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A Retrospective of Blackberry Breeding and Production in Arkansas

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Domestication of American blackberry species began in the late 1820s (1). However, improved, named cultivars did not become popular until the 1840s and 1850s, when 'Dorchester' and 'Lawton' were widely planted. The initial report of blackberries being grown in Arkansas occurred around 1880 (2). The first documented cultivar released in the state of Arkansas was named 'Bauer', after C.P. Bauer who discovered it in 1890 (1) (Table 1), although not much is currently known about this cultivar. In 1896, J. Stinson, horticulturist at the University of Arkansas, reported that the primary cultivars grown in Arkansas were 'Early Harvest', 'Lawton', and 'Snyder' (5). 'Early Harvest' was a derivative of *Rubus laudatus* Berger, also known as the "plains blackberry". Its adaptation to the central plains region of the U.S. likely contributed to its success in Arkansas. 'Lawton' was imported from New York with the background of *R. allegheniensis* Porter x *R. frondosus* Bigel. Both are common eastern North American blackberry species and are widely adapted to this region. The hybridization of *R. allegheniensis* and *R. frondosus* also gave rise to 'Snyder' (1).

By 1900, over 300 ha of blackberries were grown in Arkansas which yielded more than 660,000 kg (7) (Table 2). In 1914, the Arkansas Agricultural Experiment Station recommended 'Early Harvest', 'Kittatinny', 'Snyder', and 'Taylor' as blackberry cultivars and 'Mayes' and 'Lucretia' as dewberry cultivars (6). 'Kittatinny' also played an important role in shaping blackberry production in the eastern U.S. It was derived from *R. argutus* L. or *R. pergratus* Blanch. x *R. frondosus*. *Rubus argutus*, one of the major North American blackberry species, is also known as the "tall blackberry" or "highbush blackberry", and exhibits a number of major traits such as cane erectness (1). *Rubus pergratus* is widespread throughout the eastern U.S. and is known for having big clusters, large fruit, and sweet and juicy berries. 'Taylor' was a derivative of *R. allegheniensis* x *R. argutus* that originated in Indiana. It was very hardy and was considered to have some of the highest quality blackberry fruit (1). The dewberries are trailing by nature and incorporate different species. Both 'Mayes' and 'Lucretia' have *R. baileyanus* Britton in their genetic background which contributed large fruit size.

Throughout the 1920s and 1930s, blackberry production in Arkansas continued to increase. A cultivar named 'Austin Thornless' was released in Fayetteville, Ark. in 1924 by J.M. Parker and Son (1) (Table 1). It descended from an open-pollination of the cultivar Mayes (synonymous with 'Austin', sometimes called 'Austin-Mayes'). The new cultivar was thornless, derived from a dominant thornless gene, and was an octoploid.

Blackberry production peaked in Arkansas according to the 1940 agricultural census (8). At that time, almost 1,100 ha of blackberries were grown in the state and production exceeded 800,000 kg (Table 2). More than 10% of the total hectares of blackberries east of the Rocky Mountains were being grown in Arkansas at that time. Throughout the early decades of the century, canneries in the northwest portion of the state processed the blackberries, thus lending to the strong industry (2). However, by the 1950 census,

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Table 1. Blackberry cultivars released in Arkansas

Year	Cultivar	Female parent	Male parent	Releasing entity
1890	Bauer	*R. trivialis*	*R. trivialis*	C.P. Bauer
1924	Austin Thornless	Mayes	O.P.	J.M. Parker
1974	Comanche	Darrow	Brazos	Univ. of Arkansas
1974	Cherokee	Darrow	Brazos	Univ. of Arkansas
1985	Shawnee	Cherokee	Ark. 586	Univ. of Arkansas
1988	Choctaw	Ark. 526	Rosborough	Univ. of Arkansas
1988	Navaho	Ark. 583	Ark. 631	Univ. of Arkansas
1993	Arapaho	Ark. 631	Ark. 883	Univ. of Arkansas
1996	Kiowa	Ark. 791	Ark. 1058	Univ. of Arkansas
1998	Apache	Ark.1007	Navaho	Univ. of Arkansas
1998	Chickasaw	Ark. 842	Ark. 1242	Univ. of Arkansas
2003	Ouachita	Navaho	Ark. 1506	Univ. of Arkansas
2004	Prime-Jan™ (APF-8)	Ark. 1836	Arapaho	Univ. of Arkansas
2004	Prime-Jim™(APF-12)	Arapaho	Ark. 830	Univ. of Arkansas

Table 2. Arkansas blackberry production in hectares, kilograms, and kg/hectare from 1900-2004[z]

Year	Hectares	Kg	Kg/hectare
1900	311	660,087	2,121
1910	213	400,412	1,885
1920	514	603,052	1,174
1930	738	637,714	864
1940	1,072	842,505	786
1945	1,042	787,391	756
1950	439	367,850	839
1954	64	25,644	399
1959	30	32,169	1,060
1964	3	3,632	1,282
1969	38	98,222	2,582
1974	40	42,254	1,055
1978	26	54,450	2,070
1982	21	36,927	1,722
1987	38	99,862	2,625
1992	28	43,301	1,573
1997	72	111,947	1,554
2004	202	909,909	4,500
Total	4,891	5,757,328	–
Average	–	–	1,603

[z]All data from the U.S. Dept. of Commerce, Census of Agriculture 1900-1997, except the 2004 data which were an estimate contributed by John R. Clark.

hectarage of blackberries in Arkansas had declined to less than 500 ha (9). The steep post-World War II decline continued until 1964, when only 2.8 ha were grown in the state and produced a mere 3,600 kg (10). At the nadir of blackberry production in Arkansas, J.N. Moore greatly expanded the blackberry breeding program. Under his leadership, the new blackberry breeding program at the University of Arkansas spurred a renewed interest in production. Hectarage began a slow increase in the late 1960s due to desire for mechanically harvested processing berries and fresh market pick-your-own (PYO) operations (2).

In 1974, Moore released 'Comanche' and 'Cherokee', followed by 'Cheyenne' in 1977, initiating the Native American namesake series of blackberry cultivars (Table 1). These cultivars were products of a cross between 'Darrow' and 'Brazos'. 'Darrow' was a cultivar from New York released in 1958. It was known to be vigorous, cold hardy, very erect, and a heavy producer. It also produced fruit early with good flavor and quality. It was borne out of two prominent early cultivars, Eldorado and Brewer. 'Eldorado' was a hybrid between *R. allegheniensis* and *R. argutus*, whereas 'Brewer' incorporated *R. pergratus* and *R. frondosus* (1). 'Brazos' was a Texas A&M release from 1959, that had 'Nessberry' as a male parent. 'Nessberry' was a cross between a southeastern U.S. blackberry species, *R. trivialis* L., and the 'Brilliant' red raspberry (*R. idaeus* subsp. *strigosus* Michx.).

By the early 1980s nearly 75% of all blackberries in Arkansas were being mechanically harvested (3) due to the success of 'Comanche', 'Cherokee', and 'Cheyenne'. Yet, double blossom (rosette), caused by the fungus *Cercosporella rubi* [Wint.] Plakidas, was a prevalent disease that limited wide adaptation of those cultivars. The Arkansas blackberry breeding program continued to be productive throughout the 1980s, releasing 'Shawnee', 'Choctaw', and 'Navaho'. 'Shawnee', again, relied heavily on 'Darrow' and 'Brazos' in its background, but also incorporated new species through 'Merton Thornless', a European blackberry. The two European blackberry species present in 'Merton Thornless' are *R. ulmifolius* var. *inermis* Focke and *R. procerus* Muell. *Rubus ulmifolius* var. *inermis* is the source of the recessive thornless gene and *R. procerus* contributes large berry size. 'Shawnee' was the first blackberry cultivar to be patented at the University of Arkansas. 'Choctaw' was a product of 'Darrow', 'Brazos', and another cultivar from Texas, 'Rosborough'. A great program breakthrough was realized with the release of 'Navaho', the first thornless Arkansas cultivar.

Success at the University of Arkansas continued through the early to mid-1990s with the releases of 'Arapaho' in 1993 and 'Kiowa' in 1996. 'Arapaho' was similar in background to 'Navaho', but also had a little known cultivar from Virginia in its background named 'Hillquist'. This fortuitous inclusion of 'Hillquist' would later pay dividends in the evolution of blackberry breeding. Like 'Navaho', 'Arapaho' was also a thornless cultivar with a high quality berry. Unlike the new thornless releases, 'Kiowa' was a thorny, semi-erect cultivar with a low chilling requirement (12).

In 1996, J.N. Moore retired and J.R. Clark was hired to direct the small fruit breeding program. Under the new stewardship of Clark, along with the continued participation of Moore, the program released 'Apache' and 'Chickasaw' in 1998 and 'Ouachita' in 2003. Both 'Apache' and 'Ouachita' are thornless, and produce large, high-quality berries. 'Ouachita', like 'Apache', 'Arapaho', and 'Navaho', is nearly immune to double blossom. 'Chickasaw' is a thorny cultivar that produces large berries with a unique flavor. By the end of the century, blackberry production had risen to 72 hectares and nearly 112,000 kg (11), the highest number since the 1950 census. Near the beginning of the 21st century, production further expanded for fresh-market shipping (Table 2) based entirely on the Arkansas thornless cultivars which are among the best in the world for postharvest handling (4).

Recently, two new cultivars, 'Prime-Jan'® (cultivar APF-8) and 'Prime-Jim'® (cultivar APF-12), have been released. In both genotypes, 'Arapaho' is a parent. As mentioned previously, the propitious inclusion of 'Hillquist' in the Arkansas breeding program has paid dividends with 'Prime-Jan'® and

'Prime-Jim'®. The new genotypes are the first primocane-fruiting cultivars to be released since 'Hillquist' in 1949. However, 'Hillquist' was a wild selection that had significant problems which limited its widespread production, and thus diminished its usefulness as a cultivar. Both 'Prime-Jan'® and 'Prime-Jim'® are thorny, display a reliable expression of the primocane fruiting trait, and have good fruit size. They are primarily recommended for home garden production. Currently, new primocane-fruiting selections are being evaluated for cane erectness, high yield, and superior fruit quality.

Throughout the last 100 years, blackberry production in Arkansas has cycled through boom and bust cycles. The first half of the 20th century saw many hectares of blackberries being planted, even during the Depression-era economic downturn. However, the post-World War II years saw the industry bottom out. A rebound was observed throughout the later decades due to mechanical harvesting and fresh market potential. With the continued development of improved cultivars through the University of Arkansas blackberry breeding program the outlook for Arkansas blackberry production appears promising.

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Suppression of Fire Blight with Prohexadione-Calcium

Prohexadione-calcium (Phd-Ca) suppresses shoot growth and fire blight in apples, but there are concerns that the growth restriction by Phd-Ca may delay tree establishment. The authors used one to five year old trees of several cultivars and applied Phd-Ca at different frequencies and concentrations. Data indicate that the best balance between growth suppression and fire blight control was obtained with fewer high dosage applications (125 or 250 mg/L) of Phd-Ca than with multiple low dose applications (30 or 63 mg/L). Response of early season shoot growth to Phd-Ca was linear. Trees receiving high doses grew more later in the season so there was little difference in total shoot growth between trees receiving few high doses and those receiving several lower doses. Enhancement of fire blight resistance by Phd-Ca was correlated with growth suppression at the time of inoculation. From Norelli, J.L. and S.S. Miller. 2004. Plant Disease 88: 1099-1106.

Modelling of Seed Effects on Apple Fruit Shape

Utilizing lopsided 'Granny Smith' apple fruit, the authors investigated the influence of seed set on fruit shape. The asymmetry of seed distribution was reflected by asymmetrically shaped fruit. A three-order model was developed to predict the effect of seed weight on weight of the fruit sector. The growth of each sector was primarily influenced by the seeds within its locule (first order), less by seeds in the two flanking locules (second order), and not by seeds in the most distant locule (third order). From L. Drazeta, A. Lang, A.J. Hall, R.E. Voltz, and P.E. Jameson. 2004. J. Hort. Sci. Biotech. 79: 241-245.