



The Performance of Blackberry Cultivars in North Florida

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Plant vigor, yield, berry weight and soluble solids were determined for six blackberry cultivars at the North Florida Research and Education Center–Quincy. Five University of Arkansas cultivars ('Apache', 'Arapaho', 'Kiowa', 'Natchez', and 'Ouachita'), and a cultivar from Brazil ('Tupi') were evaluated over a three-year period. Most cultivars were fairly vigorous with the exception of 'Arapaho' and 'Kiowa' which were low in vigor. Yield estimates and berry weights were about 50% of that reported from trials in Arkansas, while soluble solids (°Brix) were similar to published values. Average yield estimate across all cultivars was about 4,300 pounds/acre (4,800 kg/ha), average berry weight was 4.4 g, and average soluble solids was 10.2 °Brix. 'Natchez' and 'Ouachita' (both thornless) and Tupi (very thorny) had the best overall performance. Data were not collected for 'Chester' and 'Triple Crown', because they both have much too high a chilling requirement for north Florida. Blackberries offer good potential for organic culture under the climate and edaphic conditions of north Florida.

Many blackberry cultivars are adapted to the southeastern United States; however, the blackberry industry is mainly reliant on thornless blackberry cultivars from the University of Arkansas breeding program. The culture of blackberries in Florida is limited to homeowner production and small commercial plantings. Blackberries require few, if any, pesticide sprays, and are good candidates for organic culture. In commercial plantings, Septoria leaf spot, stinkbugs, and the red necked cane borer are potential pests. Perhaps the biggest input of blackberry culture is weed control. One possible weed control strategy is to grow blackberry plants with a plastic or polypropylene weed mat. Most recently, the spotted-winged Drosophila (*Drosophila suzukii*) has emerged as a significant pest of blackberries, blueberries, cherries, and other fruit in many locations in the United States. This insect lays its eggs in both developing and ripe fruit and the presence of larvae in fruit can cause the rejection of the entire fruit shipment.

Blackberries are a deciduous crop and require exposure to winter cold to produce normal vegetative and reproductive bud development and bud break in the spring. Chilling hours are quantified by the cumulative number of hours 45 °F or less during the dormant season. During the last two decades, the University of Arkansas has named and released over ten thornless and thorny blackberry cultivars. Many of these cultivars appear to be adapted to north Florida with a chilling requirement of between 300 and 800 cumulative hours of chilling temperatures (Drake and Clark 2000, Warmund and Krumme 2005, J. Clark, pers. comm.). Drake and Clark (2000) reported that 'Arapaho' and 'Navaho' had a chilling requirement of 400–500 h and 800–900 h, respectively. Warmund and Krumme (2005) ranked the chilling requirement

from low to high as follows: 'Kiowa', 'Arapaho', 'Shawnee', 'Navaho', 'Chickasaw', and 'Apache'. There is great interest in the culture of blackberries in the United States and worldwide. Blackberries are a rich source of flavonoids, anthocyanins and polyphenols, and have a high antioxidant capacity (Sellappan et al. 2002).

The great majority of blackberry cultivars produce vegetative growth (named primocanes) one year that form flowers and fruit (named floricanes) the following year. There are a few blackberry cultivars that fruit on primocanes, but they are not adapted to the deep South (Clark 2014, Clark et al. 2005, Ruple et al. 2010). Blackberry plants produce an aggregate fruit and are derived from many ovaries on a single flower. There is a good market window for blackberries that mature in late May. Blackberries are extremely perishable and should be picked at least twice a week, and should be refrigerated after picking (Clark and Moore 1990). Some small commercial growers have even picked them at night to avoid high fruit temperatures during the day. Most blackberry cultivars fruit over a two- to three-week period, beginning in late May/early June in north Florida. Blackberry yields in many areas of the country may exceed 6000 pounds/acre (6735 kg/ha); however, yield data for Florida are scarce. Andersen and Crocker (2014) reported that the average yield of 'Arapaho' and 'Navaho' grown under four mulch treatments averaged 3765 kg/ha (3354 pounds/acre) and 4104 kg/ha (3656 pounds/acre), respectively.

Blackberries are best grown in areas with good air and water drainage. The soil pH should be 5.5 to 6.5. Prior to planting in-row strips 1.8 m (6 ft) wide can be treated with glyphosate herbicide (optional) and disked and plowed to a depth of at least 0.3 m (1 ft). Since weed control is the biggest labor input in blackberry production in Florida, a 1.8 m (6 ft) wide strip Arkansas blackberry cultivars are erect or semi-erect and may not require trellising. Blackberry plants are spaced between 0.76 and 1 m (2.5 and 3.3 feet) apart in a row and 3.0 to 4.6 m (10

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to 15 ft) between rows. Drip irrigation is the preferred method of irrigation. If mulch is used it may be installed prior to weed barrier deployment. Blackberries do not require much fertilizer. I recommend a fertilizer application (10N–10P–10K) 3–5 times a year. During the establishment year, 57–114 g (2–4 oz) per plant is satisfactory. For the second year and thereafter, 114–170 g (4–6 oz) per plant is satisfactory.

The purpose of this study was to evaluate the performance of thorny and thornless blackberry cultivars over a three-year period in north Florida.

Materials and Methods

On 16 Feb. 2011, a blackberry cultivar trial was initiated at the University of Florida North Florida Research and Education Center in Quincy, FL (NFREC-Quincy). Six thornless ('Apache', 'Arapaho', 'Chester', 'Natchez', 'Ouachita', and 'Triple Crown') and two thorny ('Kiowa' and 'Tupi') cultivars were represented in the trial. 'Apache', 'Arapaho', 'Kiowa', 'Natchez', and 'Ouachita' are from the University of Arkansas and are patented. Data for 'Chester' and 'Triple Crown' were not collected since their chilling requirement of 800+ hours was too high for north Florida and neither cultivar produced normal vegetative growth or fruit. The study consisted of 30 plants (rooted cuttings) of each cultivar. Plant spacing was 0.76 and 3.05 m (2.5 and 10 feet) within and between rows, respectively. Trellising was not provided. Soil type was an Orangeburg loamy fine sand. A 1.22 m-wide (4 ft-wide) polypropylene fabric weed mat was utilized for all plants. A 0.3 m (1 ft) long X was cut thru the polypropylene weed mat with a razor blade to allow for planting of the rooted cuttings and for the application of fertilizer. A 10N–4.3P–8.3K fertilizer with micronutrients was applied four times per year and 114 g (4 oz) per application (on or about 15 Mar., 1 May, 15 June, and 1 Sept.). Irrigation was supplied by drip irrigation at an 8-L/h rate on an as needed basis. The irrigation was deployed prior to installation of polypropylene weed mat. The only pesticides that were applied were herbicides (glyphosate and paraquat) to control weeds along the edges of the mulch. Primocanes were tipped 2–3 times per year during late spring and summer to promote lateral branching and create more fruiting points.

Plant vigor was rated for each plant during June 2013 and 2014 on a scale of 1–10, with 10 being the highest. The major characteristic considered was the number and the growth of primocanes, and secondarily the robustness of the floricanes. Yield was estimated during June 2012, 2013, and 2014 on a scale of 1 to 10, with 10 being the highest. I estimate that a full crop rating of 10 is equivalent to about 8,000 pounds per acre (9,000 kg/ha) or about 4.6 pounds/plant (2.09 kg/plant). Berry weights and soluble solids (°Brix) were measured during the middle of the harvest period (mid-June). In addition, during 2012 berry weights and °Brix were quantified from first to last harvest. Berry weight was determined from a representative 100-berry sample. Soluble solids were measured with a refractometer on a 5-berry subsample.

Results and Discussion

Plant vigor and yield were estimated during June on a scale from 1 to 10, with 10 being the highest (Table 1). Plant vigor was determined during 2013 and 2014. Average vigor was 6.4 to 6.8 for all cultivars except for 'Arapaho' (4.3) and 'Kiowa' (5.1). Yield rating was highest for 'Natchez' (5.9) and 'Ouachita'

(7.0) and lowest for 'Arapaho' (3.9). 'Natchez' had an extremely large crop in 2013 and a light crop in 2014. I estimate that a yield rating of 10 at the NFREC-Quincy would be equivalent to about 9000 kg/ha (8000 pounds/acre). This would equate to 2.1 kg/plant (4.6 pounds/plant). Thus, our per plant yield estimate would range from 1.5 kg/plant (3.2 pounds/plant) for 'Ouachita' to 0.9 kg/plant (2.0 pounds/plant) for 'Arapaho'.

The only published yield data for the Arkansas cultivars in Florida appears in Andersen and Crocker (2014) where yield for 'Arapaho' varied from 2787 to 4840 kg/ha (2483–4312 pounds/acre) and that of 'Navaho' varied from 3128 to 5292 kg/ha (2787–4704 kg/ha) over four different mulch treatments. Yield of the Arkansas blackberry cultivars in Arkansas have been at least twice as high as in Florida. The following yield data were published from locations in Arkansas (in kg/ha): 'Apache' [Clarksville = 8892, Hope = 9523, and Fayetteville = 7912 (Clark and Moore 1999)]; 'Arapaho' [Clarksville = 9500, Fayetteville = 6300, and Hope = 8600 (Moore and Clark 1993)]; 'Kiowa' [Clarksville = 8720, Fayetteville = 5150, and Hope = 8140 (Moore and Clark 1996)]; 'Natchez' [Clarksville = 10,735 and Hope = 7793 (Clark and Moore 2008)]; and 'Ouachita' [Clarksville = 9924, Fayetteville = 7482, and Hope = 10,384 (Clark and Moore 2005)]. No data were available for 'Tupi' for comparative purposes.

The highest berry weights were recorded for 'Apache' and berry weights were at least 4.0 g for all cultivars except 'Arapaho' (Table 2). In general, berry weights of the Arkansas cultivars were substantially higher in Arkansas than in our trial. For example, average berry weights across several locations in Arkansas were as follows (in grams/berry): 'Apache' 8.5 (Clark and Moore 1999); 'Arapaho' 6.2 (Moore and Clark 1993); 'Kiowa' 9.4 (Moore and Clark 1996); 'Natchez' 7.0 (Clark and Moore 2008); and 'Ouachita' 6.0 (Clark and Moore 2005). Thus, berry weights reported for Arkansas were 1.5- to 2-fold higher than those in Table 2. In 2012 the change in berry weights from first to last harvest was evaluated (Table 3). Berry weights averaged across all cultivars were highest during the first harvest and declined thereafter (4.5, 4.2, 3.6, 3.5); however, there was considerable variation in the pattern across cultivars.

Average soluble solids were acceptable for all cultivars ≥ 9.5 for all cultivars except 'Kiowa' (Table 2). Berries with a lower °Brix than about 9.5 are generally too sour and are not preferred by consumers. 'Arapaho' was the sweetest with a °Brix of 11.3. In 2013, 'Natchez' had a low °Brix likely due to a very heavy crop load. In contrast to the higher yields and berry weights in Arkansas compared to Florida, the °Brix data were generally similar in the two locations. For example, the °Brix data in Arkansas were as follows: 'Apache' = 10.7 (Clark and Moore 1999); 'Arapaho' = 9.1 (Moore and Clark 1993); 'Kiowa' = 10.3 (Moore and Clark 1996); 'Natchez' = 8.7 (Clark and Moore 2008); and 'Ouachita' = 9.9 (Clark and Moore 2009). A brief summary of the performance of the blackberry cultivars at the NFREC-Quincy follows. All the University of Arkansas listed are patented.

'**Apache**' is an erect thornless blackberry from the University of Arkansas breeding program (Clark and Moore 1999). In Arkansas, 'Apache' produces 10 g berries and higher yields than other blackberry cultivars. In Florida, yield was average and berry weight was 5.2 g. Chilling requirement is about 800 h. '**Arapaho**' is an erect thornless blackberry cultivar from the University of Arkansas (Moore and Clark 1993). Yields and

Table 1. Plant vigor and yield estimates of blackberry cultivars from 2012–14.

Cultivar	Plant vigor ^z			Yield ^z			
	2013	2014	Avg.	2012	2013	2014	Avg.
Apache	7.0 ± 0.3	6.5 ± 0.5	6.8 ± 0.3	4.1 ± 0.3	6.2 ± 0.3	4.0 ± 0.3	4.7 ± 0.2
Arapaho	3.9 ± 0.2	4.6 ± 0.3	4.3 ± 0.2	2.5 ± 0.2	4.3 ± 0.3	5.0 ± 0.2	3.9 ± 0.2
Kiowa	5.0 ± 0.3	5.1 ± 0.3	5.1 ± 0.3	4.9 ± 0.4	5.3 ± 0.5	5.1 ± 0.4	4.8 ± 0.3
Natchez	7.5 ± 0.2	5.5 ± 0.4	6.4 ± 0.2	6.2 ± 0.4	9.2 ± 0.2	2.6 ± 0.6	5.9 ± 0.2
Ouachita	6.8 ± 0.3	6.8 ± 0.4	6.7 ± 0.2	6.4 ± 0.4	7.4 ± 0.2	7.7 ± 0.4	7.0 ± 0.2
Tupi	6.7 ± 0.3	6.5 ± 0.4	6.6 ± 0.2	3.8 ± 0.3	6.7 ± 0.3	5.3 ± 0.5	5.4 ± 0.2

^zPlant vigor and yield estimates are based on a scale of 1–10, with 10 being the highest. Yield rating of 10 is estimated to be 9,000 kg/plant (8,000 pounds/acre).

Table 2. Berry weight and soluble solids of blackberry cultivars from 2012–14.

Cultivar	Berry wt (g)				Soluble solids (°Brix)			
	2012	2013	2014	Avg.	2012	2013	2014	Avg.
Apache	4.6	7.7	3.2	5.1	10.7	11.5	9.6	10.6
Arapaho	2.9	5.2	2.6	3.6	12.0	10.9	11.1	11.3
Kiowa	4.5	5.3	2.0	3.9	8.3	6.4	10.3	8.3
Natchez	4.3	6.2	3.0	4.5	10.5	8.1	9.9	9.5
Ouachita	4.3	6.4	2.7	4.4	12.2	9.2	10.5	10.6
Tupi	4.1	7.1	3.6	4.9	11.0	9.7	11.2	10.6

Table 3. The change in berry weight and soluble solids from first to last harvest during 2012.

Cultivar	Berry wt (g)				Soluble solids (°Brix)			
	6/5	6/13	6/21	6/27	6/5	6/13	6/21	6/27
Apache	5.0	5.1	4.9	3.3	10.1	9.0	12.7	10.8
Arapaho	3.9	1.9	3.0	2.9	12.4	10.0	14.3	11.3
Kiowa	4.9	4.7	4.3	4.0	7.6	8.1	9.8	7.8
Natchez	4.7	4.1	4.1	---	12.4	8.3	13.0	---
Ouachita	3.5	4.7	4.9	3.8	11.7	10.4	14.7	12.0
Tupi	4.7	4.6	3.0	3.8	10.6	9.2	13.1	---

fruit weights are not as high as more recent cultivars such as ‘Apache’, ‘Natchez’ and ‘Ouachita’. In Florida, yield was low. Average fruit weight and soluble solids were 3.6 g and 11.3 °Brix, respectively. Chilling requirement is about 450 h.

‘**Kiowa**’ is a thorny cultivar from the University of Arkansas breeding program (Moore and Clark 1996). It has been largely replaced by the thornless cultivars ‘Apache’, ‘Natchez’ and ‘Ouachita’. It is claimed to have a large berry size of 10 g (Moore and Clark 1996); however, in our trials berry size averaged 3.9 g. Chilling requirement is about 300 h.

‘**Natchez**’ is an erect thornless blackberry from the University of Arkansas. ‘Natchez’ has the potential to produce very high yields. Berry size (5.1 g) and sweetness (9.5 °Brix) is about average. Berries are firm and attractive. Chilling requirement is about 350 h. It is recommended for north Florida.

‘**Ouachita**’ is an erect thornless cultivar from the University of Arkansas breeding program (Clark and Moore 2005). This cultivar has produced high yields in Arkansas, and has the highest average yield in Florida. Berry weight (4.4 g) and °Brix (10.6) are about average. Chilling requirement is about 450 h. ‘Ouachita’ is recommended for north Florida.

‘**Tupi**’ is sometimes spelled ‘Tupy’. It was developed in Brazil and is not patented. It is semi-erect and extremely thorny. It is often grown in Mexico and commonly appears in grocery stores in the United States year round. ‘Tupi’ has a chilling requirement of about 250 h, and may be the one cultivar in our trial adapted to central Florida.

‘**Osage**’ is a recent blackberry from the University of Arkansas (Clark 2013), but has not been tested in our trial. It is an erect, thornless cultivar with excellent postharvest characteristics. Yield is reported to be medium high. Berry size (5 g) and soluble solids (10 °Brix) are average.

‘**Navaho**’ is an erect thornless cultivar that has largely been replaced by other new cultivars. Yield of ‘Navaho’ in Florida was rather low and berries ripen late over a prolonged period (Andersen and Crocker 2014).

‘**Chester**’ and ‘**Triple Crown**’ are two thornless blackberries planted in our trial; however, the chilling requirements are much too high for Florida (over 800 h). The bushes did not produce any fruit, nor did they grow satisfactorily.

As I mentioned earlier, the great majority of blackberry cultivars produce vegetative canes one year (primocanes) and

they fruit the following year (floricanes). Primocane-fruiting blackberry cultivars all with a prefix of “Prime” (‘Prime-Jan’, ‘Prime-Jim’ and ‘Prime Ark Freedom’) have been developed by the University of Arkansas (Clark 2014, Clark et al. 2005, Ruple et al. 2010). Although they were not included in the trial at the NFREC–Quincy, it is likely that they are adapted to climates with a cooler summer than occurs in Florida since fruiting occurs during mid to late summer.

A common question I am asked is which blackberry cultivars can be grown successfully in central and south Florida. ‘Tupi’ has the lowest chilling requirement of all cultivars in our trial, but to my knowledge it has not been tested in central Florida. Several blackberry cultivars (‘Brazos’, ‘Flordagrاند’, and ‘Oklawaha’) were developed over 50 years ago to have a low chilling requirement and can be grown in central Florida. While they can be grown in a homeowner setting, they do not have significant commercial potential. ‘Brazos’ is an erect thorny blackberry cultivar released by the Texas Agricultural Experiment Station that produces berries with a high acidity (Lewis 1959) and is self-fruitful. ‘Flordagrاند’ (Shoemaker et al. 1964) and ‘Oklawaha’ (Shoemaker and Westgate 1964) were released by the University of Florida for home and local markets, and can be grown in central Florida. They both require a pollinizer, and produce tart berries high in acid and low in sugar. ‘Flordagrاند’ and ‘Oklawaha’ pollinize one another.

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