inch deep hole with a shovel or post hole digger. Place the shoot tip in the hole and cover the entire shoot tip with soil. By the end of the winter season, many roots should have developed at the buried shoot tip. Cut off the tip of the shoot about six inches above the soil line. Dig layered plants and transplant them early in the spring.



Suckers

Most erect and some semi-erect blackberries produce suckers from their roots. Dig these small suckers and transplant them from the late fall to early spring. If the top of the sucker is large and the attached root small in size, cut the top back to be in balance with the root system. Transplanting suckers should have little affect on the production of the parent plants.

Figure 4.2: 'Kiowa' plants propagated from tip layering in October, ready for setting in December. 'Kiowa' is semi-evergreen in south Georgia.

5. SELECTING, HANDLING, AND

SETTING PLANTS

Healthy bramble plants have bark which is brown, green or red with a greenish inner bark. To check a plant, nick the bark with a knife. If the inner bark is not green, the top is probably dead. Plants with gray patches on the bark may have anthracnose. Healthy bramble roots are brown on the outside and white inside.

If root cuttings or plants arrive weeks before planting, store them in a plastic bag(s) in the refrigerator. Inside the bag(s), cover them with damp (not wet) peat moss. You may also store plants or roots for a short time "heeled in." To heel in, dig a trench in a shady area and cover the root cuttings or roots of the plants with damp soil. In the case of a severe freeze threat cover the plants with leaves or straw for insulation.

When you set plants or root cuttings, be careful not to let the roots dry out. Carry the plants to the field in buckets of water or plastic bags. You can dip the roots in a mud slurry to reduce drying. Cut back the tops of plants to about six inches before you plant. Spread out the plant roots and remove air pockets by firming the soil.

6. FERTILIZATION

Brambles have modest fertilizer requirements but are very responsive to fertilization. Be careful to not over fertilize when the plants are small. It is easy to damage young plants with excess fertilizer.

Preplant considerations

Sample your soil to determine your pH and levels of phosphorus and potassium and apply lime and fertilizer according to the soil test recommendations. If phosphorus levels are low (less than 30 pounds per acre) apply 60 pounds per acre of phosphate preplant and till it into the soil. If the pH is low, use dolomitic limestone to raise it to 6.0 to 6.5. Dolomitic limestone contains magnesium as well as calcium. The lime must be thoroughly tilled into the soil. Phosphorus and lime moves downward very slowly in many Georgia soils.

Fertilizing hedgerow plantings of erect blackberries

During the year of establishment, fertilize the planting in March, June, and August (if needed). If phosphorus and potassium do not test high, use 10-10-10 or a similar fertilizer. Apply 4.5 pounds of 10-10-10 per 100 feet of row (about 160 pounds per acre) at each application. This fertilizer should be sprinkled evenly over a two foot wide band where the plants or root cuttings are planted. This is equivalent to 16 pounds of nitrogen per acre at each application.

Fertilization the second year and thereafter should consist of two applications annually. Apply 11 pounds of 10-10-10 per 100 feet of row (about 400 pounds per acre) over a 3 foot wide band in early March. In June, apply 5.5 pounds of 10-10-10 per 100 feet of row (about 200 pounds per acre) evenly over a 3 foot wide band. For soils testing high in phosphorus and potassium, use ammonium nitrate at 1/3rd the rate of 10-10-10. Ammonium nitrate contains 33.5% nitrogen. On a per acre basis this is 40 pounds of actual nitrogen on the first application and 20 pounds of actual nitrogen on the second application.

Fertilizing semi-erect or trailing blackberries or raspberries (Dormanred) planted 4 to 8 feet apart

During the year of establishment, fertilize the planting in March and June (and August if needed). On soils not testing high for phosphorus and potassium use 10-10-10 or similar fertilizer. After the plants have been set and settled by rain, sprinkle 1/6th cup (1.3 oz.) of 10-10-10 fertilizer evenly in a 24 inch circle around each plant. Do not pile fertilizer near the plant, this could burn the root system. In June, sprinkle 1/4 cup of 10-10-10 (2 oz.) over a 30 inch circle. Scatter the fertilizer evenly over the circle

In the second year, fertilize the planting in March and again in June. In March or about the time of bud break, sprinkle one cup (8 oz.) of 10-10-10 over a five foot circle around the plant. Scatter the fertilizer evenly over the circle. In June sprinkle one cup of 10-10-10 fertilizer over the same five foot circle around each plant.

Fertilization in year three and beyond should be as follows. In early March, sprinkle two cups (one pound) of 10-10-10 fertilizer over a six foot circle around each plant. Scatter the fertilizer evenly over the circle. In June sprinkle one cup of 10-10-10 over the same six foot

circle around each plant. If new cane growth is excessive (over 12 feet for individual canes), omit this application.

For soils testing high in phosphorus and potassium, use ammonium nitrate at 1/3rd the rate of 10-10-10. Ammonium nitrate contains 33.5% nitrogen.

Fertilizing hedgerow plantings of florican raspberry varieties such as 'Latham' (summer fruiting)

If soil does not test high for phosphorus and potassium use 10-10-10 or similar fertilizer. During the year of establishment, fertilize the planting in March, June and August (if needed). Apply 4.5 pounds of 10-10-10 fertilizer per 100 feet of row (about 160 pounds per acre) at each application. This fertilizer should be sprinkled evenly over a 2-foot wide band where the plants or root cuttings are planted. This is equivalent to 16 pounds of nitrogen per acre at each application.

Fertilization the second year and thereafter should consist of two applications annually. Apply 11 pounds of 10-10-10 fertilizer per 100 feet of row (about 400 pounds per acre) over a 3-foot wide band in early March. In June, apply 5.5 pounds of 10-10-10 fertilizer per 100 feet of row (about 200 pounds per acre) evenly over a 3-foot wide band. For soils testing high in phosphorus and potassium, use ammonium nitrate at 1/3rd the rate of 10-10-10. Ammonium nitrate contains 33.5% nitrogen. On a per acre basis this is 40 pounds of nitrogen on the first application and 20 pounds of nitrogen on the second application.

Hedgerow planting of primocane raspberry varieties (late summer and fall fruiting varieties such as 'Heritage' and 'Redwing' pruned to ground level each winter)

During the year of establishment, fertilize the planting in March and June. On soils not testing high for phosphorus and potassium use 10-10-10 or similar fertilizer. Apply 4.5 pounds of 10-10-10 fertilizer per 100 feet of row (about 160 pounds per acre) at each application. This fertilizer should be sprinkled evenly over a 2-foot wide band down the row. Do not apply an excessive amount of fertilizer near newly set plants. This is equivalent to 16 pounds of actual nitrogen at each application.

In the second year, fertilize the planting in March and June. Apply 9 pounds of 10-10-10 per 100 feet of row (about 320 pounds per acre) at each application. This fertilizer should be sprinkled evenly over a 3-foot wide band down the row. This equivalent to 32 pounds of actual nitrogen at each application.

In the third year and after, fertilize the planting in March and June. Apply 13 pounds of 10-10-10 per 100 feet of row (about 470 pounds per acre) at each application. This fertilizer should be sprinkled evenly over a 4-foot wide band down the row. For soils testing high in phosphorus and potassium, use ammonium nitrate at 1/3rd the rate of 10-10-10. Ammonium nitrate contains 33.5% nitrogen. This is equivalent to 47 pounds of actual nitrogen at each application.

7. IRRIGATION

Irrigation increases plant survival, growth and yields. Drip irrigation can be performed with:

1. Button type emitters that are punched in 16 mm plastic tubing every four feet and apply one to two gallons of water per emitter per hour (depending on the type selected)
2. Drip tape with inline emitters like the type used on vegetables.

If the drip tape is used, it should be buried about three to four inches deep beside each row to reduce the problem with rodents chewing holes in the tubing. The problem is especially acute then the tubing is left on the surface of the soil. Rodents will also chew on 16 mm plastic tubing, but this tubing is thicker than the drip tape. Rodent damage is painful to repair on thorny erect blackberries! The 16 mm tubing and emitters can be buried and ported to the surface with a piece of "spaghetti" tubing to reduce the chance of rodent damage. Setting the drip system up to be operated by solenoids and time clocks is highly advisable.

Irrigation rates for lines with button emitters

There is little information available on bramble drip irrigation in the South, but typically fruit plants in Georgia carrying a fruit load need a maximum of 2400 gallons per acre per day during the hottest part of the summer. Pan evaporation rates during this part of the year are about 0.3 inches per day in Georgia. If you have one gallon emitters spaced four feet apart and the rows are 12 feet apart, the system will apply 909 gallons of water per hour. To apply 2400 gallons per acre run the system for 2.6 hours per day. When the weather is just warm instead of hot, and pan evaporation rate is about 0.2 inches per day, cut the time you run the system back by one third to 1.5 hours per day.

Irrigation rates for drip tape

Depending on the emitter spacing and rate, drip tape lines typically apply .18 to .5 gallons per minute per 100 feet. To figure the length of time you need to run your drip tape irrigation system, start by calculating your row spacing. A square acre is 208.6 feet by 208.6 feet. If the rows are 12 feet apart, there is 3626 feet of row per acre. (208.6 feet divided by 12 feet between rows = 17.38 rows per acre times 208.6 feet long = 3626 feet of row per acre). If your drip system applies .45 gallons per 100 feet per minute, then each minute it applies 16.32 gallons per acre. (3626 feet of row per acre divided by 100 = 36.26 one hundred foot units times .45 gallons per 100 feet per minute = 16.3 gallon per minute per acre). In an hour the system will apply 978 gallons per acre. To apply 2400 gallons of water, run the system for 2.5 hours per day. (2400 divided by 978 gallons of water per hour = 2.5 hours). When the weather is just warm instead of hot, and pan evaporation rate is about 0.2 inches per day, cut the time you run the system back by one third to 1.7 hours per day.

Drip irrigation should be run on a daily basis until rain is received. If a half-inch of rain is received, cut off the system for 2 days. If an inch is received, cut off the system for 4 or 5 days. During the first year when the plants are being established, water the field with drip tape for about three hours a day, twice a week, if needed. After harvest, run the drip system occasionally as needed to keep the plants healthy and promote additional growth (if needed).

Sprinkler irrigation rates

Sprinkler irrigation works well on brambles. The primary advantage is all the soil can be wetted and there are fewer problems with rodent damage and repair. In addition, a properly designed sprinkler irrigation system can also be used for freeze protection. The disadvantage is the wetting of the fruit and foliage. However, if irrigation is conducted in the morning, the plants dry off

fairly quickly. Make sure your water source is free of pathogens before using overhead irrigation close to harvest. If you use sprinkler irrigation, 1.5 inches of water per week should be applied during the hottest part of the year when fruit is on the bush and pan evaporation is .3 inches and above. During warm weather, when pan evaporation is about .2 inches, apply one inch per week. Keep a tally on rainfall and subtract this from the total needed each week. After harvest, water occasionally as needed to keep the planting healthy.

8. FROST PROTECTION

Open blooms and developing fruit can be killed at temperatures at or below 28°F. Planting brambles on high elevations and on hill tops will minimize the damage from spring freezes during radiation freezes. Many cultivars of brambles bloom later than peaches, blueberries, and other crops, so spring freeze damage is much less of a problem on brambles than on other crops. However, 'Choctaw', 'Cheyenne' and 'Rosborough' do bloom early enough to occasionally suffer freeze damage on some sites.

Single nozzle, low gallonage sprinklers which apply approximately 0.12 to 0.20 inches per hour are recommended for frost and freeze protection. They are highly effective for freezes without much wind. A trellis system may be needed to support the load of ice and prevent cane damage. Begin application of water for frost and freeze protection when the air temperature surrounding the plants reaches 34 degrees F, and continue until the air temperature goes back above 32 degrees F and the ice continues to melt when the system is turned off. Irrigation for frost and freeze protection will provide protection down to 22 degrees F at 0.12 inches per hour, under conditions of no wind. With wind, the effectiveness of the system greatly decreases because of evaporative cooling. Always provide an adequate water supply capable of running 12 to 16 hours a night for two nights in a row.

Spacing between sprinklers and between lateral lines for frost and freeze protection, will depend on pressure and sprinkler type. For permanent irrigation systems, calculation of spacings for sprinklers and lateral lines are especially critical for ensuring that adequate frost and freeze protection are provided. Therefore, it is recommended that growers contact their state Extension irrigation specialists via their county agent who have responsibility in this area prior to purchasing and installing systems which will provide for frost and freeze protection in addition to supplemental irrigation. An excellent reference is Frost/ Freeze Protection by Sprinkler Irrigation by Mr. Tony Tyson, et al. (www.smallfruits.org) copy can be obtained by contacting your county extension agent in Georgia. .

To monitor temperatures, hang thermometers* in the bushes. Locate several thermometers throughout the field. On cold nights, read these thermometers every half hour. Turn on the irrigation system when the temperature reaches 34°F on any of the thermometers, and leave the water on until the ice is freely melting the next day and continues to melt when the system is turned off.

If your brambles do freeze, assess freeze damage by examining the female flower parts for water-soaked or darkened appearance. In some cases, the petals may appear normal even though the female flower parts have been killed.

*Calibrate thermometers by placing them, bulb end first, into a wide-mouth quart jar that contains ice and cold water. Stir water for two minutes and then read the thermometer while it is in the ice water. The temperature should read 32°F. Note any needed corrections on the thermometer frame to compensate for error.

9. POLLINATION

Blackberry flowers produce nectar and pollen that attract bees. The honey produced has a light amber color and good flavor. Brambles are generally self-fruitful and lack of fruit set is usually due to poor bee activity, thrips, gall midges, virus problems or double blossom disease rather than pollen incompatibility.

The blackberry fruit is a compound fruit) each blackberry seed is the center of a distinct fruitlet and each seed is the result of pollination. Inadequate pollination often results in smaller or imperfect fruit because not all drupelets are formed. For commercial production, place two or more strong honeybee colonies in each acre of blackberries at bloom time. In 1999 and 2000 thrips and gall midges severely damaged some cultivars by entering the flowers just before they opened and eating the pollen and rasping the flower parts.

10. TRELLISING, TRAINING, AND PRUNING

Trellises are required for trailing or semi-erect brambles. They are also beneficial for some cultivars of erect blackberries such as 'Arapaho' and 'Kiowa', primocane fruiting raspberries, and floricanes fruiting raspberries. The primary reason for trellising is to keep soil from splashing on the fruit and keep the canes from falling into the aisles.

SPECIFIC TRAINING AND PRUNING INSTRUCTIONS

Erect Blackberries

Year one and second spring

Thorny and thornless erect blackberries are normally pruned into a free standing hedge in the second year. However, the first growing season many erect blackberries will be trailing or semi-trailing much like dewberries. The degree of trailing varies with the cultivar. 'Kiowa' is one of the most prostrate the first year. Normally this would make a cultivar undesirable to grow. However, since 'Kiowa' is such an outstanding cultivar, it is worth the extra effort required to grow it.

The first problem created by prostrate growth is weed control. The blackberry shoots will be intermingled with the weeds, preventing effective use of paraquate (Gramoxone), glyphosate (Roundup), etc.. Several strategies can be used to combat this problem. Trailing canes can be tipped at 18 to 24 inches from the crown several times to encourage branching and create a more compact "bush" the first growing season. After tipping, a contact (postemergence) herbicide can be applied with greater safety. Several options are then available to keep the fruit off the ground:

1. Do nothing except tipping and harvest the fruit that are not in contact with the soil or have soil splashed on them in the second year.
2. Put a bamboo stake about three feet long at each plant and tie the longer canes to the stake during the first summer and winter. In areas where bamboo can be obtained for free this is more practical. Placing a quart milk carton or plant band over the plant and the bamboo stake will allow for herbicide application to the base of the plant.
3. Put up a light string trellis about 2.5 feet off the ground. A single strand of plastic baling twine down the center of the row and supported by tomato stakes can be used. Canes that are in contact with the soil can be tied to the string with string or plastic plant tying tape. This trellis will only last one season unless the tomato stakes are treated.
4. A combination of 2 and 3.
5. Install wooden or metal fence posts about 20 to 30 feet apart and use a strings on both sides of the canopy and post to keep the canes off the ground. The strings are spaced at two feet and four feet. Single strings can also be used, but then it is necessary to tie the canes to the string. Plastic baling twine works well for the trellis line. To tie limber canes to the line, a banding machine (i.e. Maxtapener) can be used. This is a semi-permanent installation. In addition to being useful for supporting the first season growth of all cultivars of erect blackberries, it is useful for mature erect blackberries that have poorly anchored canes or a floppy growth habit. Some cultivars with this problem are 'Cheyenne', 'Arapaho', and 'Kiowa'. Once the canes reach the top of the trellis, tip them to encourage them to branch. This will help fill out the trellis with fruiting wood.

Bear in mind that trellises will limit mowing to ground level as a double blossom management tool and clean up method unless the trellis is removed. A removable T bar trellis system is described in the primocane raspberry training section.

Photos of some trellising options:

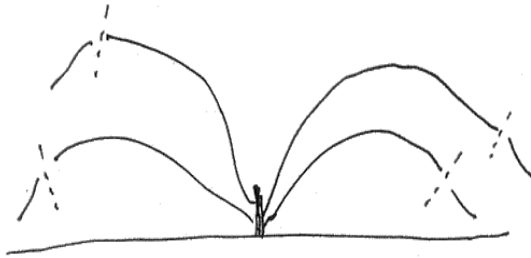


Figure 10.1: Tipping of shoots the first year to make a more compact "bush".



Figure 10.3: 'Kiowa' plants during the first growing season tied to a bamboo stake with a Maxtapener. After tying, the weeds can be sprayed with a postemergence herbicide.



Figure 10.2: 'Kiowa' plants at the end of the first summer, following summer tipping. The grass under the plants was killed with a selective grass herbicide and the broadleaf weeds pulled by hand.



Figure 10.4: 'Kiowa' plants in the first growing season. A light trellis made of wood with a single plastic baling twine lines at two and four feet. First year blackberry canes are tied to the line with a plastic banding machine (i.e. Maxtapener) or string.

Second summer

Hedging (tipping) of the new primocanes should begin at about three to three and one-half feet after they grow up through the floricanes. You can top the canes with hand shears, machetes, Christmas tree knives, gasoline hedge pruners or sickle bar type mowers. Hedging vigorous cane growth at monthly intervals from May through August or as needed will result in a well-branched, dense hedgerow with greatly increased fruit potential. If a hedgerow height of four feet is desired, begin topping at about three feet and gradually increase the height to four feet with each successive topping. Mow along side the hedge row to maintain the width at no more than four feet.

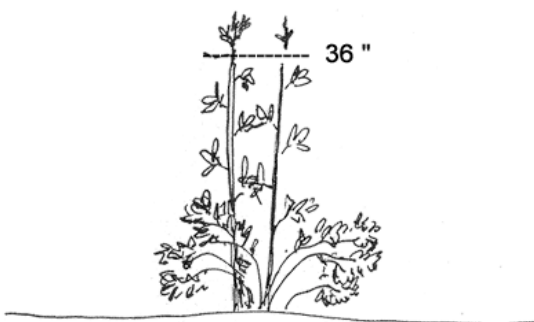


Figure 10.6: Hedging shoots the second summer should start at three feet.



Figure 10.7: Blackberries being tipped with a machete.

Figure 10.8: Winter view looking down the head of the row showing the effect of summer hedgings. After each cut, several lateral branches emerge and these are tipped when they are six to twelve inches long. The finished hedge should be about four to four and a half in height. An unpruned plant is shown on the right for contrast.

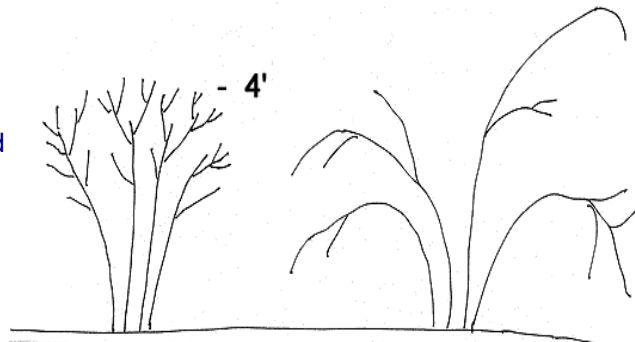


Figure 10.9: 'Arapaho' in the second year. A light trellis made of metal or wooden fence posts with plastic baling twine used on both sides of the canopy. A trellis system like this can be useful the second year on many cultivars. On cultivars that have a floppy growth habit or poorly anchored canes it can be useful on mature plantings of erect blackberries.



Figure 10.10: Hedge of 'Kiowa' at the end of the third summer. Multiple summer hedgings created this hedge.

Third and subsequent summers

Immediately after harvest, cut the hedge row back to 3 ½ to four feet, then gradually increase the hedgerow back to the desired height during subsequent summer hedgings. Two to four hedgings will be required. It is probably best to keep the hedge height at four to 4 ½ feet and hedge width at no more than four feet. This is especially true if a trellis is not used.

After harvest, the floricanes die. Ideally they should be cut out and removed from the planting after harvest to lessen the spread of disease. They are also a nuisance for pickers the following year. Removing the dieing floricanes on thorny cultivars can be very laborious and painful. Welder's gloves or heavy leather gloves with arm protection like the type used by bee keepers can be used to help reduce the number of injuries. Because removing the dead floricanes is a great deal of work, some growers prefer to leave them in the planting and mow the planting after harvest every four years.

Mowing in year four

If annual or biennial removal of the dead canes is not practiced, then mowing every four years just after harvest may have merit. This practice is especially beneficial when you have a buildup of an excessive number of dead canes, cane diseases, double blossom, and insects such as cane borers. It is necessary to mow off the plants at one foot or below to remove most of the double blossom disease. Mowing off at one foot will control the double blossom without reducing yields as much as mowing at ground level. The reduction usually ranges from 50 percent or more with irrigation and good management, to 100 percent with no irrigation and poor management.

Use a sickle bar mower, if possible. If a sickle bar mower is not available, a tractor driven rotary mower with newly sharpened blades can be used. This is not as good as a sickle bar mower, since many of the primocanes canes will be shattered and have to sprout from near ground level. After mowing, it is best to remove the infected canes from the field and burn them. If this can not be done, place the cut canes in the aisles and chop them up thoroughly with a rotary mower or flail mower.

Mowing for alternate year production

One approach to pruning has been to plant double the acreage needed and mow one-half the field each winter. This system should reduce the amount of double blossom disease and clean up the old canes nicely, however, it has not been popular because there is no production in an off year. This method could be used by organic growers who cannot achieve rosette control since they are not using fungicides.

Trailing or Semi-erect Blackberries

Trailing or semi-erect blackberries require a trellis as a support system. There are many options. A brief description of a few of the systems is included. For additional information consult one of the references listed at the end of the publication.

1. Single-wire trellis
2. Two or three-wire vertical trellis
3. Two-wire horizontal trellis
4. Double curtain V trellis
5. Single sided shift trellis (SSST)

Single -wire trellis

A trellis with a wire at least four feet above ground is constructed. In the winter, the plants are tied to the wire and the ends shortened if needed so they do not overlap the adjacent plant by more than two or three feet. Side laterals are shortened to 18 inches. Laterals on the lower two feet of cane are removed. Canes are thinned to 6-8 per hill if needed. Crowding of the canes on the wire is a problem with this system. During the summer new primocanes of trailing cultivars should be directed into the herbicide band to minimize damage from pickers stepping on the canes and tractors running over the canes. Immediately after harvest, the dieing floricanes should be removed and the new primocanes tied to the wire.

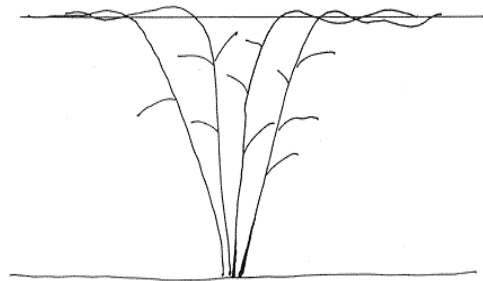


Figure 10.11: Single wire trellis for trailing or semi-erect bambls. Note how the side shoots have been cut back to 18 inches.

Two or three wire vertical trellis

End posts are typically seven to 7 ½ long and at least six inches in diameter. Set them two to 2 1/2 feet in the ground. Line posts should be six-and-a-half feet long, at least three inches in diameter, and set one-and-a-half feet in the ground. Place line posts 20 feet apart. If you use a two-wire system, use #9 gauge galvanized wire for the upper wire and #10 or #11 wire for the lower wires. Loosely staple wires to the line posts and pull the wire tight at the end.

Brambles can be trained to one, two, or three wire trellises. The number of wires you plan to use determines the training style. Three wire trellises are more costly but are ideal for weaving trailing brambles. Tying or banding machines are available at reasonable cost from many horticulture supply dealers. See your county agent if you do not know a source, he or she can contact the senior author of this publication for you.

During late winter, select and retain six to eight of the most vigorous main canes produced during the preceding year. Train canes in a fan pattern away from the crown and tie them where canes cross each trellis wire. Prune back lateral shoots to lengths of 10 to 20 inches. However, if they are vigorous and originate below the bottom wire, do not prune them back as much. Tie these longer lateral shoots to the upper trellis wires just as you do with main canes. Head-back (shorten) main canes as necessary to prevent competition among plants, but allow shoots of adjacent plants to overlap a foot or two at their ends. Second year plants should retain a total cane length of 20-50 feet. The growth habit of thornless blackberries may change as the plants and crowns become large and more mature. In the third year and after, you may have mostly very large diameter canes and few small diameter canes. In this case, the lateral shoots may bear most of the fruit. Be sure to keep a sufficient number of shoots during dormant pruning to maintain a total cane length of approximately 55 feet (example: 37 laterals averaging 18" length). Large, healthy plants may be able to support cane lengths of up 100 feet

During the summer, train the new primocanes into the herbicide strip, or tie them temporarily to the trellis to keep them from being crushed. After harvest, the dieing floricanes are removed and the primocanes are tied to the trellis to keep them out of harms way. The primary problem with this trellis type is the potential of sun scald on the fruit and high labor requirements.

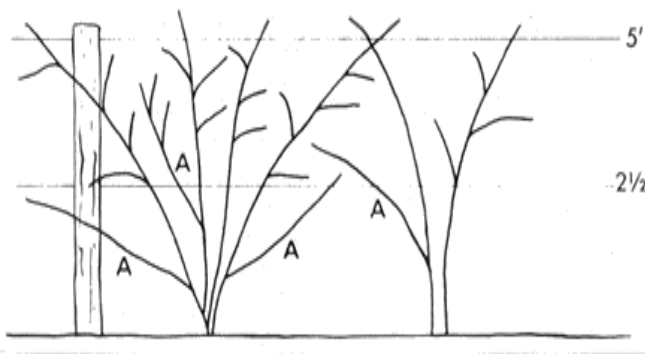


Figure 10.12: This is a two wire trellis system which works well on semi-erect thornless blackberries such as 'Hull.' The canes are trained in a fan shape and side shoots are cut back to 10-20 inches, except where an extra cane is needed (A). Canes are tied to the wire with string or plastic tying ribbon.

Brambles with wiry growth such as dewberry- type blackberries and 'Dorman Red' raspberry can be trained to a three wire trellis. After harvest, the old canes are removed and the new primocanes placed on the wire. As the new canes grow they are "woven" between the wires.

Double curtain V trellis

The double curtain V trellis uses a V shaped trellis to allow the primocanes and floricanes to be separated. Primocanes are tied to one side of the trellis and floricanes (fruiting canes) to the other side of the trellis. Floricanes can also be tied to both sides and primocanes trained to go in between, in the middle of the V. After harvest the dieing floricanes are removed. The following

spring the new primocanes are trained to this wire. The primary problem with this trellis type is difficulty of harvesting fruit on the inside of the trellis.

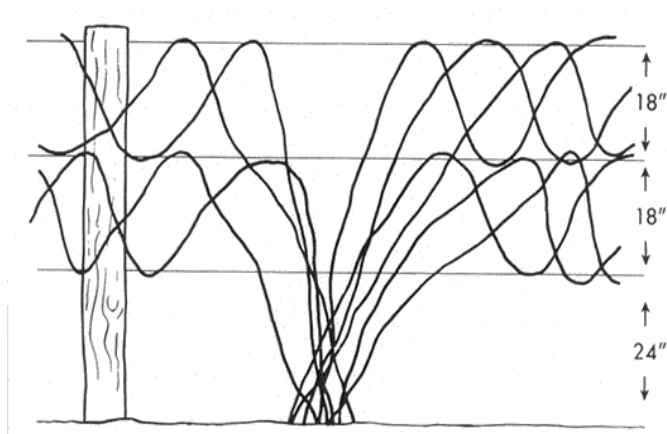


Figure 10.13: This shows a trellis and training system which works well on trailing brambles such as 'Dorman Red' raspberry. Canes can be arranged in many patterns, but this weaving technique is one of the best. Care must be taken not to bend the canes too far or they will be damaged.

Figure 10.14: Double curtain V trellis. Metal fence posts are placed at 20-30 degree angles. Primocanes are tied to one side and floricanes are tied to the other side of the trellis.

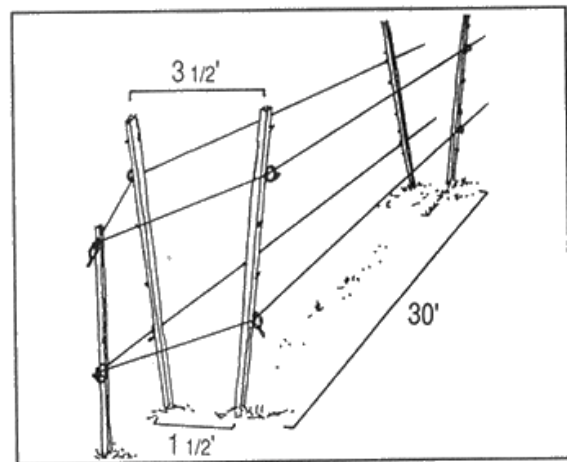


Figure 10.15: First and second leaf plantings of thorny erect blackberries on V trellis. In this case black plastic with methyl bromide fumigate was used preplant to help control weeds. The black plastic is split in the middle and pulled back as the plants grow to allow new canes to emerge..

Stiles single-sided shift trellis (SSST) and limited arm rotation system (LARS)

Two new types of trellis systems which have recently been developed in Virginia by Dr. Herbert Stiles are the single-sided shift trellis and limited arm rotation system. Both operate on the following basic system. Canes are trained onto a trellis which can be shifted between near vertical and horizontal. In late winter, the canes are tied to the trellis while in its horizontal position. When buds break in the spring they grow upward and flower profusely like a carpet of wildflowers. After fruit set, the trellis is shifted to a near vertical position leaning about 25 degrees to the West, so the fruit can be easily harvested and protected from sun scald. During the spring and summer, the new primocanes are tied to the trellis while in the near vertical position. Old canes are removed after harvest.

Additional information on these systems is available
<<http://www.vaes.vt.edu/research/publications/index.html>>

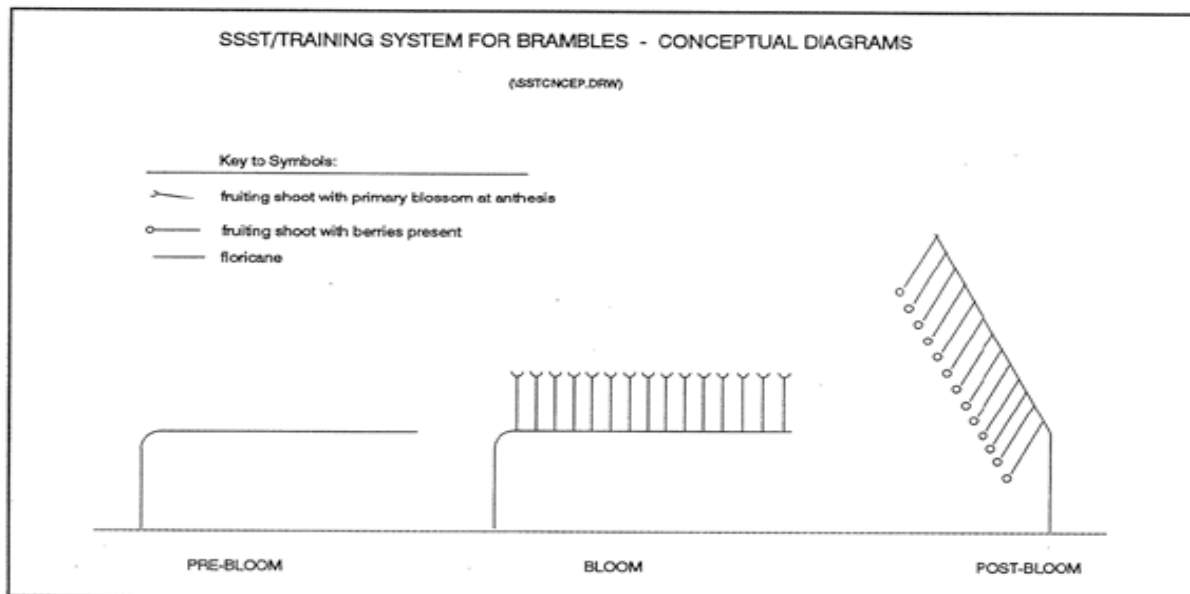


Figure 10.16: Single-sided shift trellis conceptual diagram. In the Spring, the shoots grow to the sun, and the blossoms are produced on one plane. After bloom, the trellis is shifted to a near vertical position leaning to the West. This makes harvesting easy and protects the fruit from morning sun scald.

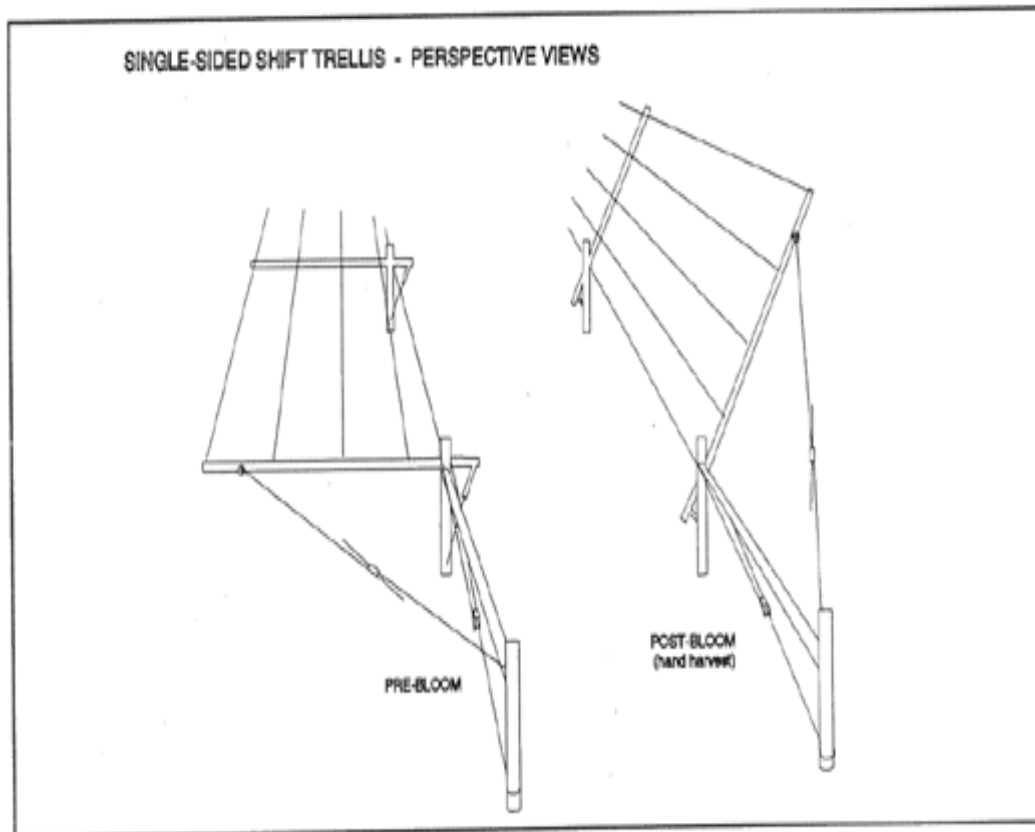


Figure 10.17: Single-sided shift trellis-perspective views. For detailed information on construction consult the web site listed or ask your county extension agent to print you a copy from the web site.

Pruning and Trellising Erect Primocane Fruiting Raspberries

Primocane fruiting raspberries such as 'Heritage' and 'Redwing' produce fruit on the tops of first year canes in late summer and fall. If allowed to overwinter, these same canes (now called floricanes) will produce fruit again in early summer of the second year. However, double cropping is too stressful on the plants in Georgia and the quality of the summer fruit can be poor. For this reason, it is recommended that only a fall crop be produced.

To produce only a fall crop, cut the canes as close to the ground as possible in mid- winter so that buds will break from below ground level. Canes can be mowed off at about one inch. Collect the cut canes and burn or compost them to help control diseases. As the canes develop in mid-summer, pinching out the tips will help stimulate growth of laterals and also help delay fruiting until cooler weather.

Allow all the canes in a 12-18 inch wide band to grow. Leaving all the canes that come up in this area to grow will increase yields, but not decrease fruit size. A T bar trellis is normally used for primocane raspberries to help support the crop. Wooden or metal posts, approximately seven feet long, with a three foot cross arm are used. The ends of the cross arms have a screw eye to hold a length of baling twine. Each T-shaped post is set into a hole in the center of each row and

holes are placed 25-30 feet apart within the rows. A three foot section of PVC pipe can be set into the holes immediately after they are dug to prevent them from collapsing. Before harvest, T-posts are slid into the PVC-lined holes. The baling twine is strung from pole to pole and pulled tightly to lift canes upright. After harvest, the twine can be cut and posts removed and stored for another year.

(This paragraph with permission from Bramble Production Guide by Marvin Pritts).

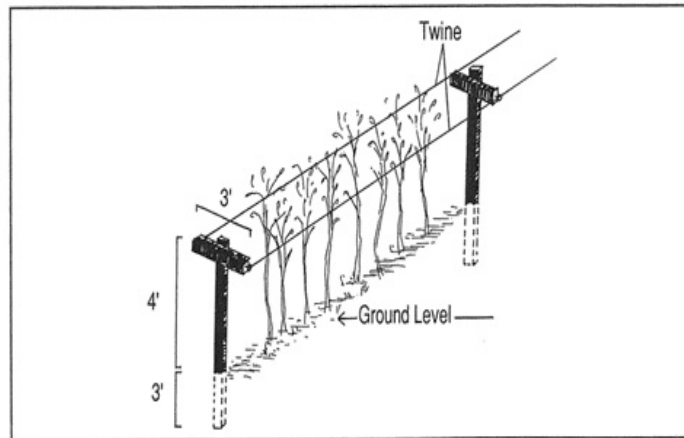


Figure 10.18: T-bar trellis system commonly used on raspberries. To make this type of trellis removable, bury a four inch diameter piece of PVC and slip the post into this PVC sleeve.

Pruning and Trellising Floricane Fruiting Raspberries

Floricane fruiting raspberries produce non-fruiting canes the first year, called primocanes. The second year, these canes produce fruit in spring / early summer and are called floricanes. After fruiting the floricanes die. Row widths for floricane raspberries should be no more than 18 to 24 inches. There are many different systems of managing floricane raspberries. Since they are rarely grown in Georgia, only one management system is illustrated in the next paragraph. For additional information consult The Bramble Production Guide by Dr. Marvin Pritts. The address is listed at the end of this bulletin.

Thinning of primocanes is beneficial. Allow only four or five primocanes per foot of row to develop. Rejected primocanes are cut to the ground when 8 inches tall. After harvest, the dying floricanes are cut off at ground level. Summer pinching (hedging) of primocane raspberry shoots is generally not recommended. A canopy of up to 4.5-5 feet in height is allowed to develop. If the canopy grows too tall or the tips have been winter injured the canopy can be hedged in late winter. Generally no more the 1/4th of the height should be removed, or yield will be severely reduced. Yields can be increased by the use of V trellis system (Figure 10.13) in which the primocanes and floricanes are tied to separate wires. There are many other systems for training floricane raspberries.

Pruning Dormanred Raspberries and Dewberries

Dormanred raspberries are trailing, so new canes grow along the ground. After harvest, remove the canes which have just fruited. In south Georgia, tie the new canes to the trellis after you remove the old ones. In north Georgia, leave the new canes on the ground until the next spring to reduce winter injury. Often the canes will be excessively long. Shorten the canes to fit their allotted space on the trellis.

11. WEED CONTROL

Weed control can be a major problem in bramble production. Since brambles produce new canes from ground level each year, during much of the season it is not possible to use “burn down” type herbicides like those used on trees and grapes. However weed control is very important in bramble production. Try to keep a band at least four feet wide with the plant row in the center free of weeds. An exception to this rule may be a situation where you have a light sandy soil that is prone to splashing up on the fruit. In this case it may be advisable to narrow the herbicide band to two feet and / or allow a light weed cover to grow along side the row. Keep the weeds closely mowed. Mulching may also be an option (see next section). The aisles between the rows should be kept mowed. Cultivation is generally not recommended. It can damage the roots and help spread crown gall disease. Cultivation also increases soil erosion and can lead to heat build up problems during the summer.

In the year of planting several strategies can be used. If you are planting root cuttings, put on a “cracking” spray of postemergence, systemic herbicide (such as glyphosate (Roundup or various other brands) or sulfosate (Touchdown)) when the first plants break the surface of the soil. Cover the first plants to emerge with paper cups or they will also be killed. This will destroy the weeds that have emerged since planting the root cuttings. A burn down material such as paraquat (Gramoxone or Boa) can also be used for this application.

If you are setting out plants, a low rate of preemergence herbicide (Surflan) can be used after the plants have been settled by rain or overhead irrigation. See the Georgia Pest Control Handbook for rates. This will control some of the weeds which emerge from seeds. Grasses can be controlled with several different postemergence grass materials. These materials will kill only grasses. Mulching is another option.



11.1 Weeds should be controlled in at least a four to six foot wide band centered on the row. Weed free area should be two feet beyond each side of row edge. If the area under the plants is two feet wide, and a two foot wide weed free band is used each side of the row, the total weed free area is six feet. Exceptions are very steep land prone to erosion and situations where splashing soil is a problem. In this case control weeds under the plants and one foot on each side of row edge.

After the young plants are up and growing, weeds can be controlled with carefully applied applications of postemergence systemic herbicides such as Roundup and Touchdown. Great care must be taken to keep the herbicide off the bramble leaves and green canes. Use a back pack sprayer or tank sprayer with a hand wand with low operating pressure (25 psi or less) and a flat fan herbicide nozzle such as a type E80-04 (even distribution, 80 degree angle, .04 gallon per minute). Apply the herbicide early in the morning or late in the evening when no wind is present. Hand pulling of weeds which come up in the crown area of the plant will probably be necessary. Use of a milk carton or similar plant shield around each plant will allow application of preemergence herbicide to the base of the plant and virtually eliminate the need for hand weeding.

From the second year on, an application of preemergence herbicide in the spring before March 15th and in the fall before Oct. 15th can be used to help control summer and winter weeds. The fall application is only needed where winter weeds are a problem. One of the main reasons for control of winter weeds is to have a strip of fairly bare soil under the plants in the spring. If winter weeds cover the soil, the spring application of preemergence herbicide can not make contact with the soil and weed control will be reduced. During the summer, spot sprays of postemerge herbicide can be used to help kill weeds that have escaped the preemergence herbicide. Some hand pulling of tall weeds growing in the center of the row will probably also be necessary.

12. MULCHING

Mulching with wheat straw, pine needles, leaves, peanut hulls, pine bark, or black plastic can help control weeds and increase soil moisture. Mulching is especially beneficial on young plants where weed control is a major problem. If mulch is in limited supply, the area just around the plant can be mulched and contact herbicides used to control weeds away from the plant. If you are using an organic mulch, apply a layer at least four inches thick for weed control. Most organic mulches applied about four inches thick will last about two years in Georgia. Pine bark will last longer. It deteriorates at the rate of about one inch per year in Georgia. When a mulch is used, watch out for damage from pine mice or voles. These rodents tunnel underground and eat roots of many types of plants. They will also chew on drip tubing. They can be controlled with poison baits if they become a problem. Mulching with an organic material which cools the soil such as wheat or pine straw is highly recommended for raspberries.

Plastic mulch can also be used on brambles. With brambles that develop canes from root sprouts such as the thorny and thornless Arkansas "Indian" cultivars and raspberries, the plastic mulch must be removed or pulled back after the first year or development of many of the new canes will be disrupted. If splashing of soil on the fruit is a problem, it may be beneficial to just pull back the plastic mulch, but leave it along side the plants. If heat build up is a problem, consider using white on black plastic instead of black plastic. Black plastic can also be spray painted with a 1:10 mixture of latex paint and water.

If plastic mulch is used preplant with methyl bromide or other fumigants, additional weed and disease control can be achieved. Normally plastic mulch is used in conjunction with a drip irrigation tape under the mulch. A preplant fertilization of about 700 pounds per acre (broadcast rate) of 10-10-10 can be used to fertilize the soil under the plastic before the plastic is laid. If the phosphorus and potassium levels in the soil are high, amounts of these elements can be reduced based on soil samples. In most situations, this will take care of the fertility needs of the brambles for the first season. If additional nitrogen is needed, it can be injected into the irrigation water.



12.1 Using wheat straw as mulch to help control weeds. Mulching can also be used to help control splashing soil near harvest.

13. INSECTS

Blackberries may be attacked by several insect pests in Georgia) stink bugs, strawberry weevil, rednecked cane borer, thrips, and gall midges have been the most serious to date. Raspberries are subject to attack by blackberry insect pest complexes. Mites have also been a serious problem on blackberries on some sites in dry years.

A variety of pests occasionally feed on brambles. These pests are sporadic and only occasionally serious, though all may be harmful. Blackberry psylla, aphids, Japanese beetle, and raspberry crown borer are all potential problems. Base treatment decision on observation of pests, damage, crop condition, time of year, and previous history of damage.

Stink bugs and leaf-footed bugs often attack individual drupelets of the fruit. As the fruit matures, these turn white, ruining the appearance of the fruit. Malathion may be applied before the damage is done to help control stink bugs. However, burn from malathion has been observed under hot conditions, so apply the malathion in the evening. Do not add a surfactant to the malathion.

Strawberry weevils are small, 1/10 inch weevils or snout beetles. They vary from dull red to nearly black, with a dark spot just back of center on each wing cover. Strawberry weevil females injure brambles by laying eggs in flower buds and girdling petioles, which kills the buds. They are normally present just before and during bloom. If you usually have problems with weevils, treat when weevils are present and when you find cut buds. Otherwise, examine flower and fruit clusters on 50 feet of row. As a guideline, treat when weevils are present and when you find at least one cut bud every two feet. Experience is the most reliable guide.

Red-necked cane borers are 1/4 inch long, black beetles that have a red "neck" or thorax. Adults are generally present from May to early June. Larval feeding causes a cane swelling one to three inches long. The bark often splits in the swollen area. Always remove infested canes and burn them as they appear. Research from Arkansas indicates that one to two insecticide applications (when adult weevils are active) provide good control.

Raspberry crown borers have been a serious problem in blackberry plantings in Mississippi. Infested canes become spindly, lack vigor, and often break off at ground level. Primocanes may wilt and die in May or June. The raspberry crown borer has a two-year life cycle. Eggs are laid on the foliage of brambles from late-June until late-October. The newly hatched larvae crawl down the cane to a point below the soil surface to a depth of two inches. The excavate small cavities on the cane or root crown covered with a flap of bark. Larvae overwinter under this protective covering. The following spring, larvae enter and feed in the root crown or roots. That summer the larvae produce tunnels in the roots and crown extensive enough to reduce plant vigor.

The following spring, the larva feeds upward and enters the cane, where it eats out the pith for a distance of one to five inches. It then tunnels sideways through the wood and bark leaving the epidermis intact. Larval growth is completed early in June the second summer and pupation occurs in the hollowed out area of the cane. Adults emerge from late-June to late-October and leave the pupal skin projecting from the emergence hole in the cane. The females release a sex pheromone to attract the males. Mating occurs and females lay eggs singly on the underside of bramble leaves during the daylight hours before noon (Johnson and Schaefer in Small Fruit Pest Management and Culture, 1989).

Periodically during the mid to late-summer, the field should be examined for wilted or dead canes that are hollowed out at the base. Control would be justified if the number of infested canes per row exceeds five percent of the total producing canes or the vigor of the planting is declining.

Chemical control is the only effective means of reducing populations. Because of the two-year life cycle of the pest it is necessary to apply control measures for several years in both the spring and after harvest to kill both generations of the insect. An insecticide drench applied to the base of the plant. Other approaches include removing and destroying weakened or infested canes.

Thrips are tiny, 1/20 inch long insects with "fringed" wings. They are yellow to dark brown. Larvae look like adults but have no wings. Both move rapidly. In 1999 and 2000 they were present in very high numbers during the bloom of some blackberry cultivars in south Georgia and reduced the crop significantly on these cultivars. Some years they may be present at harvest in such high numbers that they bother some consumers and contaminate harvested berries.

Gall midges are sometimes found in the developing unopened blooms of brambles. These tiny flies lay eggs which develop into maggots that eat the flower parts, resulting in sterile blossoms or reduced numbers of drupelets per blossom. Since gall midges are a recent discovery on brambles, little information is available on their control. Insecticide applied prebloom to kill the adults during egg laying may be advisable.

Spider mites can be a serious problem in some areas, especially during hot, dry years. Affected leaves develop an off color and growth of the plant is stunted. Treat with a miticide when significant numbers of spider mites are discovered.

Blackberry psyllids are small, 1/8 inch long insects that look somewhat like aphids. Their wings have three reddish stripes running lengthwise. Adult psyllids jump when disturbed. Blackberry psyllids overwinter in conifers and move to brambles in the spring. Therefore brambles that are near conifers are more likely to have psyllid problems. Feeding damage stunts plant growth and causes leaves to curl tightly. Treat if leaf distortion is severe and psyllids are present.

Japanese beetles are ½ inch long, metallic green to greenish-bronze beetles. Their wing covers are reddish-brown with tufts of whitish hair that form spots near the tip of the abdomen and along the sides. They feed on and may defoliate a variety of plants. In brambles, defoliation from Japanese beetles may cause stunted, unthrifty plants, especially if plants are otherwise stressed. Treat as necessary.

Tarnished plant bug adults are 1/4 inch long and slightly flattened. They are brown to bronze with either a yellow or red mottled pattern. The wing tips slant downward in the rear when the bug is at rest. Adults fly rapidly when disturbed. Nymphs look like small, wingless, green versions of the adult. Both adults and nymphs have long antennae and legs. Feeding damage from plant bugs or early season stink bugs causes misshapen, seedy berries. Drupelets attacked near harvest may turn off color. Serious infestations may substantially reduce fruit quality.

Tree crickets are slender, pale-green crickets with small heads and very long antennae. They damage brambles by laying eggs in late summer. Look for long rows of punctures running lengthwise in the canes. These egg-laying punctures greatly weaken canes. Injured canes are easy to identify in the spring when foliage growth begins. Cut out and burn infested canes. Remove wild brambles from the vicinity. Use insecticides if there is a history of the problem, or if you see signs of adults or fresh egg laying.

Sap beetles are small (1/8 inch) black beetles that feed on ripe or injured berries. Promptly harvest berries to minimize the problem. Use of pesticides is seldom necessary.

Stink bugs damage was observed in a number of fields in south Georgia in 2001. The damage occurs as off-white or cream colored drupelets found at random on the berry at harvest. Insecticides such as malathion have reduced the problem. There is a one day preharvest interval for malathion.



Figure 13.3: Stink bug damage to blackberries at harvest.

14. DISEASES

Brambles can be infected by numerous plant pathogens, and several pathogens which occur in Georgia have the potential to greatly reduce yield and/or fruit quality. Primary among these are anthracnose, rosette (double blossom), orange rust, crown gall, and numerous viruses.

Anthracnose

This disease, caused by *Elsinoe veneta*, first appears as small purplish spots on the new canes. As it progresses, the spots enlarge and become grayish in the center with purplish-brown, slightly raised edges. Cracking bark on diseased canes is very common. Badly-infected canes may wilt and die. Infections in the berry clusters result in withered, dry berries. Anthracnose is much more severe on trailing than erect blackberries. Leaf and fruit infection by the anthracnose fungus is more common in raspberries than in either trailing or erect blackberries. If chemical control is necessary, current fungicide recommendations are available from your county Extension office. The most important cultural practice for anthracnose control is to remove and destroy all infected and old fruiting canes immediately after harvest.



14.1: Anthracnose on bramble stems.

Rosette (double blossom)

Rosette is a severe disease of blackberries in the southeastern United States. If not controlled, rosette often limits commercial production. Caused by the fungus *Cercospora rubi*, rosette disease has a biennial cycle that matches the growth pattern of blackberries. Primocanes are infected in the spring or early summer, but disease symptoms are not evident until the following year when new growth begins on the fruiting canes. Most blackberry cultivars adapted to Georgia are very susceptible to rosette; however, many growers do not recognize this disease until it is widespread in their planting. Usually, few symptoms of rosette are evident in a new planting until about the third or fourth year. At this point, a large percentage of the plants suddenly display signs of infection as new growth emerges in the spring, and yield is drastically reduced.

The rosette fungus produces spores on infected flowers during bloom. These spores are dispersed by wind and insects, and they subsequently infect the young buds of primocanes. Infected primocanes grow normally the first year - showing no external symptoms until the following spring. As the infected buds begin to develop, several to many branches may grow from each infected node, as opposed to the single branch per node that is characteristic of healthy stems. Young foliage of infected stems is a light green and later becomes yellowish-brown to bronze as compared to the dark green foliage on healthy stems. Infected flowers are pink, purple or reddish as compared to healthy flowers of the same variety, and they may have a ruffled or distorted appearance (hence the name Adouble blossom®). Little or no fruit is produced from infected flowers.

Rosette can be controlled through the following combination of cultural practices and chemical treatments. 1) Plant resistant cultivars. Most erect, thorny cultivars are very susceptible to rosette, whereas most trailing, thornless cultivars are tolerant. Two erect, thornless cultivars from Arkansas, 'Navaho' and 'Arapaho', are also tolerant to rosette. The development of rosette-resistant

cultivars is a primary objective of all blackberry breeding programs in the southeastern U.S. 2) Eradicate wild blackberries. Many wild blackberry plants in the southeast are infected with rosette, and these wild plants are the initial source of infection in most fields. Wild blackberries should be removed from the immediate vicinity of cultivated blackberry fields to reduced the amount of natural inoculum in the area. Since the rosette fungus normally does not occur in the roots of blackberry plants, fields established from root cuttings should not become infected with rosette, assuming that there are no other blackberries with the disease nearby. 3) Prune out infected rosettes. Effective disease control can often be accomplished in new plantings by rigorously pruning out any rosetted stems in early spring before the infected buds open. In areas of low disease pressure, this may be the only control practice necessary. The fungus is not systemic within the blackberry plant so only the side stems showing disease symptoms have to be removed. 4) Apply fungicides. Spread of the rosette fungus from infected flowers to primocanes can be dramatically reduced if fungicides are applied at the correct time. Most rosette infections occur during bloom; therefore, fungicide applications must begin at bud break and continue at a ten to fourteen-day interval through petal fall. Infected flowers will continue to bloom during and after harvest, so it is important to continue fungicide applications as long as infected flowers on the rosettes continue to bloom. Among the fungicides currently registered for use on blackberries, (benomyl) Benlate is the most effective for rosette control. Benlate has a three-day pre-harvest interval. Only five applications of Benlate are allowed in a year and it cannot be applied during harvest in Apick-your-own fields.® Fungicides cannot stop symptom development on fruiting canes. The goal of the fungicide treatments is to prevent infection from occurring on the primocanes. There is about a nine-month delay between fungicide application and any evidence of control. By maintaining a rigorous fungicide spray program, rosette infection should be minimal. 5) Mow down severely infected plantings. Heavily infected blackberry plants should be pruned to about a foot above the ground (usually by mowing) immediately after harvest. In fields where the disease is so severe that harvest is not feasible, the plants may be mowed before harvest. Remove all diseased plant material from the field, and fertilize with a complete fertilizer. Continue irrigation to ensure good regrowth, and begin a fungicide spray program. Mowing the entire planting to the ground is only necessary when the infection is wide-spread. Yield from mowed fields will be drastically reduced the following year. Except in the southern part of Georgia where the growing season is longest, most cultivars should not be mowed more than once every three or so years.



Figure 14.2: Rosette disease of blackberry
1) Healthy blackberry cane
2) Rosette infected cane



Figure 14.3: Rosette disease of blackberry

Orange Rust

Numerous rust diseases attack brambles, but orange rusts, caused by *Arthuriomyces peckianus* and *Gymnoconia nitens*, are very common fungal disease of wild and domestic brambles. Of the two fungi which cause orange rusts diseases, *G. nitens* is the predominant organism found on blackberries. Rust usually appears in the spring as new leaves begin to unfold. Infected leaves appear pale. Infected canes look weak and spindly, and they often grow in clusters. Vivid, orange masses of fungal spores cover the underside of infected leaves as soon as they unfold. These spores fall on young vegetative shoots and infect the canes. Cane infections become systemic, and such infections often spread to the plant crown. When the crown becomes infected, the whole plant will eventually show infection. Several years may pass between the first sign of plant infection and the time when the whole plant shows orange rust.

In mid-summer, plants may appear to outgrow the rust as new leaves form without symptoms. However, because the fungus is systemic it will resume activity the next spring. The best means of controlling orange rust is through sanitation or the use of Nova® fungicide. Cane and leaf rust is sometimes seen in late summer on blackberries such as 'Kiowa'. The disease has not caused a serious problem in Georgia to date.



Figure 14.4: Orange rust disease. (Photo not available)

Figure 14.5: Leaf rust disease

Crown gall



Figure 14.3: Crown galls on Shawnee blackberry

Crown gall is caused by the soil-borne bacterium *Agrobacterium tumefaciens*. Infection occurs through wounds, including the fresh-cut ends of root cuttings. Infection results in tumorous growths (galls) on the plant crowns and/or root systems. Galls, when young and active, have russet-brown skins (much like a potato), and they also have a white, potato-like texture inside. When galls are mature, they become dark brown to black, with a woody texture. Eventually, they break up through natural rotting and insect feeding. Crown gall bacteria are transported by anything that moves soil. Once a field is infested with the bacteria, it is permanently contaminated. Do not plant cuttings with galls on them or take cuttings from any field where crown gall is present. Even apparently healthy plants in an infested field may be infected or may have bacteria in the soil around the roots, even if no visual galls are present. Crown gall infection may kill the individual canes as the gall surrounds the stem; if death does not occur, plant vigor will likely be reduced. Decreased vigor reduces productivity and increases plant loss from other causes.

You can, however, reduce your losses to crown gall by using sanitation practices and/or a biological control treatment you apply at planting. (See "Sanitation" section). Biological control involves dipping root cuttings into a solution of non-pathogenic bacteria just before planting. This bacteria prevents the crown gall bacteria from infecting the cuttings after planting. The biological control will not work if cuttings are already infected. This treatment only helps when you plant crown gall-free cuttings in soil that may be infected with crown gall bacteria. Because the biological control

product is not readily available, contact your county Extension agent several weeks before you plan to use it. Your Extension agent can give you more information on where to get the product and how to use it.

Septoria leaf spot

Septoria leaf spot can be severe on erect and trailing blackberries grown in Georgia. Septoria leaf spots are circular and about 1/6 inch in diameter with a white or gray center surrounded by a brown or purple border. Tiny black spots form in the center of the spots. On susceptible cultivars, Septoria leaf spot can cause premature defoliation which weakens the plant. Fungicides used for rosette and anthracnose control should control most leaf diseases. In addition, cultural practices (see ASanitation@ section) will reduce disease severity.



Figure 14.4: Septoria leaf spot.

Viruses

Numerous viruses can be found in commercial bramble plantings. Viruses can result in less vigorous plants, decreased yields, and reduced fruit quality. Symptoms are often observed as mosaic patterns, interveinal chlorosis, or general leaf distortions. Virus symptoms can often be confused with nutrient deficiencies and herbicide damage. Confirmation of a virus infection can easily be obtained through use of enzyme-linked immunosorbent assays (ELISA), and use of such tests is advisable in order to identify a specific virus - before taking action. Depending on the specific virus, means of dissemination can include aphids, leafhoppers, nematodes, or pollen. However, the vast majority of viruses can easily be transmitted through propagation. Use of planting stock which has been propagated from virus-free plants is of extreme importance in preventing viral introduction within a commercial planting. Removal of wild brambles is also helpful. Other control practices may include destruction of weeds (which may harbor the viruses within and around the planting), use of resistant or tolerant cultivars (where available), vector control, and/or roguing of plants which show symptoms.

Sanitation

Sanitation practices are very helpful in dealing with anthracnose, rosette, orange rust, crown gall, or viral symptoms. These practices include:

1. DO NOT take cuttings from any plants that show orange rust, crown gall or rosette.
2. As much as possible, remove nearby wild blackberries before you establish your planting.
3. In the spring, cut out and destroy (burn or haul away) all canes that show symptoms of rosette. Individual infected blossoms can also be picked off and destroyed. This must be done before the end of the bloom period.
4. In the spring, remove and destroy any plants that show symptoms of orange rust. This must be done before the waxy covering over the orange spore masses breaks and the spores are dispersed.
5. If rosette is a serious problem, cut off all plants within one foot of the ground just after harvest. Research from Tennessee indicates that pruning the primocanes off one foot above

ground level immediately after harvest will largely eliminate rosette but increase yields over pruning at ground level. Remove and destroy the cut material. Sufficient primocanes will regrow to provide a partial crop the next season. Since bloom is past, these canes are free of infection and the disease cycle is broken unless the fungus becomes reestablished from outside sources. The yield response following this practice will probably be greater in south Georgia where the growing season is long. The response will be more favorable in any site when you provide adequate irrigation. This practice is drastic; however, it may be the best way to handle a badly infected site before beginning an annual fungicide program. This practice may be more useful in erect than trailing blackberries. It is also possible to pick or cut off infected blossoms just as they are opening. In some trailing types, the infection becomes systemic in the plant crown. Once this occurs, the crown can be a continuous source of infection regardless of how often you cut canes. It may be possible to kill and remove plants in this condition before the entire planting becomes infected with rosette.

15. HARVESTING AND MARKETING

Blackberries are fully ripe when they change from a shiny black color to a dull black color. However, at this stage they are too soft to harvest for the shipping market. Blackberries are highly perishable. Harvest the fruit early in the day and refrigerate them (at 32 to 34°F) as quickly as possible. A forced air precooler combined with a cold storage room is ideal, since the precooler can drop the temperature of a pallet of fruit to 34 degrees in about one to two hours prior to moving the pallet to a cold storage room. The ideal holding temperature for brambles is 32 degrees and 95% relative humidity. However, do not allow the temperature to fall below 31 degree F or freezing injury may occur. Small growers may wish to consider building a “Cool and Ship” (www.smallfruits.org/CoolShip/colship.htm).

The shelf life of harvested blackberries varies with weather conditions, storage temperature, and cultivar. At 35 degrees F ‘Choctaw’, ‘Shawnee’, and ‘Kiowa’ should have a shelf life of 3 to 5 days, ‘Arapaho’ a shelf life of 7-10 days, and ‘Navaho’ a shelf life of 10-14 days. However, at a slightly higher temperature, the shelf life is greatly shortened. A 1990 study indicated that ‘Choctaw’ and ‘Shawnee’ had a good fruit quality shelf life of only one day at 38 degrees F. However, ‘Navaho’ and ‘Cheyenne’ had a shelf life of four days to seven days at 38 degrees F. Arkansas cultivars of blackberries shipped from Mexico and Central America have become a common grocery store item in recent years. They are picked as soon as they turn black, cooled, and air freighted or express trucked to the U.S. However, information on distant shipping of blackberries is limited, so growers need to experiment on a small scale before establishing large plantings.

Blackberries for distant shipping should be harvested directly in pint or half-pint clam shells containing an absorbent layer of paper in the bottom to catch the leaking juice. These are available with hinged tops or as two piece clam shells with detached tops. A picking aid which attaches to the belt can be used to hold several clam shells. Another method is to place the cardboard flat filled with clam shells on a stepping stool, wheel barrow, or special wire tripod stand and pick directly into the clam shells. After the flat is filled the tops are popped on. Generally half-pints bring the best return to the grower since the price per pound of fruit is usually higher than pints. There is also less fruit bruising in half-pints. Half-pints may be too small for some very large fruited cultivars such as ‘Kiowa’ since the number of berries in the half-pint will be limited. Check with your fruit buyer before deciding on a packing system. For local shipping, pint pulp containers work well. These will absorb some of the juice from leaking berries.

For pick-your-own markets, blackberries can be sold by the gallon or pound. There are about 5 to 5.5 pounds of blackberries in a gallon. Current pick-you-own prices for blackberries (2001) in Georgia range from about \$1 to \$1.75 per pound. Raspberries yield much less than blackberries and must be sold for a much higher price. For the prepicked, direct market sales, blackberries can be sold in 12 pint flats which weigh about 10 pounds or by the gallon in flats. For gallon sales, undivided, solid bottom cardboard flats can be purchased. Soft drink and beer flats discarded from convenience stores also work well. Fresh frozen blackberries also sell very well. Much of the blackberry crop is sold for jelly making, and many customers like frozen blackberries. This is an ideal way of salvaging the crop when there are not enough pick-your-own customers. Pick into gallon buckets and when the bucket is full, pour it into a gallon freezer bag and freeze immediately.



15.1 Half-pint blackberry clamshell with absorbent material in bottom.



15.2 Half pints of blackberries, raspberries, and blueberries in a single layer tri-pack in Chile.
Note the insulated shipping container in the background.



15.3 Half-pint blackberry clamshells in a two layer "shoebox" flat.



15.4 Blackberries are a popular pick-your-own crop in Georgia. Gallon buckets are the normally used for pick-your-own sales. After picking, recycled drink flats make good containers for the trip home.

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, Director