

Blackberry and Raspberry¹

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Introduction

Blackberry (*Rubus* spp.), family Rosaceae (somatic number 21, 28, 35, 42, 56, 63, 70, 77, 84), is a deciduous crop that grows best in temperate climates. Several blackberry species are native to Florida. Wild blackberries are often harvested in Florida; however they have several limitations including comparatively small berries, lack of uniformity, low yield and late maturation. The culture of improved blackberries in Florida is primarily limited to homeowner production, although there is some potential for U-Pic and local sales in north central and north Florida. Blackberry yields in many areas of the country may exceed 6,000 lb/ac, however quantitative yield data from Florida are scarce. In Florida, blackberries typically ripen during May and June. Blackberries are extremely perishable, and as such are very difficult to ship satisfactorily to distant markets. The major blackberry and raspberry production areas in the United States are the Pacific Northwest, Michigan and Arkansas.

Blackberry bushes may be erect or trailing with gradations in between. Although most blackberries produce shoots with thorns, many cultivars are thornless. Historically, 'Oklawaha,' 'Flordagrind,'

and 'Brazos' have been the cultivars recommended for Florida. However, many new blackberry cultivars are available from breeding programs, and they increasingly appear in the retail market. Some of the new blackberry cultivars have been tested by the University of Florida and will be discussed in more detail below.

Blackberry and raspberry fruit produce an aggregate fruit and are derived from many ovaries from a single flower. The major difference between blackberries and raspberries is that when blackberry fruit are consumed the receptacle of the inflorescence (known as a torus) is also consumed. By contrast, raspberries when picked ripe for consumption will have a hollow center since the receptacle remains on the cane. Raspberries are not generally recommended for the southeastern United States and will be discussed only very briefly. 'Dorman Red' is the only raspberry cultivar recommended for trial in Florida when grown as a perennial crop; however, berry flavor is poor to fair. 'Heritage' raspberry has been grown as an annual crop during the winter in the southern parts of the state after it receives its chilling requirement.

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1. This document is HS807, one of a series of the Horticultural Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date May 2001. Revised April 2008. Visit the EDIS Web Site at <http://edis.ifas.ufl.edu>.
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Cultivars

'**Apache**' is an erect, thornless blackberry bush released by the University of Arkansas. In Arkansas it produces higher yields and larger fruit than the other thornless cultivars, 'Arapaho' and 'Navaho.' 'Apache' produces a 10.0 gram berry, which is the largest of the three thornless cultivars. Berries are conical in shape with a glossy black finish. Soluble solids average 10% and fruit firmness is acceptable and similar to that of 'Arapaho.' 'Apache' has not been adequately tested in north Florida, although it is expected to do well in areas where 'Arapaho' and 'Navaho' have done well. For additional information consult Clark and Moore (1999a).

'**Arapaho**' is an erect, thornless blackberry bush released from the University of Arkansas breeding program (Moore and Clark 1993). It has good fruit quality and ripens before 'Apache' and 'Navaho.' It is moderately vigorous. Symptoms of rosette have not been observed. Yield characteristics in north Florida have been as follows: Yield 1.7 tons/acre; Berry weight 4.5 g, soluble solids 10.0 Brix. For additional information concerning the performance of 'Arapaho' in north Florida consult Table 1. In Florida it is likely only adapted to extreme north Florida.

'**Brazos**' is an erect, thorny blackberry cultivar released by the Texas Agricultural Experiment Station in 1959. Yields have generally been high in north Florida and south Georgia. The fruit are medium in size. Since fruit are high in acidity 'Brazos' has been mostly used for jams, jellies, and for baking. 'Brazos' generally ripens from mid- to late-May. Rosette disease has been a serious problem. This disease contributes to the loss of productivity of 'Brazos' blackberry plants with age.

'**Flordagrاند**' was released in 1964 by the University of Florida for home and local markets. Flordagrاند is adapted to central Florida where it is evergreen in growth habit. 'Flordagrاند' has a trailing growth habit. The berries are oblong in shape and are shiny black and average just over 5 g in weight. The berries are tart in favor (high in acidity) and soluble solids average 8.3 Brix. It is not often grown any longer. For more information the reader is referred to Shoemaker et al. (1964).

'**Chickasaw**' was released in 1999 by the University of Arkansas. It is an erect, thorny blackberry bush that produces among the highest yields of any cultivar in Arkansas. Berries are long and cylindrical. Berry weight is about 7 - 10 g and firmness is rated high. Berries are sweet averaging about 9.5 Brix. Quantitative yield data are not available for Florida. 'Chickasaw' has better post harvest keeping quality than 'Shawnee.' For more information the reader is referred to Clark and Moore (1999b).

'**Choctaw**' is an erect, thorny, high yielding blackberry cultivar from the University of Arkansas. The fruit are medium in size (about 5 g). The fruit are moderately sweet in flavor. This cultivar is most noted for early ripening, small seed size and good flavor. Consult Moore and Clarke (1989) for more information.

'**Kiowa**' is a large fruited, erect, thorny cultivar from the University of Arkansas breeding program. A large fruit size is maintained throughout the season. It has good firmness and flavor. 'Kiowa' has averaged 10 Brix. For more information consult Moore and Clarke (1996).

'**Navaho**' is an erect, thornless blackberry cultivar from the University of Arkansas breeding program. Yields in Arkansas have been moderate to high. In Florida, yields have been 1.8 tons/acre or slightly higher than that of 'Arapaho' (Table 1). The berries are small to moderate in size 3.5 - 4 g), and they are moderately sweet in flavor (8.6 - 9.4 Brix). Disadvantages include late ripening and a prolonged ripening period. Consult Moore and Clark (1989b) for more information.

'**Oklawaha**' was released by the University of Florida in 1964. It is semi-evergreen to evergreen and trailing in growth habit. 'Oklawaha' requires trellising. It was released as a pollinizer for 'Flordagrاند'. It is moderate in size. Soluble solids average 8.3 Brix. It is not often grown any longer. The reader is referred to Shoemaker and Westgate (1964) for more information.

'**Shawnee**' is a 1984 release from the University of Arkansas breeding program. It has a prolonged ripening period, but the fruit retain a large size from

beginning to end of the ripening period. This cultivar has largely been replaced by 'Choctaw' 'Chickasaw' and 'Kiowa.'

'**Ouachita**' is an erect growing, thornless cultivar released from the University of Arkansas breeding program (Clark and Moore 2005). It is expected to do well where 'Apache', 'Arapaho' and 'Navaho' have performed well. Desirable characteristics of 'Ouachita' include consistent high yields, large fruit size and good postharvest keeping quality. Fruit has averaged 9.9 Brix. Fruit size is larger than that of 'Arapaho' and 'Navaho' and yields are comparable to 'Apache'. For more information consult Clark and Moore (2005).

Site Selection and Site Preparation

Ideally, a prospective commercial blackberry grower should select a site with good air and water drainage. Low lying areas should be avoided to minimize the probability of frost injury to flowers and newly developing fruit and flood injury during periods of excess rainfall. Blossoms can be injured by temperatures below 28°F. For the homeowner site selection often becomes less practical as the choices for site selection become more limited. The site should be located conveniently to a source of water as the period of fruit ripening is often quite dry in many parts of the state. Hilltops often accord the grower improved air circulation during the growing season and hilltops can be a prime location if the soil has not been eroded by previous agricultural use.

Prior to planting, in-row strips about 5 feet wide can be treated with a herbicide such as Glyphosate to remove all weeds and vegetation. In-row strips should be thoroughly disced to at least a depth of 1 foot. In some regions of the country green manure crops are grown on the site and plowed under. Although blackberries do well in most soils, deep well drained soils are ideal. Blackberries perform best at a soil pH between 5.5 and 6.5. In general, to increase pH 1 unit, mix 5 lb dolomitic lime with 100 square feet of soil, and to decrease pH 1 unit, mix 1 lb of elemental sulfur with 100 square feet of soil. In addition, components of the irrigation system should be in place to provide water once the blackberries are planted. Drip irrigation, as compared to overhead

irrigation, will minimize subsequent weed control efforts which can be a substantial portion of the labor in cultivating blackberries.

Planting and Spacing

Planting is best performed from December through February. Upon arrival bareroot plants should be kept moist, but not wet. If these plants arrive prior to the anticipated planting date they can be stored in the refrigerator (small quantity) or be heeled in a trench (larger quantity) to stay moist. To heel plants in, simply dig a trench and cover the roots with damp soil. While planting do not allow the blackberry roots to dry out. Cut back the shoots to about 6 inches in length and plant to the same depth they were in the nursery. Spread the roots but try to avoid excessive root bending in the hole. Remove air pockets by compacting the soil.

Plant spacing is cultivar dependent. In general, erect cultivars and trailing blackberries are spaced from 2 to 4 feet apart and 3 to 5 feet apart within a row, respectively. The spacing between rows can be 10 to 15 feet depending on plant vigor and farm machinery limitations.

Pollination

Blackberry fruit is borne on the current year's growth with usually 10 to 20 flowers per cluster. Blackberries and raspberries are an aggregate fruit with individual pistils which form drupelets. To obtain a large well formed berry most of the individual pistils in an inflorescence should be pollinated. Inadequate pollination results in smaller or imperfect fruit since not all seeds and drupelets are formed. Blackberries range from completely self-fruitful to completely self-unfruitful. Most erect blackberries are fruitful yet trailing cultivars often require cross pollination. It is often reported that cross pollination results in highest yields. Several different blackberry cultivars should be planted together to insure cross pollination particularly if wild blackberries are not in the vicinity. Blackberries flowers produce nectar and pollen that attract bees which serve as pollinators. Honey derived from blackberry flowers is reported to be light in color with good flavor.

Bloom date for most cultivars is during early March, although 'Oklawaha' and 'Flordagrind' may bloom as early as mid February. Bloom date tends to be earlier as one progresses further south. Frost injury can be a problem in some locations. Open flowers can be injured by a temperature of 28°F. Sprinkler irrigation can be employed to reduce the risk of freeze injury.

Propagation

Leafy Stem Cuttings. This is the most feasible method to propagate large quantities of plants. Leafy stem cuttings may be propagated from the apical 4 to 6 inches of cane when the cane is succulent but still firm. Cuttings should be placed to a depth of 2 inches in a perlite peat or peat sand mixture. The cuttings should be misted especially in the 2 to 4 week period before the roots are formed. It is important to promote good water drainage. Application of Rootone to the cut stem can also improve rooting efficiency.

Root Cuttings. All blackberries can be propagated by root cuttings. This is the fastest method to produce new plants. Cut roots 1/4 to 1/2 inch in diameter into six inch strips. They can be directly planted in the new location, grown as a potted plant or they can be placed in a plastic bag in a refrigerator. When planted directly in the field uneven stands often results during the first year. Potted plants can be grown in the nursery for up to one year. When planted in soil they should be covered with 2 to 4 inches of soil. Planting is best accomplished during the winter. Substantial quantities of suitable roots can be had by plowing a furrow and severing the roots adjacent to the mother plant.

Suckering. The easiest and most rapid method to propagate blackberry is to utilize the suckers that naturally form from roots. Simply sever the sucker from the point of attachment with the mother plant and move it to its desired location. Removing suckers has minimal or no impact on the mother plant. Genetically thorny blackberry cultivars will remain thorny and genetically thornless blackberry cultivars will remain thornless whether propagated from stem cuttings, root cuttings or suckers.

Tip Layering. Semi-erect or trailing blackberries can be propagated by tip layering. Tip layering sometimes occurs in nature and it is a viable method for the homeowner to propagate a relatively few plants. The technique is to bring first year vegetative shoots into contact with the ground and cover the shoot under approximately 3 inches of soil. A more efficient method to tip layering is to remove the shoot apex to induce lateral branching. Next, during the summer dig a 3 inch deep hole which is sloping toward the mother plant and vertically away from the plant. Place the terminal end of the shoot in the hole with back vertical portion of the hole. Then cover the shoot with 3 inches of soil. By the fall new rooted shoots will have developed and newly layered shoots should be transplanted in the spring.

Fertilization

Blackberries do not require much fertilizer in most soils in north Florida. Blackberry roots are located close to the surface and excess fertilizer can burn leaves or even kill plants. Fertilizer can be applied in an 18-inch ring surrounding a plant or it can be applied parallel to the row 12 to 18 inches from the row center. Fertilization with 10-10-10 N-P-K with micronutrients is satisfactory. Do not apply fertilizer at planting in the winter; rather wait until late spring or summer. Fertilization applied during planting may not only be injurious to the plant, but it may also be wasted since the roots are not yet sufficiently distributed in a row. During the establishment year fertilize with about 1/4 pound per plant or up to 5 lbs per 100 foot of row. During the second year and thereafter fertilize in the winter and in the summer (after harvest) with 1/4 to 1/2 lb per plant or about 10 lbs per 100 feet of row.

Irrigation

Irrigation is a requirement for consistent blackberry production in north or north central Florida. Irrigation is most critical for the establishment year. Irrigation and weed control are the two most important cultural practices during the establishment year. Drip irrigation is preferable to overhead irrigation as drip irrigation conserves water, does not wet blackberry foliage (which can enhance disease), and does not promote excessive weed

growth. Drip irrigation can be in the form of biwall tubing or 3/4" poly tubing either buried or on the ground surface. In the case of poly tubing run 1 gallon per hour emitters (spaced 3 to 5 feet apart) for 2 to 4 hours per day. Irrigation frequency can vary from once every two days during a summer drought to not at all from November through March. Soils with a high water holding capacity require less frequent irrigation than sandy soils. Organic mulches such as mushroom compost mulch, pine straw, or pine bark further enhance water conservation.

Training and Pruning

Erect or Semi-erect Blackberries. Blackberry plants are perennial plants that can live for many years. Typically, bareroot blackberry plants will be 6 to 12 inches in length. Container-grown plants are more variable in size and stature. During the establishment year blackberry plants will produce shoots from the buds and perhaps from root suckers adjacent to the crown of the plant. The tendency for a blackberry to produce suckers and expand beyond the crown is cultivar dependent. During the first year shoots elongate but do not produce berries. They are known as primocanes. For erect or semi-erect blackberries it is advisable to cut the tip off primocanes after they reach a height of 30 to 36 inches to promote lateral branching. Especially vigorous canes or plants may benefit from two tippings. For 'Oklawaha' and 'Flordagrاند' or vigorous cultivars such as 'Brazos' tip at a longer cane length. Tipping should be performed as early as possible in the season so as to ensure that the flower bud initiation process is complete prior to the onset of dormancy. Blackberries produce fruit on canes that were formed the previous year. They are known as floricanes. Cutting the tip off primocanes to promote lateral branching and enhance flower bud initiation increases yield considerably. After fruiting, floricanes dry up and die. Primocanes will bear fruit the following year. It is advisable to prune out and remove all floricanes at the ground or crown level after fruiting. Ideally in a healthy blackberry stand 5 to 6 canes should exist per foot of row and blackberries can form a solid hedgerow.

Some growers mow the entire planting at a height of about 1 foot after harvest to invigorate

blackberry plants. The major reason for mowing is to reduce insect and disease pressure by removing infected canes. It is likely that yield will be reduced the following year since the primocanes are removed with the floricanes. One possibility is to mow every 3 or 4 years or mow a percentage of your planting every year so that a yield reduction will be less noticeable.

Trailing Blackberries or Dewberries. Trailing blackberries require a trellis otherwise canes (and berry production) will tend to grow on the ground. Many trellis designs have been used by commercial blackberry growers. End posts should be 7 1/2 to 8 foot long and they should be buried at least 2 feet deep and well anchored. Interior posts may be smaller. Post spacing should be about 20 feet apart. Galvanized wire #9 to #12 should be stapled loosely to the posts. One may construct a single wire system with wire about 5 1/2 above the ground or a two wire vertical system with wires 2 1/2 and 5 1/2 above the ground. Three wire systems have also been used. Blackberry canes can be gradually wrapped around the wires and/or canes can be attached to the wire with string. Alternatively, in the case of a two wire vertical system canes can be interwoven between the upper and lower wires. The tips of canes should be pinched off to promote lateral branching as in the case of erect blackberries. However, with trailing blackberries canes are generally longer (40 to 48 inches when they are tipped).

Production and Harvesting

Harvest seasons are cultivar and location dependent. The harvest season of most cultivars lasts about 3 to 4 weeks. 'Oklawaha' and 'Flordagrاند' ripen during April and May. 'Brazos' and the Arkansas cultivars generally ripen from mid-May through June. The harvest season can be prolonged substantially by including cultivars with different ripening dates.

Blackberries are generally harvested by hand. Generally they must be picked once or twice a week during the harvest period. Remember that they turn from red to black before they are fully ripe. Blackberries are extremely perishable and must be handled with care. Growers often pick fruit during

the early morning or even at night when temperatures are low. Blackberries should be marketed immediately after picking or refrigerated at 32 to 40°F.

Quantitative yield data are very limited for blackberry plants in Florida. 'Flordagrind' and 'Oklawaha' have been reported to produce 3 to 8 pints per plant or 1.5 to 4 lbs/plant in Florida (Shoemaker and Westgate 1964, Shoemaker et al. 1964). In Texas, 'Brazos' has produced 6500 to 6800 lbs/acre (Lewis 1959). In Arkansas the average yield of thorny cultivars ('Chickasaw', 'Choctaw', 'Shawnee', 'Kiowa') and thornless cultivars ('Apache', 'Arapaho' and 'Navaho') has varied considerably (approximately 4,000 to 12,000 lbs/acre) depending on location and year.

Yield and berry characteristics of Arapaho and Navaho were evaluated in 1994 in a planting at the NFREC-Monticello (Table 1). The treatments were as follows: 1) pine bark mulch; 2) plastic mulch; 3) mushroom compost mulch, and 4) no mulch. Yield varied from 1.1 to 2.0 lbs/bush or 2483 to 4312 lbs/acre for 'Arapaho' and 1.3 to 2.2 lbs/bush or 2787 to 4704 lbs/acre for 'Navaho.' Thus, yields were on the low end of that reported from Arkansas. Yields were lowest for the pine bark mulch and highest for the plastic mulch treatment for both cultivars. Berries of 'Arapaho' were larger than 'Navaho.' In addition, 'Navaho' exhibited a reduction in berry size from first to last harvest. 'Arapaho' berries also tended to be sweeter and have a lower acidity than Navaho. Mulch treatment had no or a very slight influence on berry weight, soluble solids, pH, or titratable acidity.

Weed Control

It is extremely difficult to gain control of weed problems in a blackberry planting. Methods to control weeds in blackberry plants include mulching, cultivation, herbicides, and mowing. The yield results of a mulching trial conducted at the NFREC-Monticello were discussed above. The plastic mulch treatment was the most effective in controlling weeds followed by pine bark. Mushroom compost and bare soil treatments were equally prone to weed problems. Cultivation, whether it be by

hoeing or disking should be very shallow and no more than 2 inches in depth. Blackberry roots are very shallow and are easily injured by deeper cultivation. Contact your county extension agent concerning specific herbicides that can be applied to control weeds in blackberry plants. It is beneficial to mow grass in between blackberry rows to enhance air circulation and to minimize the seeding of in row strips.

Insects

Several insect species attack blackberries such as the strawberry weevil, the red necked cane borer, thrips, gall midges, stink bugs, and beetles. Some of these insects are occasional pests of blackberry and seldom require control. Control measures for insects may not be required in some regions; however, in other regions insects may have to be controlled. Contact your county agent for current pesticides and rates.

Diseases

Diseases incited by different disease organisms are a common problem in blackberry. All the following diseases are caused by a fungus except crown gall which is caused by a bacterium. Consult your county extension agent for current pesticides and rates. Sanitation and cultural control methods will be described below.

Anthracnose. This disease has a very broad host range. Anthracnose appears as small purplish lesions on canes. The lesions enlarge and the center turns a grayish color with purplish margins. The canes may turn dark, crack, and may eventually die. Cultural control includes removing and burning all infective canes and the floricanes after fruiting

Leaf Spot. Leaf spot appears on the foliage as dark red spots with a whitish center. It occurs to some extent in all blackberry plants and tends to weaken the plants. Proper sanitation procedures as mentioned above should be followed.

Crown Gall. This disease is caused by a soil borne bacterium which results in plant tumors in the crown of the plant. It spreads by entering open wounds. When young, crown galls can resemble a

russet potato in appearance, but they eventually turn dark with age. Crown gall reduces stand productivity and once a field is infected it could stay infected for many years. Do not take cuttings from any plant that shows evidence of crown gall. Also be careful to disinfect pruning tools in plants where crown gall may be a factor.

Rosette (Double Blossom). Double blossom is a serious fungal disease in the southeastern United States. It infects Brazos and erect or semi erect thorny cultivars developed in Arkansas.

It also infects wild blackberry, so wild blackberries should not be planted near blackberry plants. Thornless or trailing blackberries appear to be resistant. Double blossom disease is very distinctive. It starts as an abnormal flowering stage followed by a witches broom stage in which tightly clustered shoots form in bunches. In certain plants cutting back infected canes to the ground after harvest and burning them seems to prevent serious infection. Buds on the vegetative primocanes become infected by the fungal spores on the flowers on the infected floricanes. Once the fungus enters the primocane it becomes systemic, and next season floricanes show symptoms early in the growing season.

Orange Rust. Orange rust starts out as bright orange masses of spores on the underside of the leaves in the spring. It is systemic and can last from year to year. It is first noticeable on expanding leaves in the spring. The spores are disseminated in early to mid spring and they are spread great distances to adjacent canes and plants. Once plant crowns are infected orange rust becomes systemic and the entire plant needs to be removed. In the summer plants appear to outgrow the infection, but that is not the case. The only solution is to remove and burn infected plants.

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Table 1. Yield and berry quality of 'Arapaho' and 'Navaho' thornless blackberry subjected to pine bark, plastic, or mushroom compost mulch, or no mulch.

	Yield per bush (lb)	Yield per acre (lb)	Avg berry wt ^x (g)	Soluble solids (° Brix)	pH	Titrateable acidity
Arapaho	1.14	2483	4.51	10.2	3.50	0.82
Pine bark mulch	1.98	4312	4.59	9.4	3.48	0.74
Plastic mulch	1.65	3594	4.53	9.4	3.50	0.88
Mushroom compost mulch	1.39	3027	4.20	10.5	3.49	0.82
No mulch	1.28	2787	3.85	9.1	3.26	1.06
Navaho	2.16	4704	3.82	8.6	3.35	0.96
Pine bark mulch	1.56	3398	3.51	8.6	3.29	1.19
Plastic mulch	1.72	3737	3.57	9.4	3.41	1.01
Mushroom compost mulch						
No mulch						
^z Harvest period was 3 to 22 June for 'Arapaho' and 16 June to 22 July for 'Navaho'						
^y Yield was determined on 10 plants of each treatment. Plants were spaced 0.61 and 3.0 m within and between rows, respectively						
^x Average berry weight from first to last harvest declined from 4.58 to 4.29 g for 'Arapaho' and 4.34 to 2.31 g 'Navaho'						