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‘Osage’ Thornless Blackberry

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‘Osage’ is the thirteenth release in a series of erect-growing, high-quality, productive floricane-fruiting blackberry (*Rubus* L. subgenus *Rubus* Watson) cultivars developed by the University of Arkansas Division of Agriculture. An enhanced effort in the improvement of flavor in blackberries has been underway in the Arkansas program for a number of years, and ‘Osage’ was developed with the intention of advancing flavor to a higher level in a thornless blackberry cultivar. ‘Osage’ ripens midearly, slightly before ‘Ouachita’ (Clark and Moore, 2005) and just after ‘Natchez’ (Clark and Moore, 2008). ‘Osage’ produces medium-sized berries, smaller than that of ‘Natchez’ but comparable to that of ‘Ouachita’. ‘Osage’ has excellent postharvest quality for the shipping market in addition to local market use. It is expected that ‘Osage’ will complement ‘Ouachita’ in the midearly to midseason harvest period.

Origin

‘Osage’ is a result of a cross of Ark. 1719 × Ark. 2108 made in 2000 (Fig. 1). The original plant was selected in 2003 from a seedling field at the University of Arkansas Fruit Research Station, Clarksville, AR (FRS) and tested as selection Ark. 2362. The most thorough testing of ‘Osage’ has been at this location.

A single, 6.1-m plot was established at FRS [west–central Arkansas, lat. 35°31′58″ N, long. 93°24′12″ W; U.S. Dept. of Agriculture (USDA) plant hardiness zone 7a (USDA Plant Hardiness Zone Map, 2013); soil type was Linker fine sandy loam (Typic Hapludults)] in summer of 2003 and observational data were taken on ‘Osage’ on this plot for the fruiting seasons of 2005 through 2011. Plots of ‘Apache’, ‘Natchez’, ‘Navaho’, and ‘Ouachita’ were also present in this planting for comparison and observational data were collected on these during this evaluation period. In all plantings, standard cultural practices for erect blackberry production were used including annual pre-emergence and postemergence herbicide applications, annual spring nitrogen fertilization (56 kg·ha^{-1} N) using ammonium nitrate (NH_4NO_3), summer tipping of primocanes at 1.1 m, and dormant pruning. All plantings received an annual single application of liquid lime sulfur (94 L·ha^{-1}) at each spring at budbreak for control of anthracnose [*Elsinoë veneta* (Burkh.) Jenkins] and this was the only fungicide applied to any plantings in any year.

Data were collected for soluble solids concentration [based on a 25-berry sample collected once each season for 6 years (2005–11 excluding 2007 when frost damage severely damaged the crop and measurements were not taken)] with soluble solids measured using a handheld refractometer. Ratings for a range of characteristics were taken for 7 years (2005–11), including 2007, for which soluble solids data were not collected. Fruit ratings were taken based on a rating scale of 1 to 10, where 10 = best, including size (10 = largest), firmness (as measured subjectively by hand in the field on eight to 10 berries, with rating of 10 indicating very firm), and flavor. Flavor ratings were conducted by the author and were subjective with higher ratings indicating sweet berries with a desirable balance of acidity with sweetness. Plant ratings for vigor (1 to 10 with a rating of 7 to 10 acceptable; vigor rating based on both flori- and primocanes), health (1 to 10 with 10 = excellent health; components of this rating include freedom from diseases and uniform leaf color and size), and erectness (1 to 10 with 10 = very erect) were conducted one time each year. Winter injury was evaluated (seen as bud or cane injury) each year at the time of fruiting. Additionally, replicated trials were established at FRS in 2007 and 2010 and the Southwest Research and Extension Center, Hope, AR [southwest Arkansas, lat. 33°42′30″ N, long. 93°33′0″ W; USDA hardiness zone 8a (USDA Plant Hardiness Zone Map, 2013); soil type was Bowie fine sandy loam (Fragic Palendults)] in 2007. For the Hope trial, only data for 2008 were collected as a result of the entire planting of all genotypes developing poor plant health from undiagnosed reasons but possibly excess winter and spring soil moisture that resulted in poor performance in 2009 and 2010. These trials consisted of three replications with only two replications used for data collection; the other plots were used for observation. Plots in both trials were 3.1 m in length containing five plants per replication spaced at 0.6-m intervals and were planted on raised beds covered with black plastic (that remained in the plantings the first 2 years) at FRS and on a flat surface with no plastic at Hope. The cultivars Natchez, Ouachita, and Prime-Ark® 45 were included for comparison in the FRS replicated trials, and at Hope, the same cultivars plus ‘Apache’ and ‘Prime-Jim’® were also included. Only floricane-fruiting data are included in the analysis for ‘Prime-Ark® 45’ and ‘Prime-Jim’®. Both locations received chilling in excess of 800 h (hours below 7 °C) during the years of evaluation. Data for 10% and 50% bloom and first, peak, and last harvest dates were recorded for 2008 and 2009 for the 2007-planted trial and 2011 for the 2010-planted trial at FRS. Average berry weight (average for 25 berries/replicate on each harvest date at each location with the average for each replicate for the season being used in the analysis) and total yield data from the replicated plantings for both locations were analyzed as a randomized complete block separately by year (2008, 2009, 2011 for FRS, 2008 for Hope) and location by the GLM procedure of SAS (SAS Institute, 2012). All mean separations for each planting were by least square means ($P \leq 0.05$). Additionally, the average berry weight for each harvest for 2011 for the 2010-established trial at FRS was recorded.

Postharvest evaluations were done on floricane fruits for ‘Osage’ and several other cultivars for 2008–11 for fruit from FRS. The procedures used were previously described (Clark and Perkins-Veazie, 2011). Briefly, dry, shiny-black berries (not treated with preharvest fungicides) were harvested in the morning into hinged, clear, vented, polyethylene 260-g clamshell containers (Century Corrugated Container, Kilgore, TX). Each clamshell contained on average 20 berries. Two clamshells were gathered from each genotype at two consecutive harvest dates (resulting in four replications). The berries were then stored at 5 °C, 80% relative humidity, for 7 d. Subjective evaluations were made for firmness, presence or absence of visible mold, leak, or reddening. The variables of percent berries decayed, with leakage, and soft were used in a calculation for marketability. The marketability value was calculated as: 100 – [sum (% decayed + % soft (4- and 5-rated berries) + % leaky)]. A minimum score of 85 was desired for a genotype to be considered likely acceptable for shipping based on the variables measured. Data were analyzed for each year by the GLM procedure of SAS (SAS Institute, 2012). All mean separation for each planting was by *t* test ($P \leq 0.05$).

Description and Performance

‘Osage’ originated from a cross designed to combine enhanced flavor from crossing two of the higher-rated flavor selections in the program (Ark. 1719 and Ark. 2108), and excellent flavor was noted at each observation of fruit of this cultivar over the years of evaluation. It had an average flavor rating of 8.4, very similar to ‘Ouachita’ with 8.3 (Table 1). However, this is the first Arkansas release that exhibited excellent flavor consistently during adverse conditions during harvest

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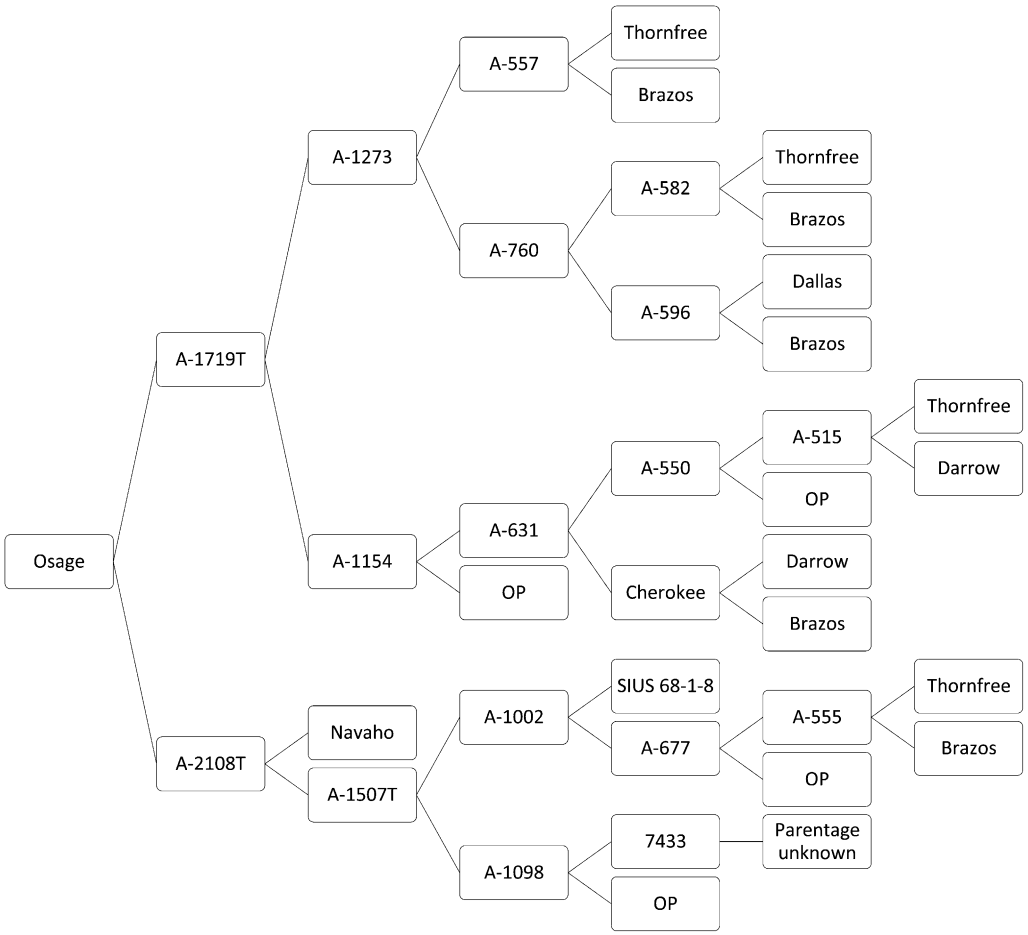

Fig. 1. Pedigree of 'Osage' thornless blackberry.

such as rain and cloudiness. One component of the consistently good flavor was berry sweetness as reflected in average soluble solids in the observational plots of 11.2% (Table 1) and replicated trials, 10.3% to 10.7% among the 2007 and 2010 trials (Table 2).

Fruit of 'Osage' are round and similar in shape to 'Ouachita'. One difference observed was that 'Osage' fruit had even drupelet fill, whereas 'Ouachita' often has uneven drupelet size; this complete drupelet fill provides for more uniform and attractive shape. Berries of 'Osage' are glossy with a uniform black finish. In recent years at test sites in Arkansas, white drupelets have been observed on some blackberry genotypes near or at fruit maturity and has been most severe on 'Apache'. In repeated trials, 'Osage' was observed to have no white drupelets, whereas incidence of this was very high for 'Apache' and other genotypes in some portions of some fruiting seasons.

Fruit firmness is an exceptional characteristic of 'Osage' because firmness rating was 8.0, similar to other thornless cultivars but higher than 'Natchez' (Table 1) and this firmness was consistent whether in rainy or dry periods of fruit maturity. Average berry weight of 'Osage' ranged from a high of 5.5 g to a low of 4.4 g in the FRS-replicated trials (Table 2) and 5.0 g at Hope (Table 3), comparable to 'Ouachita' in all trials but smaller than 'Natchez'. 'Osage' was also observed to retain its fruit weight throughout most of the harvest season with some decrease in berry weight toward season's end (Tables 1 and 4).

Table 1. Plant and fruit characteristics of five thornless blackberry cultivars at the University of Arkansas Fruit Research Station, Clarksville.

Characteristic	Osage	Apache	Navaho	Natchez	Ouachita
Bloom date[z]					
10% bloom	26 Apr.	3 May[y]	—	20 Apr.	30 Apr.
50% bloom	2 May	8 May[y]	—	29 Apr.	6 May
Harvest date[z]					
First	10 June	18 June[y]	—	5 June	13 June
Peak	26 June	6 July[y]	—	17 June	29 June
Last	24 July	9 Aug.[y]	—	15 July	27 July
Berry weight[z] (g/berry)					
First	4.6	7.5[y]	—	7.7	5.1
Peak	5.6	8.2[y]	—	7.9	5.8
Last	4.0	6.8[y]	—	7.2	4.0
Fruit[x,w]					
Firmness	8.0 ± 0.6	8.0 ± 0.0	8.0 ± 0.0	7.7 ± 0.5[v]	8.3 ± 0.5
Flavor	8.4 ± 0.5	8.0 ± 0.0	7.9 ± 0.4	7.3 ± 0.5[v]	8.3 ± 0.5
Soluble solids (%)[u]	11.2 ± 1.0	11.4 ± 0.8	10.3 ± 1.1	10.0 ± 1.6	11.1 ± 1.1
Plant[x,w]					
Vigor	7.3 ± 0.5	6.9 ± 0.9	6.9 ± 1.1	6.8 ± 0.4[v]	7.0 ± 0.0
Health	7.6 ± 0.5	7.7 ± 1.0	6.9 ± 0.7	7.3 ± 0.5[v]	7.6 ± 0.8
Erectness	8.1 ± 1.1	8.0 ± 0.6	7.0 ± 0.6	6.5 ± 0.5[v]	8.3 ± 0.5

[z]Means of 3 years (2008, 2009, 2011) from replicated trials in Clarksville, AR.
[y]2011 data not taken.
[x]Means of 7 years, 2005 to 2011, with data collected from the observational plots; ± = SD.
[w]Rating scale of 1 to 10 where 10 = best.
[v]Missing 2008 data.
[u]Means of 6 years 2005, 2006, and 2008 to 2011.

Postharvest evaluations done in 2008–11 indicated that 'Osage' demonstrated excellent storage potential with marketability above 85% every year, comparable to 'Ouachita', 'Natchez', and 'Prime-Ark® 45' and exceeding that of 'Tupy' (data for 2008–09 only for 'Tupy') (Table 5). 'Tupy' was included in the

Table 2. Yield and berry weight of four blackberry cultivars in two plantings established in replicated trials at the University of Arkansas Fruit Research Station, Clarksville, with the first in 2007 with data collected in 2008 and 2009 and the second established in 2010 with data collected in 2011.

	Yield (kg·ha^{-1})			Berry wt (g)			Soluble solids (%)		
Cultivar	2008	2009	2011	2008	2009	2011	2008	2009	2011
Osage	13,832 a[z]	8,797 a	13,681 ab	5.5 c	4.4 b	5.0 b	10.4 ab	10.3 a	10.7 b
Natchez	14,137 a	6,759 a	19,773 a	7.9 a	6.2 a	7.6 a	9.3 b	10.3 a	9.5 b
Ouachita	8,800 b	4,888 a	12,076 b	5.8 bc	4.7 b	5.5 b	10.7 a	10.8 a	12.3 a
Prime-Ark 45	13,142 a	5,110 a	7,866 b	6.1 b	4.7 b	5.5 b	10.6 ab	10.0 a	11.0 ab

[z]Means followed by the same letter are not significantly different at the 5% level by least square means.

Table 3. Yield and berry weight for 2008 for replicated trial planted at the University of Arkansas Southwest Research, Hope, in 2007.

Genotype	Yield (kg·ha^{-1})	Berry wt (g)
Osage	19,151 ab[z]	5.0 bc
Prime-Ark 45	15,210 bc	5.1 bc
Ouachita	14,323 c	5.5 b
Apache	15,770 bc	8.1 a
Prime-Jim	7,572 d	4.6 c
Natchez	14,240 c	7.5 a

[z]Means followed by the same letter are not significantly different at the 5% level by least square means.

evaluation because it is the most widely planted fresh-market blackberry cultivar in the world, produced almost exclusively in Central Mexico, and considered to have very good postharvest handling when produced there. Development of red drupes on berries was very low in most years for 'Osage', 0% to 1% except for 2008 when this value was higher for 'Osage' along with most other cultivars (Table 5). Means for leak, decay, and soft were also good for 'Osage' compared with other cultivars (Table 5). 'Osage' is expected to perform well in commercial shipping use based on these comparisons.

'Osage' produced yields in the highest mean value categories in all replicated plantings, comparable to or higher than 'Ouachita' and 'Natchez' (Tables 2 and 4). The lowest yield for 'Osage' at FRS was in 2009, the year when raspberry crown borer (*Pennisetia marginata* Harris) infestation was found throughout the planting on all genotypes, and this likely contributed to the yield reduction. Consistent production among years and locations is a positive reflection of yield stability for 'Osage'.

'Osage' bloomed on average 26 Apr. (10% bloom) with 50% bloom on 2 May; these bloom dates are several days later than that for 'Natchez' but earlier than 'Ouachita' and 'Apache' (Table 1). First harvest date for 'Osage' averaged 10 June, 5 d after 'Natchez', 3 d before 'Ouachita', and 8 d before 'Apache' (Table 1). Peak and last harvest dates had similar trends. A primary consideration in planting 'Osage' will be the substantial overlap in harvest period with the highly successful 'Ouachita', but it is hoped that 'Osage' will complement 'Ouachita' for this period and diversify cultivar choice for growers.

Canes of 'Osage' are thornless and erect. Average erectness ratings for 'Osage' were 8.1, similar to 'Ouachita' and 'Apache' but more erect than 'Natchez' (Table 1). A common trellis used on erect cultivars by growers consists of two wires placed ≈1.0 to 1. 2 m above the soil surface and separated horizontally 1.0 m, and this trellis will be excellent in production of 'Osage'. Vigor rating of 'Osage' was 7.3, good and slightly higher than other cultivars (Table 1). Average health rating for 'Osage' was 7.6, comparable to higher than most comparison cultivars (Table 1). Overall, ratings and comments of plant vigor and health indicated that 'Osage' had a consistent health level, and also it was noted to establish well in all evaluation plantings. Sprouting from root cuttings has not been formally measured, but indications from the initial plot establishment in 2003 and from propagation with root cuttings in a greenhouse are that it sprouts readily from root cuttings. No orange rust [caused by *Gymnoconia nitens* (Shwein.) F. Kern & H.W. Thurston] has been observed on 'Osage' in any evaluations, although infected plants have been seen within 50 m of plots of 'Osage'. 'Osage' is moderately resistant to anthracnose, because only a small amount of anthracnose was noted

Table 4. Average berry weight in grams at each harvest date for four cultivars for 2011 in a 2010-established replicated blackberry planting at the University of Arkansas Fruit Research Station with dates ranging from 2 June to 11 July.

Cultivar	2 June	6 June	9 June	13 June	16 June	20 June	27 June	30 June	5 July	7 July	11 July
Osage			5.0[z]	6.0	6.1	5.4	5.8	5.3	5.1	3.7	4.8
Natchez		8.0	7.7	8.1	7.2	7.5	7.1	6.9	8.4		8.3
Ouachita				5.7	6.4	6.1	5.8	5.2	5.3	6.5	5.7
Prime Ark 45		4.2	5.7	5.9	5.0	5.3	5.5	6.1	6.3	5.6	

[z]Average individual berry weight is calculated from a 25 berry subsample collected from two replications for each cultivar at that particular harvest date.

Table 5. Postharvest evaluations of 'Osage' blackberries from 2008 to 2011 collected at the University of Arkansas Fruit Research Station, Clarksville, compared with named cultivars (7 d in cold storage at ≈5 °C).

Cultivar	Marketability[z]	Red (%)[y]	Leak (%)[x]	Decay (%)[w]	Soft (%)[v]
		2008			
Osage	85.5 ab[u]	18.4 ab	4.3 b	2.8 b	18.2 ab
Natchez	91.8 a	66.6 a	12.6 b	1.4 b	10.6 a
Prime-Ark 45	85.6 ab	25.3 ab	7.5 b	0.9 b	9.6 a
Apache	80.8 ab	4.7 b	21.3 ab	10.6 a	21.1 ab
Arapaho	80.0 ab	6.1 b	26.8 ab	4.3 ab	22.9 ab
Ouachita	76.8 ab	22.8 ab	15.5 b	11.5 a	19.9 ab
Tupy	64.3 b	35.1 ab	39.7 a	1.8 b	30.7 b
		2009			
Osage	94.7 a	1.0 b	16.3 ab	3.0 a	1.0 a
Natchez	89.3 ab	14.8 ab	14.7 a	1.3 a	12.8 ab
Prime-Ark 45	89.0 ab	4.8 b	29.9 ab	3.4 a	5.7 ab
Apache	72.4 cd	0.0 b	68.8 c	18.2 bc	23.3 b
Arapaho	80.2 bc	0.0 b	56.4 c	0.0 a	22.9 b
Ouachita	88.8 ab	0.0 b	35.0 ab	3.5 a	6.3 ab
Tupy	65.4 d	12.0 ab	64.0 c	19.6 c	43.0 c
		2010			
Osage	92.3 a	0.0 a	15.8 a	1.9 a	5.8 ab
Natchez	85.3 a	5.0 a	27.7 a	0.0 a	16.3 bc
Prime-Ark 45	93.5 a	0.0 a	19.9 a	0.0 a	0.0 a
Arapaho	87.0 a	0.0 a	33.8 ab	0.0a	5.3 ab
Ouachita	92.0 a	0.0 a	20.4 a	1.6 a	2.5 a
Tupy	71.3 b	5.2 a	56.3 b	3.1 a	26.0 c
		2011			
Osage	87.8 a	0.0 a	26.3 a	2.0 a	8.3 a
Natchez	87.7 a	0.0 a	30.8 a	0.0 a	6.3 a
Prime-Ark 45	91.2 a	0.5 a	20.8 a	1.0 a	4.3 a
Ouachita	92.8 a	1.5 a	18.5 a	2.3 a	1.0 a

[z]Percent marketability ratings are used as an indicator of performance after 7 d in the cooler. Percent marketability is calculated as: 100 – [sum(% decayed + % soft (4- and 5-rated berries) + % leaky)/3]. A minimum of 85 is desired. Marketability is calculated using the per replication data for decayed, soft, and leaky berries, not the mean values presented here; this can result in differences between marketability presented and what would be calculated using the mean values presented in the formula.

[y]The berries were rated on a yes/no scale for presence of red drupelets in clusters of three or more.

[x]The berries were rated on a yes/no scale for presence of leakiness.

[w]The berries were rated on a yes/no scale for presence of decay .

[v]The berries were rated on a 1 to 5 scale for softness, where 1 = firm and 5 = collapsed berry, very leaky. Means represent berries that scored a 4 or 5.

[u]Means followed by the same letter are not significantly different ($P > 0.05$) by *t* test.

on berries or leaves in 2 of 7 years in the selection of observation planting in evaluations where a single spray of lime sulfur was applied. Reaction of 'Osage' to rosette/double blossom [*Cercosporella rubi* (Wint.) Plakidas] has not been evaluated. It is expected that 'Osage' is resistant to this disease as are the other Arkansas thornless cultivars and 'Osage' should hold promise for production in areas where this disease is limiting.

Winter-hardiness can be one of the more important characteristics of successful blackberry cultivars, particularly in colder climates or in severe winters. Overall, 'Osage' appears similar in hardiness to most of the other Arkansas-developed cultivars such as 'Ouachita' and 'Navaho' (data not shown). During the evaluation of 'Osage' at Clarksville, a winter minimum of –13 °C was experienced in Dec. 2004 and 2007, and no plant or crop damage was noted the next fruiting season. Furthermore, a low of –16 °C occurred in Feb. 2010 and only slight winter injury to fruit buds was noted; crop was rated 7 for that year (data not shown). Finally, a winter low of –17 °C occurred in Feb. 2011 and only slight injury to fruit buds was observed and very good yield was recorded (Table 2). Hardiness to temperatures lower than experienced in Arkansas is not known because 'Osage' has not been tested in colder sites.

The chilling requirement for 'Osage' has not been measured and it has not been tested fully in environments of less than 800 h of chilling (hours below 7 °C during dormancy). In 2006, it was noted to have budbreak with 'Kiowa', a low chill (200 to 300 h chilling requirement), a possible indication of low chill. This consistent early budbreak has not been observed subsequently, however. It is expected that 'Osage' has a chilling requirement similar to or possibly lower than 'Ouachita', which is considered to have a chilling requirement of 400 to 500 h.

Outstanding characteristics of 'Osage' include very good fruit flavor, overall high fruit quality with excellent postharvest fruit-handling potential, consistent high yields, and excellent plants. Also, diversification of a midseason cultivar choice beyond 'Ouachita' is considered a merit. The most substantial limitation to 'Osage' is only medium fruit size, smaller than some cultivars. 'Osage' should be a commercial cultivar with good potential for shipping as well as an option for home gardens. 'Osage' is expected to perform well in areas where 'Apache', 'Arapaho', 'Ouachita', 'Natchez', or 'Navaho' is adapted, including all areas of the South and into the Midwest in addition to the West and Pacific Northwest.

Availability

An application for a U.S. plant patent will be filed for 'Osage', and it will be licensed on a non-exclusive basis in the United States.

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