Blackberry Growth Cycle and New Varieties from the University of Arkansas

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Virginia

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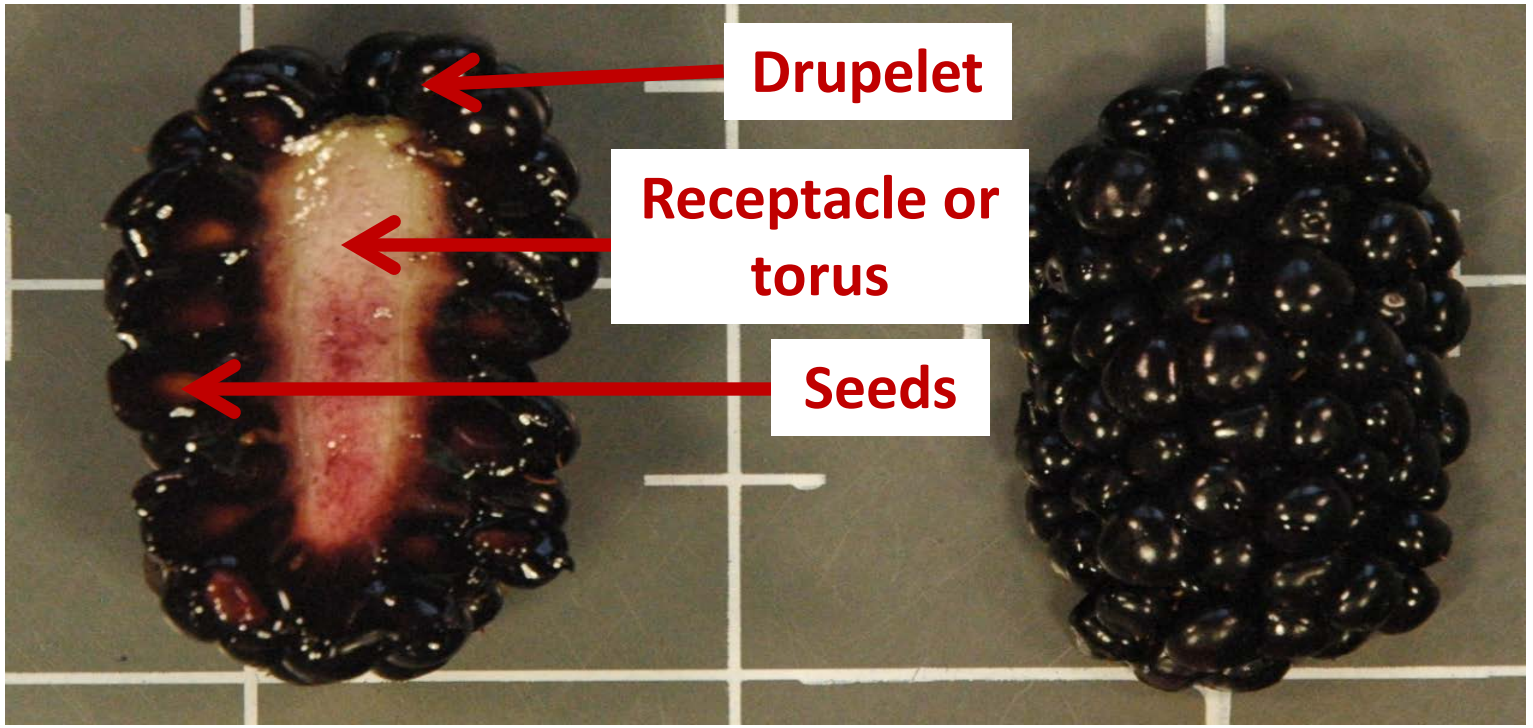
Morphology

- 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



Plant Structure – Biennial cane

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

Plant Structure

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**

First year's growth

Time period: Late Summer time to Fall

- Primocanes stop growing and begin to acquire **cold hardiness** for winter
- During winter time axilary 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

<u>Period of time: second Spring</u>

- 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

Second year's growth - Primocane fruiting cultivars

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

Second year's growth

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 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

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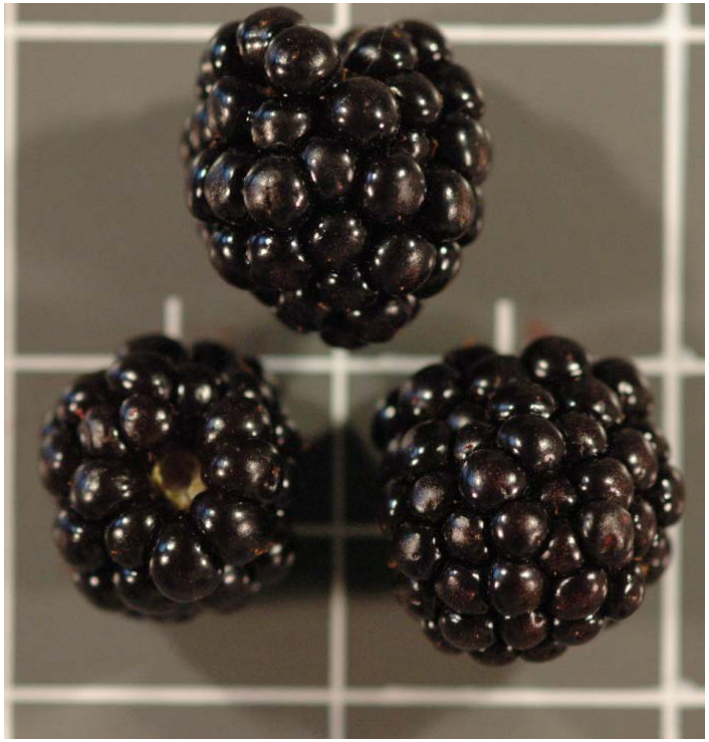
Prime-Ark® Freedom

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

Characteristic	Osage	Navaho	Natchez	Ouachita
Soluble solids (%)[z]	11.2	11.0	10.0	11.3
pH	3.6	3.2	3.1	3.2
Titratable acidity (g/L)[y]	**0.7**	1.3	1.0	1.0

[z]means of 8 years 2005, 2006, & 2008-2013.

[y]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**

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Natchez

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

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Yield Comparison

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

Variety	Yield (lb/acre)					
	2008	2009	2011	2012	2013	Average [y]
Osage	**12,341 a**	**7,849 a**	**12,206 ab**	**12,902 a**	**22,923 b**	**13,644**
Natchez	12,613 a	6,030 a	17,641 a	17,351 a	34,208 a	17,569
Ouachita	7,851 b	4,361 a	10,774 b	14,021 a	20,567 b	11,515

[z] Means followed by the same letter are not significantly different at the 5% level within single columns.

[y] Average is a mean of the 5 years presented in this table (2008, 2009, 2011, 2012, 2013).

Postharvest Measurements

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

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

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

Floricane fruit, (Ark)

Primocane 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)

Fruit Characteristics

Prime-Ark® Freedom and Prime-Ark® 45 floricane data, 2011-2013, for 2010-established planting, Fruit Research Station, Clarksville, AR.

Variety	1st Harvest	Yield (lb/acre)		Weight / berry (g)	Soluble solids[y]	Titratable acidity[y]	Average pH[y]
				2013			
Prime-Ark® Freedom	6-Jun	15,639	a	12.6a	8.6a	0.60a	3.45a
Prime-Ark® 45	13-Jun	20,967	a	6.2b	10.5a	0.74a	3.18a
				2012			
Prime-Ark® Freedom	10-May	9,582	a	8.7a	10.9a	- -	- -
Prime-Ark® 45	20-May	11,811	a	5.4b	11.9a	- -	- -
				2011			
Prime-Ark® Freedom	29-May	5,584	a	9.2a	9.8a	- -	- -
Prime-Ark® 45	9-Jun	7,018	a	5.5b	11.0a	- -	- -

[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.

Characteristic	Prime-Ark® Freedom	Natchez	Osage	Ouachita	Prime-Ark® 45
Floricane harvest date[z]					
First	28 May	6 June	9 June	13 June	6 June
Peak	6 June	13 June	20 June	28 June	18 June
Last	20 June	7 July	25 July	25 July	18 July
Fruit[y]					
Firmness	7.8 (0.5)	7.8 (0.5)	8.3 (0.5)	8.5 (0.6)	8.3 (0.5)
Flavor	7.8 (0.5)	7.0 (0.8)	8.3 (0.5)	8.8 (0.5)	7.8 (0.5)

[z]Data from 2010 replicated trial.

[y]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*.

Variety	First harvest	Yield (lb/acre)[y]	Weight/ berry (g)[y]	Soluble solids[y]	Titratable acidity[y]
Prime-Ark® 45	5-Aug	3,268 a	5.8b	9.6a	1.09 a
Prime-Ark® Freedom	11-Jul	2,581 a	8.8a	8.8a	0.66 b

[y] 2 reps were analyzed using student's t-test with α = 0.05, using SAS.

Fruit Characteristics

2012 Planted Blackberry Rep Trial; 2013 Collected Data from Clarksville, AR; *FIRST-YEAR YIELD*

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

[z]2 reps were analyzed using student's t-test with α = 0.05, using SAS

2011 Planted Blackberry Rep Trial; 2013 Collected Data from Clarksville, AR; *SECOND-YEAR YIELD AFTER VERY HOT SUMMER*

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

[z]2 reps were analyzed using student's t-test with α = 0.05, using SAS

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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-fruiting and three floricane-fruiting blackberry genotypes in a replicated trial that was established in 2012 at the University of Arkansas Fruit Research Station, Clarksville.

	Yield ($kg \cdot ha^{-1}$)		Wt./berry (g)	
Cultivar	2013	2014	2013	2014
	Floricane harvests			
Prime-Ark® Traveler	**13,057 cd[z]**	**13,283 b**	**6.7 bc**	**7.3 b**
Natchez	38,342 a	21,725 a	8.3 a	10.9 a
Osage	25,693 b	–	5.7 c	–
Ouachita	23,052 bc	12,456 b	6.2 bc	7.4 b
Prime-Ark® 45	20,845 bc	10,234 b	7.1 b	7.9 b
	Primocane harvests			
Prime-Ark® Traveler	4,963 a	7,568 a	4.7 a	6.4 a
Prime-Ark® 45	7,798 a	4,978 a	6.3 a	7.3 a

[z] Mean separation within columns within cane type by t-test ($P \leq 0.05$).

Postharvest Characteristics-*Prime-Ark® Traveler*

Cultivar	Overall[z]	Red (%)[y]	Leak (%)[x]	Decay (%)[w]	Soft (%)[v]
		2013			
Prime-Ark® Traveler	**52.5 a**	**17.8 ab**	**30.0 abc**	**1.5 b**	**3.5 c**
Natchez	58.5 a	43.0 ab	6.3 c	0.0 b	9.5 c
Ouachita	11.0 ab	38.5 ab	21.0 bc	6.0 b	35.8 abc
Prime-Ark® 45	16.8 ab	16.8 b	27.0 abc	4.8 b	20.0 bc
Tupy	-63.5 c	47.5 a	50.3 a	26.8 a	61.5 a
		2014			
Prime-Ark® Traveler	**55.5 ab**	**19.3 b**	**16.8 ab**	**0.0 a**	**1.3 a**
Natchez	67.7 ab	50.5 a	1.8 b	2.0 a	2.5 a
Ouachita	42.3 b	18.8 b	22.0 a	3.5 a	1.3 a
Prime-Ark® 45	73.3 ab	26.3 ab	6.3 b	1.3 a	1.3 a

Questions?