Blackberry Cultivar Development at the University of Arkansas

John R. Clark
University Professor of Horticulture
Good Morning Friends!

• Celebrating 51 years of fruit breeding in Arkansas!!!
• Begun in January, 1964 by Dr. James N Moore
• Lots accomplished, lots yet to get done
Arkansas Breeding Location

- Primary location
- Clarksville
The Absolute Newest Thing From Arkansas - **Prime-Ark® Traveler**
The First Primocane-Fruiting, Thornless, SHIPPING QUALITY Blackberry - **EVER!!**

- Medium size – 7 g
- 9-11% SS, reduced acidity
- Shipping potential for distant markets
- Target use is shipping, local markets and home gardens
The Next to Absolute Newest Thing From Arkansas - **Prime-Ark® Freedom**
The First Primocane-Fruiting Thornless, **EVER!!!**

- LARGE – 9-12 g
- 9-11% SS
- Does not appear to have shipping potential
- Target use is local markets and home gardens
But First, Let’s Examine Blackberries a Minute......

• Largely a native crop to the US
• Historically picked from the wild
• First commercial use for local markets and pick-your-own
• Shipping market began in the 1990s
• Now, 75% of the retail (grocery store marketed) blackberries in the US are produced in Central Mexico, Oct to June production
Today, A Major Focus is Fresh Market Blackberry Use

- Fresh market blackberries appeared in US retail markets in the 1990s
- Since that time have become available almost year around (with imports from Mexico)
- Production for fresh market is carried out in many states, both eastern and western US
Other Fresh-Fruit Markets

• On-farm sales
• Pick your own
• Community supported agriculture (farmers sell and deliver to customers)
• Farmers markets

THE MAIN POINT IS THE FRESH MARKET BLACKBERRIES HAVE EXPANDED GREATLY IN THE US MARKETS – AND ARE PROFITABLE TO FARMERS!
The Blackberry Plant

• Thorny or thornless canes

• Perennial plants (live year after year) with biennial canes (canes live two years)
  – Primocanes – first year canes (may fruit)
  – Floricanes – second year canes (always fruit if survive the winter)
Blackberries Vs Raspberries

• How do blackberries and raspberries differ? The major difference is:
  – Blackberries are picked with the fruit containing the receptacle tissue – the torus is picked with the plant
  – Raspberries have the torus or receptacle tissue remaining on the plant at harvest; thus the fruit is hollow
Blackberry Cane Types

• Categorization by growth habit – three types
  - Trailing – canes grow very near ground level - trellised
  - Semi-erect – canes grow upward and then horizontal - trellised
  - Erect – canes grow upward for 4’ or more
Blackberry Cane Fruiting Types

Floricane fruiting – no flowers on primocanes; summer season fruiting

Primocane-fruiting – fruiting on first-year canes, autumn season;

Almost all world blackberry production is floricane-fruiting

The first primocane-fruiting production commercially appeared **Five** years ago
First, Let’s Discuss Floricane-Fruiting Varieties
Osage– The Newest Arkansas Thornless Floricane-fruiting Blackberry

- Ripens (in Ark.) between Natchez and Ouachita, ave. June 10 beginning harvest
- Yields have been consistent and good, comparable to higher than Ouachita
- Berry size is medium, 5.0 g, slightly smaller than Ouachita
- Flavor is a key attribute of Osage, lower acid flavor with notable flavor components coupled with high soluble solids
- Good even on “bad flavor days” as noted by JRC over the years
- Great postharvest handling potential
Osage—Why Consider?

• *A complement to Ouachita* in size and season to diversify cultivars for this harvest period

• Consistently uniform in drupelet fill whereas Ouachita can have uneven fill

• Is hoped to expand on *flavor* and enjoyment of blackberries by consumers
<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield (lb/acre)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Average (^y)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
<td>2011</td>
<td>2012</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>Osage</td>
<td>12,341 a</td>
<td>7,849 a</td>
<td>12,206 ab</td>
<td>12,902 a</td>
<td>22,923 b</td>
<td>13,644</td>
</tr>
<tr>
<td>Natchez</td>
<td>12,613 a</td>
<td>6,030 a</td>
<td>17,641 a</td>
<td>17,351 a</td>
<td>34,208 a</td>
<td>17,569</td>
</tr>
<tr>
<td>Ouachita</td>
<td>7,851 b</td>
<td>4,361 a</td>
<td>10,774 b</td>
<td>14,021 a</td>
<td>20,567 b</td>
<td>11,515</td>
</tr>
</tbody>
</table>

\(^z\) Means followed by the same letter are not significantly different at the 5% level within single columns.

Postharvest evaluations of several cultivars of blackberries at Clarksville, AR, Fruit Research Station.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Overall</th>
<th>Marketability</th>
<th>Red (%)</th>
<th>Leak (%)</th>
<th>Soft (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natchez</td>
<td>54.0</td>
<td>89.9</td>
<td>15.5</td>
<td>20.9</td>
<td>9.8</td>
</tr>
<tr>
<td>Osage</td>
<td>51.0</td>
<td>87.2</td>
<td>3.2</td>
<td>24.3</td>
<td>12.4</td>
</tr>
<tr>
<td>Ouachita</td>
<td>52.3</td>
<td>89.7</td>
<td>7.5</td>
<td>22.4</td>
<td>9.4</td>
</tr>
<tr>
<td>Prime-Ark® 45</td>
<td>56.9</td>
<td>90.5</td>
<td>5.1</td>
<td>22.6</td>
<td>6.2</td>
</tr>
<tr>
<td>Tupy</td>
<td>-10.1</td>
<td>71.0</td>
<td>18.8</td>
<td>50.8</td>
<td>34.2</td>
</tr>
</tbody>
</table>

2009-2013 averages.
Plant and fruit characteristics of four thornless blackberry cultivars at the University of Arkansas Fruit Research Station, Clarksville.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Osage</th>
<th>Navaho</th>
<th>Natchez</th>
<th>Ouachita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble solids (%)(^z)</td>
<td>11.2</td>
<td>11.0</td>
<td>10.0</td>
<td>11.3</td>
</tr>
<tr>
<td>pH</td>
<td>3.6</td>
<td>3.2</td>
<td>3.1</td>
<td>3.2</td>
</tr>
<tr>
<td>Titratable acidity (g/L)(^y)</td>
<td>0.7</td>
<td>1.3</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>


\(^y\)expressed as citric acid in g/100 mL.
Ouachita

- Berry size 6-7 g
- Flavor good and sub acid; 10% soluble solids
- Postharvest potential very good
- *The largest selling Arkansas variety – and most widely adapted and planted*
Natchez

- Berry size large, 8-10 g; remain large season-long
- Early ripening
- Flavor good; 9.5% soluble solids
Apache

- Large, 7-10 g; (ave. 8 g)
- 10-11% soluble solids
- Later season
- Very productive

- White drupe limitation is a major concern and shippers are not recommending this variety; others comment only a minor concern for local sales
- **Still a good seller!**
Blackberry Planting Considerations

• Order of ripening, Clarksville, Arkansas
  – Natchez: June 5
  – Osage: June 10
  – Ouachita: June 12
  – Navaho: June 20
  – Apache: June 25
Blackberry Varieties: How to decide?

• Order of ripening
  – Natchez: Early, large, popular, sometimes tart, always large and impressive, not as erect
  – Osage: New, consider trying
  – Ouachita: The top Arkansas variety – make sure you plant this one if nothing else
  – Navaho: older, not large, but good for late season and excellent quality, orange rust susceptible
  – Apache: some like, some don’t, and reason is white drupes; not for shipping; shift trellis help?
  – Von? Sure need to consider for later season – A new one from NC State, not sure where on the market yet tho...
Von
Von

• ‘Von’ produces fruit in the mid-late season, with average date of harvest commencing in the third week of June, peaking in the second week of July and ending the first week of August.

• In post harvest evaluations, when blackberries were held 7 days at 4 C, 90% RH in pint clamshells, ‘Von’ has a marketable score of 90.6, which is as good or better than the leading commercial cultivars.

• Soluble sugars content of ‘Von’ was 9.4% and pH was 3.57, traits that characterize ‘Von’ as sweet with low acid.
What About Primocane-Fruiting Varieties?

- Prime-Ark®45 is the most planted variety
- This one and all others continue to suffer in the Arkansas heat in primocane fruit set and quality
- 2011 and 2012 were terrible for PF blackberries in Arkansas; few fruits produced on any plants on primocanes
- 2013, 2014 were much better and PC fruit produced
What About Primocane-Fruiting Varieties and HEAT?

• Breeding is being done in a very hot climate, 2011 and 2012 among hottest ever in Arkansas
• Unfortunately progress thought to be made was not confirmed or supported these years
• What to do?
  – Shadecloth
  – Rotating crossarm trellis????
  – Floricane crop
    • Values are early, high-quality berries
    • Negative is thorns on PA 45
What About Primocane-Fruiting Varieties?

• Floricane crop of Prime-Ark® 45 being used by some growers as is early (near Natchez) and very firm with good quality

• Can floricane yields be substantial? Yes – the less PC crop the year before, the greater the FC crop potential
Prime-Ark® 45

- Berry weight 6-7g (floricanes)
- Much larger on primocanes in California
- Very erect canes; thorny

Upper FF fruit, (Ark)

Lower PC fruit, (Calif.)
Prime-Ark® 45 in California

Nipomo, CA, Oct 9, 2012

No matter what you hear or see, this PF trait CAN really work!
Prime-Ark® Freedom

- FC crop ripens 7-10 days before Natchez – really early
- Huge primocane crop in California – a cooler location...
- Primocane berries up to 16 g in (cool places)
**Prime-Ark® Freedom and Prime-Ark® 45 floricane data, 2011-2013, for 2010-established planting, Fruit Research Station, Clarksville, AR.**

<table>
<thead>
<tr>
<th>Variety</th>
<th>1st Harvest</th>
<th>Yield (lb/acre)</th>
<th>Weight / berry (g)</th>
<th>Soluble solids&lt;sup&gt;y&lt;/sup&gt;</th>
<th>Titratable acidity&lt;sup&gt;y&lt;/sup&gt;</th>
<th>Average pH&lt;sup&gt;y&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime-Ark® Freedom</td>
<td>6-Jun</td>
<td>15,639&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.60&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.45&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Prime-Ark® 45</td>
<td>13-Jun</td>
<td>20,967&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.18&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Prime-Ark® Freedom</td>
<td>10-May</td>
<td>9,582&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Prime-Ark® 45</td>
<td>20-May</td>
<td>11,811&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Prime-Ark® Freedom</td>
<td>29-May</td>
<td>5,584&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Prime-Ark® 45</td>
<td>9-Jun</td>
<td>7,018&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
</tr>
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</table>

<sup>y</sup> Reps were analyzed using student's t-test with α = 0.05, using SAS.
Fruit data for **Prime-Ark® Freedom**; University of Arkansas Fruit Research Station, Clarksville.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Variety</th>
<th>Prime-Ark® Freedom</th>
<th>Natchez</th>
<th>Osage</th>
<th>Ouachita</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Floricane harvest date</strong></td>
<td></td>
<td>28 May</td>
<td>6 June</td>
<td>9 June</td>
<td>13 June</td>
</tr>
<tr>
<td>First</td>
<td></td>
<td>6 June</td>
<td>13 June</td>
<td>20 June</td>
<td>28 June</td>
</tr>
<tr>
<td>Peak</td>
<td></td>
<td>20 June</td>
<td>7 July</td>
<td>25 July</td>
<td>25 July</td>
</tr>
</tbody>
</table>

**Fruit**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>7.8 (0.5)</th>
<th>7.8 (0.5)</th>
<th>8.3 (0.5)</th>
<th>8.5 (0.6)</th>
<th>8.3 (0.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firmness</td>
<td></td>
<td>7.8 (0.5)</td>
<td>7.0 (0.8)</td>
<td>8.3 (0.5)</td>
<td>8.8 (0.5)</td>
<td>7.8 (0.5)</td>
</tr>
<tr>
<td>Flavor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data from 2010 replicated trial.

Rating scale of 1 to 10 where 10=best.
Primocane fruiting data: 2010 Blackberry Rep Trial; 2013 data from Fruit Research Station, Clarksville, AR; *almost no PC crop in 2011 and 2012.*

<table>
<thead>
<tr>
<th>Variety</th>
<th>First harvest</th>
<th>Yield (lb/acre)(^y)</th>
<th>Weight/ berry (g)(^y)</th>
<th>Soluble solids(^y)</th>
<th>Titratable acidity(^y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime-Ark® 45</td>
<td>5-Aug</td>
<td>3,268 a</td>
<td>5.8 b</td>
<td>9.6 a</td>
<td>1.09 a</td>
</tr>
<tr>
<td>Prime-Ark® Freedom</td>
<td>11-Jul</td>
<td>2,581 a</td>
<td>8.8 a</td>
<td>8.8 a</td>
<td>0.66 b</td>
</tr>
</tbody>
</table>

\(^y\) 2 reps were analyzed using student's t-test with \(\alpha = 0.05\), using SAS.
Floricane data for **Prime-Ark® Freedom** and floricane varieties; University of Arkansas Fruit Research Station, Clarksville, established in 2010, data for 2011-2013.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield (lb/acre)</th>
<th>Weight/berry (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime-Ark® Freedom</td>
<td>5,584 b</td>
<td>9,582 a</td>
</tr>
<tr>
<td>Prime-Ark® 45</td>
<td>7,018 b</td>
<td>11,811 a</td>
</tr>
<tr>
<td>Natchez</td>
<td>19,773 a</td>
<td>19,448 a</td>
</tr>
<tr>
<td>Osage</td>
<td>13,681 ab</td>
<td>14,461 a</td>
</tr>
<tr>
<td>Ouachita</td>
<td>12,076 ab</td>
<td>15,716 a</td>
</tr>
</tbody>
</table>

\(^y\) Mean separation within columns by Duncan's multiple range test and LS Means where appropriate (P<0.05).
### First-Year Yield

<table>
<thead>
<tr>
<th>Genotype</th>
<th>1st Harvest date</th>
<th>Average harvested yield (lbs / acre)</th>
<th>Berry wt. (g)</th>
<th>Soluble solids</th>
<th>Titratable acidity</th>
<th>Average pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natchez</td>
<td>13-Jun</td>
<td>34,208 a</td>
<td>8.3 a</td>
<td>9.5 a</td>
<td>1.13 a</td>
<td>2.84 a</td>
</tr>
<tr>
<td>Osage</td>
<td>15-Jun</td>
<td>22,923 b</td>
<td>5.7 c</td>
<td>10.0 a</td>
<td>0.96 a</td>
<td>3.24 a</td>
</tr>
<tr>
<td>Ouachita</td>
<td>20-Jun</td>
<td>20,567 b</td>
<td>6.2 c</td>
<td>11.8 a</td>
<td>1.03 a</td>
<td>3.12 a</td>
</tr>
<tr>
<td>Prime-Ark® 45</td>
<td>11-Jun</td>
<td>18,597 b</td>
<td>7.1 b</td>
<td>11.2 a</td>
<td>0.93 a</td>
<td>3.17 a</td>
</tr>
</tbody>
</table>

²2 reps were analyzed using student's t-test with α = 0.05, using SAS

### Second-Year Yield After Very Hot Summer

<table>
<thead>
<tr>
<th>Genotype</th>
<th>1st Harvest date</th>
<th>Average harvested yield (lbs / acre)</th>
<th>Berry wt. (g)</th>
<th>Soluble Solids</th>
<th>Titratable Acidity</th>
<th>Average pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natchez</td>
<td>13-Jun</td>
<td>32,513 a</td>
<td>9.3 a</td>
<td>9.7 a</td>
<td>1.07 a</td>
<td>2.93 a</td>
</tr>
<tr>
<td>Ouachita</td>
<td>20-Jun</td>
<td>27,457 a</td>
<td>7.1 c</td>
<td>9.8 a</td>
<td>1.50 a</td>
<td>2.87 a</td>
</tr>
<tr>
<td>Prime-Ark® 45</td>
<td>6-Jun</td>
<td>28,374 a</td>
<td>8.2 b</td>
<td>10.1 a</td>
<td>1.02 a</td>
<td>3.06 a</td>
</tr>
</tbody>
</table>

²2 reps were analyzed using student's t-test with α = 0.05, using SAS
What’s Coming in Arkansas Blackberries?

• Some very nice complements to early season Natchez showing promise
• Exceptional firmness now incorporated into thornless plants – crisp-like texture
• Later season floricanne-fruited improvements in place but not as sweet as desired
• Shipping-quality primocane-fruited thornless
What About the RCA Trellis?

Trellis Growing Systems, LLC
2427 S. Hadley Road
Fort Wayne, IN 46804
rcbarnes@trellisgrowingsystems.com
Rotating Crossarm Trellis

• Benefits are:
  – Fruit easy to pick
  – Sun damage is less with shaded berries
  – Can be covered in the winter
Arkansas Variety **Acreage** Established by TGS 2010-2014

Natchez – 43
Ouachita – 135
Apache – 19

**TOTAL – 197 acres from TGS**

Newly planted Ouachita in northeast Kansas
Ouachita in Circleville, OH

Natchez in Circleville, OH
Bedford, PA – view of 20 acres
Bedford, PA
Harvest
<table>
<thead>
<tr>
<th>Variety</th>
<th>Buds</th>
<th>Ripened</th>
<th>Harvest start</th>
<th>Harvest end</th>
<th>Berry size</th>
<th>Taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natchez</td>
<td>April 30</td>
<td>July 2</td>
<td>July 2</td>
<td>August 8</td>
<td>Very long &amp; large</td>
<td>Sour</td>
</tr>
<tr>
<td>Ouachita</td>
<td>May 1</td>
<td>July 11</td>
<td>July 11</td>
<td>Sept 2</td>
<td>Short &amp; fat</td>
<td>Very sweet</td>
</tr>
<tr>
<td>Apache</td>
<td>May 11</td>
<td>July 16</td>
<td>*July 25</td>
<td>Sept 2</td>
<td>Average</td>
<td>Sweet</td>
</tr>
</tbody>
</table>

*sunscald delayed harvest
Hardiness with the RCA Trellis and Covering?

• The winter of 2013-2014 was the first to fully evaluate this system commercially – The RCA and Row Cover

• In general, it appears that below -20 damage under cover is substantial, higher temperatures allow cropping – Arkansas varieties that is
After -16 in Ohio, 2014

Left picture canes still on ground; right picture after shifting trellis upright
After -16 in Ohio, 2014

• Comments from grower:
  – Triple Crown suffered the most damage of all varieties.
  – Ouachita seems to be the shining star at this time.
  – Osage seems to have great primocane growth.
  – Apache trains well and yields great –with the aid of shade cloth we hope to make it a staple.
Arkansas Fruit Breeding-Still More Good Things Coming! **For 51 Years!!!!**

AND THANKS FOR YOUR TIME!

jrclark@uark.edu