Blackberry Growth Cycle and New Varieties from the University of Arkansas

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Virginia
Roots and crown are **perennial**

Vegetative growth is **biennial** and usually canes require a dormant period before fruiting

Fruit production is on **fruit laterals/inflorescences** on one year-old canes

Flowers are perfect and self-fertile → consist of five petals and numerous stamens and pistils
Blackberry Fruit Structure

- Aggregate fruit
- Each drupelet is an individual fruit with a single ovary
- Fleshy receptacle
- Drupelets usually ripen together
- Drupelets and fruit vary in size and shape among cultivars
First year’s growth

Period of time: Late winter – early spring

• Roots show a seasonal pattern of growth with a peak at mid-summer

• Shoot and root growth begins at about the same time → root growth continues until much later in the year & is influenced by soil temperature

• Primocanes growth vigorously with strong apical dominance during the spring through summer
First year’s growth

One year-old plants

By trellising your plants you will have higher yields next season
First year’s growth

Time period: Spring to early Fall

• Primocanes grow and elongate during spring time

• Depending of the vigor, **summer tipping*** removes apical dominance and encourage branching
  - Lateral branching enhance fruiting area
  - Laterals need to be pruned to 15-20 inches during dormant pruning

* **Soft-tipping** is normally done by removing the upper 1-3 inches of the primocane when the tissue is soft
First year’s growth

- Growth is stopped by low temperatures in the fall
First year’s growth

Time period: Summer time

• If is a floricane cultivar no fruit production the first season of growth

• If is a primocane cultivar minimal to no fruit it is expected in the first year on primocanes

• Primocanes leaves are the active photosynthesis center in the plant which transport photosynthates (sugars) to reserve sites on the plant >>> important for next spring
Time period: Late Summer time to Fall

- Primocanes stop growing and begin to acquire **cold hardiness** for winter
- During winter time axillary buds are in an **endo-dormancy** state and buds need to accumulate **chilling hours** to satisfy chilling requirement:
  - Blackberry needs between 200-1200 chilling hours
  - Arkansas cultivars range from 300-900 chilling hours
- During the first year of growth winter pruning could be necessary to regulate the height of canes & remove weak and infested canes
- **Flower bud induction** occurs in late summer/fall in cane axils
Bud Dormancy

Time period: Winter

- Defined as “the temporary suspension of visible growth of any plant structure containing a meristem”

- **Endo-dormancy** is a inhibition of growth due to internal factors in the bud → chilling hours are necessary to overcome this state

- **Eco-dormancy**: bud is ready to develop but environmental conditions are not right

- Generally buds are in eco-dormancy after chilling requirement is accomplished
Bud Dormancy

Time period: Winter

• During dormancy water content in plants is minimum (~55% in Oct to ~38% in mid winter)

• Blackberry cold hardiness
  – Max hardiness: 1 or 2 months after growth ceases
  – Blackberry plants can resist to ~0 °F
  – Below 0°F plants are almost always damage; damage first to buds, then canes
Second year’s growth

Period of time: second Spring

• Fruit laterals will develop leaves, flowers, and finally fruits

• In average two-thirds of the nodes develop fruit laterals

• At the same time new primocanes are emerging and will start a new biennial cycle**
Second year’s growth

Fruit lateral:
• Early fruiting cultivars could have five to 10 fruits per lateral
• Late cultivars may have more than 50 fruits per lateral
Second year’s growth

Period of time: second summer – Floricane season

• ~40-70 days from pollination to ripening
• Correct stage of picking: **shiny black fruits**
• Soluble solids: > 10% perceived as a sweet eating experience
• Dull black are sweeter → inferior postharvest handling compared to shiny black

• **Recommendation:** harvest dry fruit in early morning to avoid hot temperatures → results in firm fruit and less color reversion in postharvest

Color reversion after cold storage
- Genetic component
- Environment
- Harvest and postharvest handling
Second year’s growth

**Shiny black blackberries**
- Superior postharvest handling
- Firm fruit
- Good postharvest potential
- Also, it must have good flavor, high SSC, balanced acidity

**Dull black blackberries**
- Sweeter fruits compared with shiny black fruits
- Soft fruit
- Poor postharvest potential
Second year’s growth

Primocane fruiting trait:

• Canes of PF cultivars do not need to overwinter → this cultivars can be grown in areas where they are winter-killed

• Potential to be produced in areas of inadequate chilling accumulation

• Potential to produce fruits from September to November
Period of time: Late summer - fall

- After floricane fruit production is over PF cultivars begin to produce fruit on primocanes.
- PF blooming period in primocanes occurs while floricane fruit is ripening.
  - High temperatures during summer could be detrimental for PF blooming.
  - In Arkansas some PF genotypes flowered and fruited when average daily high temperatures are 86 °F to 95 °F.
Second year’s growth – Primocane fruiting cultivars

Period of time: Late summer- fall

Summer: Primocane blooming

Late Summer to Fall: Primocane fruiting

Days from blooming to black fruit normally range 40-50 days, depending on the cultivar and climatic conditions.
Period of time: Winter

- Pruning floricane cultivars:
  - Remove floricanes by cutting down to the ground

- Pruning primocane cultivars:
  - If you produce only in primocanes:
    - remove by mowing all primocanes down to the ground
  - If you produce both floricanes and primocanes fruit:
    - remove the upper part of the primocanes where fruit production occurred → the remaining cane will support floricane production next season
The First Primocane-Fruiting, Thornless, SHIPPING QUALITY Blackberry - EVER!!!
Prime-Ark® Freedom

The First Primocane-Fruiting Thornless in the program

- LARGE: 9-12 g
- 9-11% SS
- Does not appear to have shipping potential
- Target use is local markets and home gardens
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
Why Consider Osage?

- 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
## Fruit Flavor Components of Osage

<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 (%)&lt;sup&gt;z&lt;/sup&gt;</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)&lt;sup&gt;y&lt;/sup&gt;</td>
<td>0.7</td>
<td>1.3</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>


<sup>y</sup>expressed as citric acid in g/100 mL.
Ouachita

- Released in 2003
- Berry size 6-7 g
- Flavor good and sub acid; 10% soluble solids
- Firm
- Postharvest potential very good
- The largest selling Arkansas variety and most widely adapted and planted
Natchez

- Released in 2007
- Berry size large, 8-10 g; remain large season-long
- Elongated
- Early ripening
- Flavor good; 9.5% soluble solids
### Yield Comparison

Osage, Natchez and Ouachita yield comparison, Fruit Research Station, Clarksville, AR.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield (lb/acre)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Average (^{\text{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.
Apache

• Released in 1998
• 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
Prime-Ark® 45

- Berry weight 6-7 g (floricanes)
- Fruit much larger on primocanes in California
- Very erect canes; thorny
- Floricane crop of Prime-Ark® 45 being used by some growers as is early (near Natchez) and very firm with good quality
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(\text{y})</th>
<th>Titratable acidity(\text{y})</th>
<th>Average pH(\text{y})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime-Ark®</td>
<td>6-Jun</td>
<td>15,639 a</td>
<td>12.6a</td>
<td>8.6a</td>
<td>0.60a</td>
<td>3.45a</td>
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<tr>
<td>Freedom</td>
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<td></td>
</tr>
<tr>
<td>Prime-Ark®</td>
<td>13-Jun</td>
<td>20,967 a</td>
<td>6.2b</td>
<td>10.5a</td>
<td>0.74a</td>
<td>3.18a</td>
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<td>45</td>
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</tr>
<tr>
<td>Prime-Ark®</td>
<td>10-May</td>
<td>9,582 a</td>
<td>8.7a</td>
<td>10.9a</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Freedom</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Prime-Ark®</td>
<td>20-May</td>
<td>11,811 a</td>
<td>5.4b</td>
<td>11.9a</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
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<tr>
<td>Prime-Ark®</td>
<td>29-May</td>
<td>5,584 a</td>
<td>9.2a</td>
<td>9.8a</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Freedom</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Prime-Ark®</td>
<td>9-Jun</td>
<td>7,018 a</td>
<td>5.5b</td>
<td>11.0a</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>45</td>
<td></td>
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</tr>
</tbody>
</table>

\(\text{Y}\) Reps were analyzed using student's t-test with \(\alpha = 0.05\), using SAS.
## Fruit Characteristics

Fruit data for Prime-Ark® Freedom; University of Arkansas Fruit Research Station, Clarksville.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Prime-Ark® Freedom</th>
<th>Natchez</th>
<th>Osage</th>
<th>Ouachita</th>
<th>Prime-Ark® 45</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Floricane harvest date</strong>&lt;sup&gt;z&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>28 May</td>
<td>6 June</td>
<td>9 June</td>
<td>13 June</td>
<td>6 June</td>
</tr>
<tr>
<td>Peak</td>
<td>6 June</td>
<td>13 June</td>
<td>20 June</td>
<td>28 June</td>
<td>18 June</td>
</tr>
<tr>
<td>Last</td>
<td>20 June</td>
<td>7 July</td>
<td>25 July</td>
<td>25 July</td>
<td>18 July</td>
</tr>
<tr>
<td><strong>Fruit</strong>&lt;sup&gt;y&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firmness</td>
<td>7.8 (0.5)</td>
<td>7.8 (0.5)</td>
<td>8.3 (0.5)</td>
<td>8.5 (0.6)</td>
<td>8.3 (0.5)</td>
</tr>
<tr>
<td>Flavor</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>
</tbody>
</table>

<sup>z</sup>Data from 2010 replicated trial.

<sup>y</sup>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)$^\text{y}$</th>
<th>Weight/ berry (g)$^\text{y}$</th>
<th>Soluble solids$^\text{y}$</th>
<th>Titratable acidity$^\text{y}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime-Ark® 45</td>
<td>5-Aug</td>
<td>3,268 $^\text{a}$</td>
<td>5.8 $^\text{b}$</td>
<td>9.6 $^\text{a}$</td>
<td>1.09 $^\text{a}$</td>
</tr>
<tr>
<td>Prime-Ark® Freedom</td>
<td>11-Jul</td>
<td>2,581 $^\text{a}$</td>
<td>8.8 $^\text{a}$</td>
<td>8.8 $^\text{a}$</td>
<td>0.66 $^\text{b}$</td>
</tr>
</tbody>
</table>

$^\text{y}$2 reps were analyzed using student's t-test with $\alpha = 0.05$, using SAS.
## Fruit Characteristics

**2012 Planted Blackberry Rep Trial; 2013 Collected Data from Clarksville, AR; ** 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>

2 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>

2 reps were analyzed using student's t-test with α = 0.05, using SAS
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
Table 2. Floricane yield and berry weight (average weight of 25 berries measured three to five harvest dates per cane type each year) of two primocane-fruited and three floricane-fruited blackberry genotypes in a replicated trial that was established in 2012 at the University of Arkansas Fruit Research Station, Clarksville.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>2013</th>
<th>2014</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Floricane harvests</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prime-Ark® Traveler</td>
<td>13,057 cd(^z)</td>
<td>13,283 b</td>
<td>6.7 bc</td>
<td>7.3 b</td>
</tr>
<tr>
<td>Natchez</td>
<td>38,342 a</td>
<td>21,725 a</td>
<td>8.3 a</td>
<td>10.9 a</td>
</tr>
<tr>
<td>Osage</td>
<td>25,693 b</td>
<td>–</td>
<td>5.7 c</td>
<td>–</td>
</tr>
<tr>
<td>Ouachita</td>
<td>23,052 bc</td>
<td>12,456 b</td>
<td>6.2 bc</td>
<td>7.4 b</td>
</tr>
<tr>
<td>Prime-Ark® 45</td>
<td>20,845 bc</td>
<td>10,234 b</td>
<td>7.1 b</td>
<td>7.9 b</td>
</tr>
<tr>
<td><strong>Primocane harvests</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prime-Ark® Traveler</td>
<td>4,963 a</td>
<td>7,568 a</td>
<td>4.7 a</td>
<td>6.4 a</td>
</tr>
<tr>
<td>Prime-Ark® 45</td>
<td>7,798 a</td>
<td>4,978 a</td>
<td>6.3 a</td>
<td>7.3 a</td>
</tr>
</tbody>
</table>

\(^z\) Mean separation within columns within cane type by t-test ($P\leq 0.05$).
<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Overall²</th>
<th>Red (%)²y</th>
<th>Leak (%)²x</th>
<th>Decay (%)²w</th>
<th>Soft (%)²v</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2013</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prime-Ark® Traveler</td>
<td>52.5 a</td>
<td>17.8 ab</td>
<td>30.0 abc</td>
<td>1.5 b</td>
<td>3.5 c</td>
</tr>
<tr>
<td>Natchez</td>
<td>58.5 a</td>
<td>43.0 ab</td>
<td>6.3 c</td>
<td>0.0 b</td>
<td>9.5 c</td>
</tr>
<tr>
<td>Ouachita</td>
<td>11.0 ab</td>
<td>38.5 ab</td>
<td>21.0 bc</td>
<td>6.0 b</td>
<td>35.8 abc</td>
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Questions?