Pawpaw Cultivar, Rootstock, and Training System Trials at Kentucky State University

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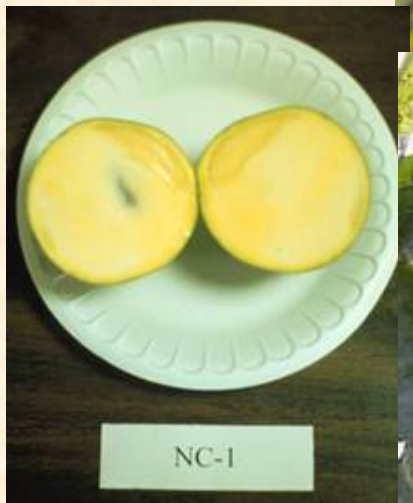
Introduction: What is Pawpaw?

- Pawpaw: *Asimina triloba* (L.) Dunal.
  - Native tree fruit in the southeastern U.S.
- Tropical-like flavor
  - mixture of banana, mango, and pineapple.
- Early stages of commercial production.

Pawpaw Flowering and Harvest

- Flower on 1 year old wood
- Cross-pollinate
- Pollinated by flies and beetles
- Ripe fruit should yield when squeezed and give way with a gentle tug
- Color change not a reliable indicator of ripeness
- Fruit may be harvested from the same tree over several weeks

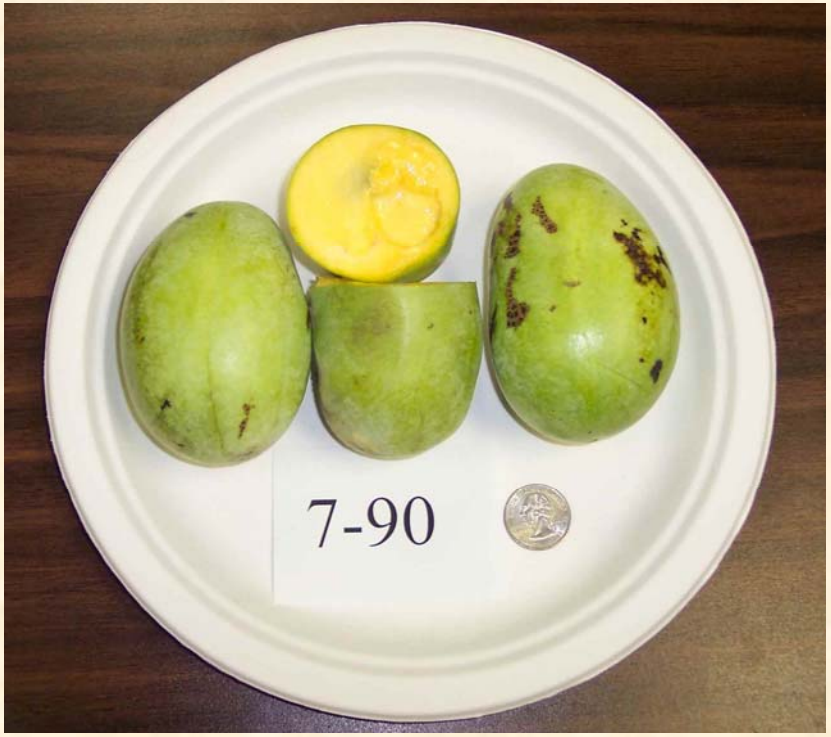


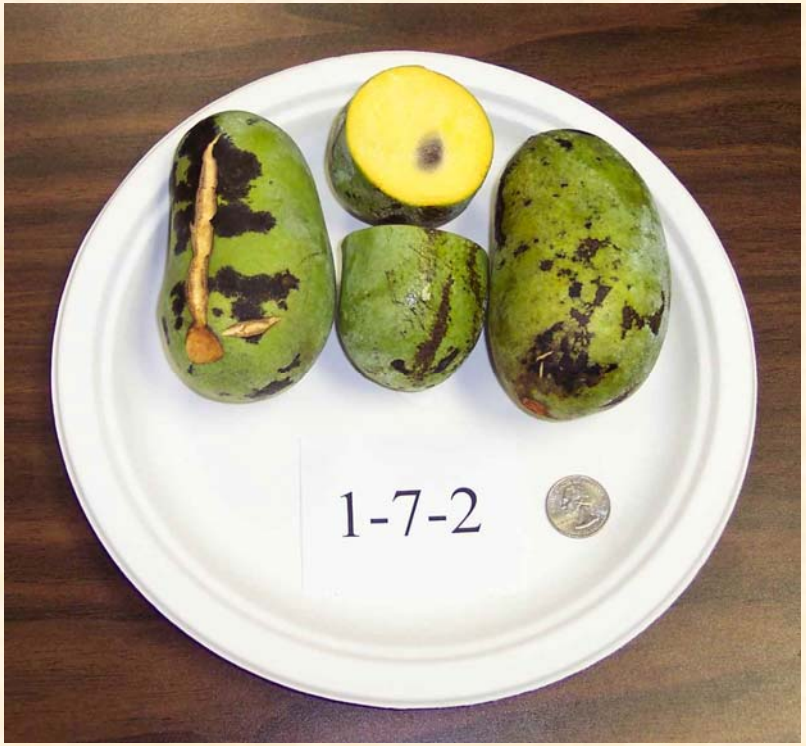
Pawpaw Pests

- Organic production possible?
- Some Past Problems
  - Japanese beetles
  - Zebra swallowtail butterfly-not necessarily a pest
  - *Talponia plummeriana* - pawpaw peduncle borer

New Pawpaw Diseases and Pests?

- Leaf and fruit spot (Phyllosticta)

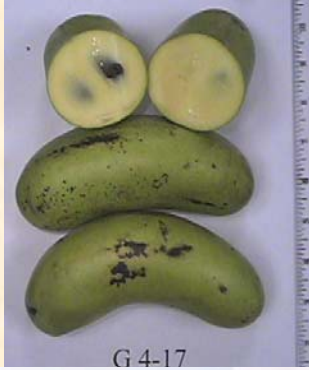




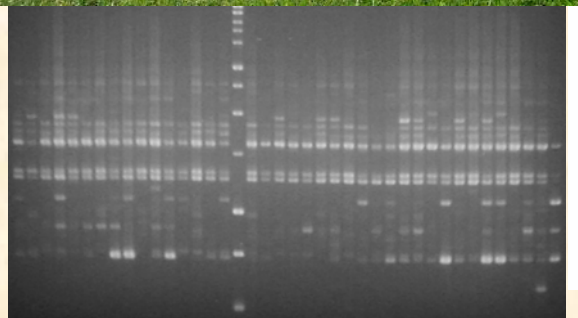
New Pawpaw Diseases and Pests?

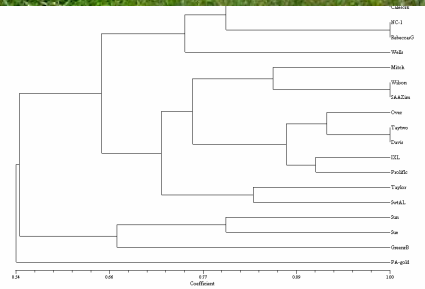
Asian Ambrosia Beetle *Xylosandrus crassiusculus*

The Kentucky State University Pawpaw Research Program



- Program Leaders: Brett Callaway (1990-1993), Desmond Layne (1994-1997), and Kirk Pomper (1998-Present)
- USDA National Clonal Germplasm Repository for Pawpaw (1994)
- The orchards at KSU contain more than 2000 accessions sampled from native stands from 17 different states in the papaw's native range.



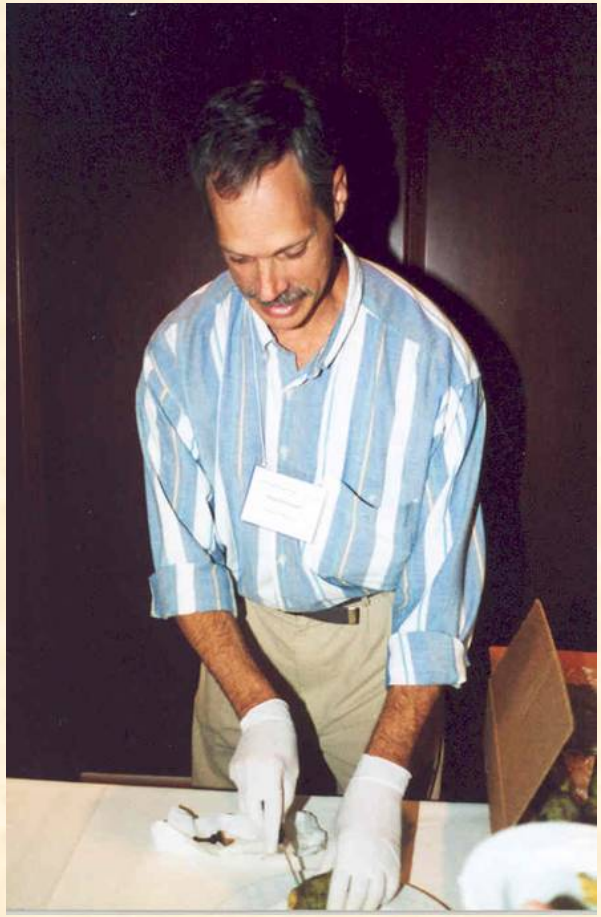


Pomper et al., 2003. J. Amer. Soc. Hort. Sci. 128:521-525.

Pawpaw Regional Variety Trial

Collections

- Neal Peterson and Dr. Harry Swartz began collecting pawpaw germplasm in 1981
- They assembled a germplasm collection of about 1500 accessions
  - Open pollinated seedlings from the historic collections of Buckman, Zimmerman, Hershey, Allard, the Blandy Experimental Farm, Ray Schlaanstine, and some modern cultivars



Some Desirable Pawpaw Tree characteristics

- Small tree size, easier harvest
- Precocious bearing, 4 years or less
- Vigorous growth with low to medium inputs
- Open branching with strong crotch angles
- High flower density
- High fruit set under natural pollination
- Consistently high fruit yields
- Cold hardiness and drought tolerance

Some Desirable Pawpaw Fruit Characteristics

FRUITFULNESS

over 40 fruit per tree

FLAVOR

sweet, firm texture, delicate blend of flavors, rich but not cloying, no bitter aftertaste

FLESHINESS

visually: mostly flesh. By weight: less than 5% of the fruit is seed

FRUIT SIZE

over 10 ounces

SEEDS

over 45 seeds per oz., av. seeds as small as 3/4" (2 cm) long

APPEARANCE

bright clear colors, no brown mottling (ripe); even, symmetrical

PECULIARITIES

SKIN: waxy/ fuzzy/ thick and hard/ yellow/ bluish.

FLESH (ripe): white/ pink/ red.

SEEDS: in a single row.

RIPENING TIME: early / late

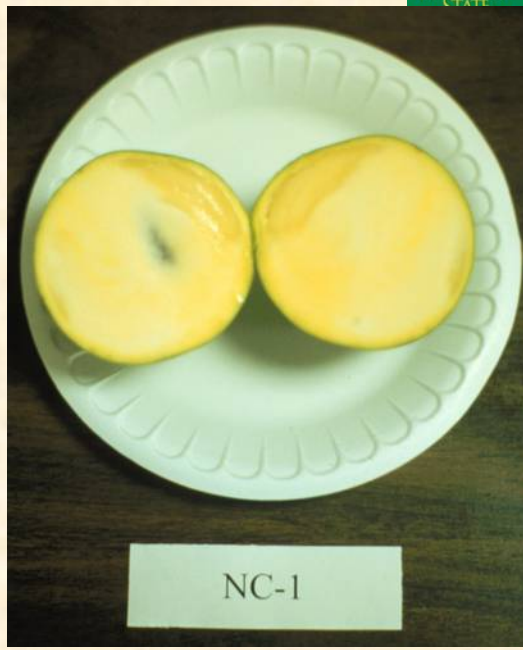
KEEPING ABILITY: 2+ in refrig.

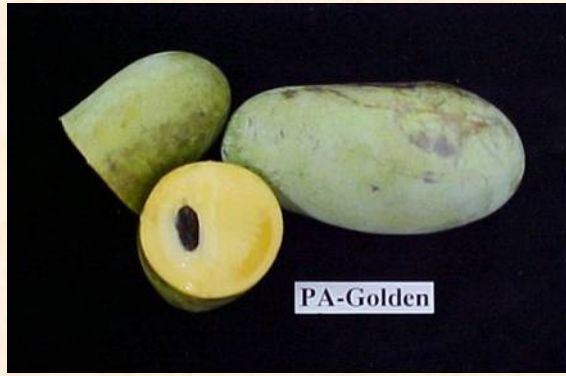
Materials and methods

- 28 selections, 10 named varieties, 224 total grafted trees on PPF seedling rootstock (half-sib seed)
- Spacing 2 m (6.5 ft) between trees, 5.5 m (18 ft) between rows
- Princeton, KY (1995) and Frankfort, KY (1998)

Commercially Available Cultivars

Clone	Genetic background
‘Middletown’	Wild seedling from Middletown, Ohio
‘Mitchell’	Wild seedling from Iuka, Ill.
‘NC-1’	‘Davis’ female × ‘Overleese’ male
‘Overleese’	Cultivated (open-pollinated) seedling from Rushville, Ind.
‘PA-Golden’	Second-generation seedling from G.A. Zimmerman collection
‘Sunflower’	Wild seedling from Chanute, Kans.
‘Taylor’	Wild seedling from Eaton Rapids, Mich.
‘Taytwo’	Wild seedling from Eaton Rapids, Mich.
‘Wells’	Cultivated (open-pollinated) seedlings from Salem, Ind.
‘Wilson’	Wild seedling from Cumberland, Ky.





Seedlings of Commercially Available Cultivars

Clone	Genetic background
1-7-1 Shenandoah	Open-pollinated seedling of ‘Overleese’
1-23	Open-pollinated seedling of ‘Taylor’
1-68	Open-pollinated seedling from ‘Overleese’
8-20	Open-pollinated seedlings of ‘Sunflower’

Seedlings from Collections

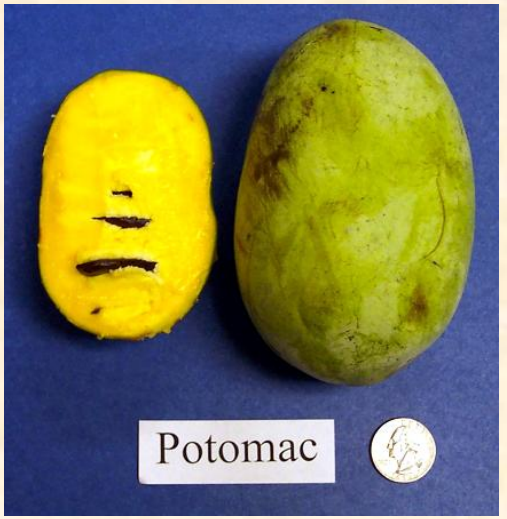
Clone	Open-pollinated seedling of
1-7-2 Wabash	BEF-30
2-10	BEF-30
2-54	GAZ-VA
3-11	BEF-33
3-21	BEF-43
4-2 Potomac	BEF-53
5-5	BEF-54
7-90	RS-2
8-58 Rappahannock	BEF-30
9-47	BEF-49
9-58	BEF-50
10-35	BEF-49
11-5 Susquehanna	BEF-53
11-13	BEF-53

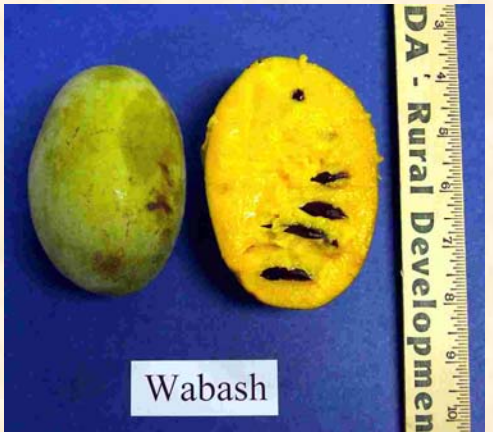
BEF = Blandy Experimental Farm Collection, Boyce Va.

GAZ = George A. Zimmerman Collection., Linglestown, Pa.

RS = Ray Schlaanstine Collection, West Chester, Pa.

Fruit Production on Mature Trees 2004-2006 in Frankfort





Clone	Average fruit weight (g)	Average number of fruit per tree
Potomac	235 a	44 ghi
5-5	188 b	39 hi
Wabash	185 b	65 fg
Susquehanna	184 b	39 i
NC-1	179 bc	44 ghi
Overleese	170 bcd	54 fghi
8-20	170 bcd	59 fghi
1-68	167 bcd	90 cde
2-10	160 cde	52 fghi
Shenandoah	156 def	78 def
Sunflower	155 def	74 def
9-58	146 efg	79 def
10-35	145 efg	105 abc

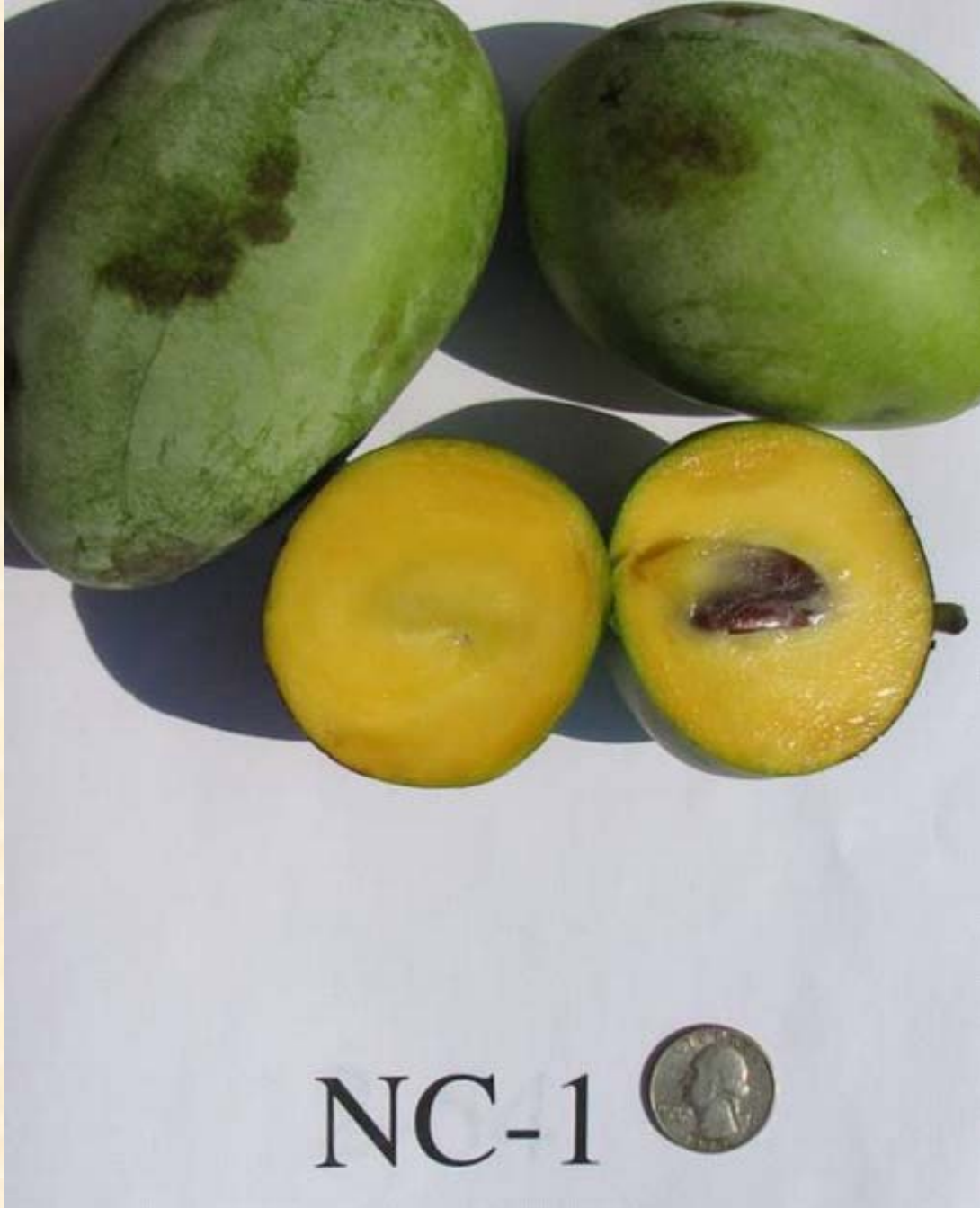
Fruit Production on Mature Trees 2004-2006 in Frankfort

Clone	Average fruit weight (g)	Average number of fruit per tree
3-11	137 efgh	68 ef
7-90	135 fghi	74 def
1-23	126 ghij	90 cde
11-13	124 hij	75 def
Taytwo	121 hijk	73 def
2-54	121 hijk	73 def
3-21	115 ijkl	60 fghi
Mitchell	112 jkl	58 fghi
PA-Golden	108 jklm	118 ab
Taylor	106 jklm	68 efg
Wells	104 klm	64 fgh
9-47	100 lm	74 def
Rappahannock	96 lm	96 bcd
Wilson	89 mn	128 a
Middletown	75 n	74 def

What cultivars should I plant?

NC-1

- Fruit weight: 167 g
- Number of fruit/tree: 36
- Good flavor
- Available from many commercial nurseries



Overleese

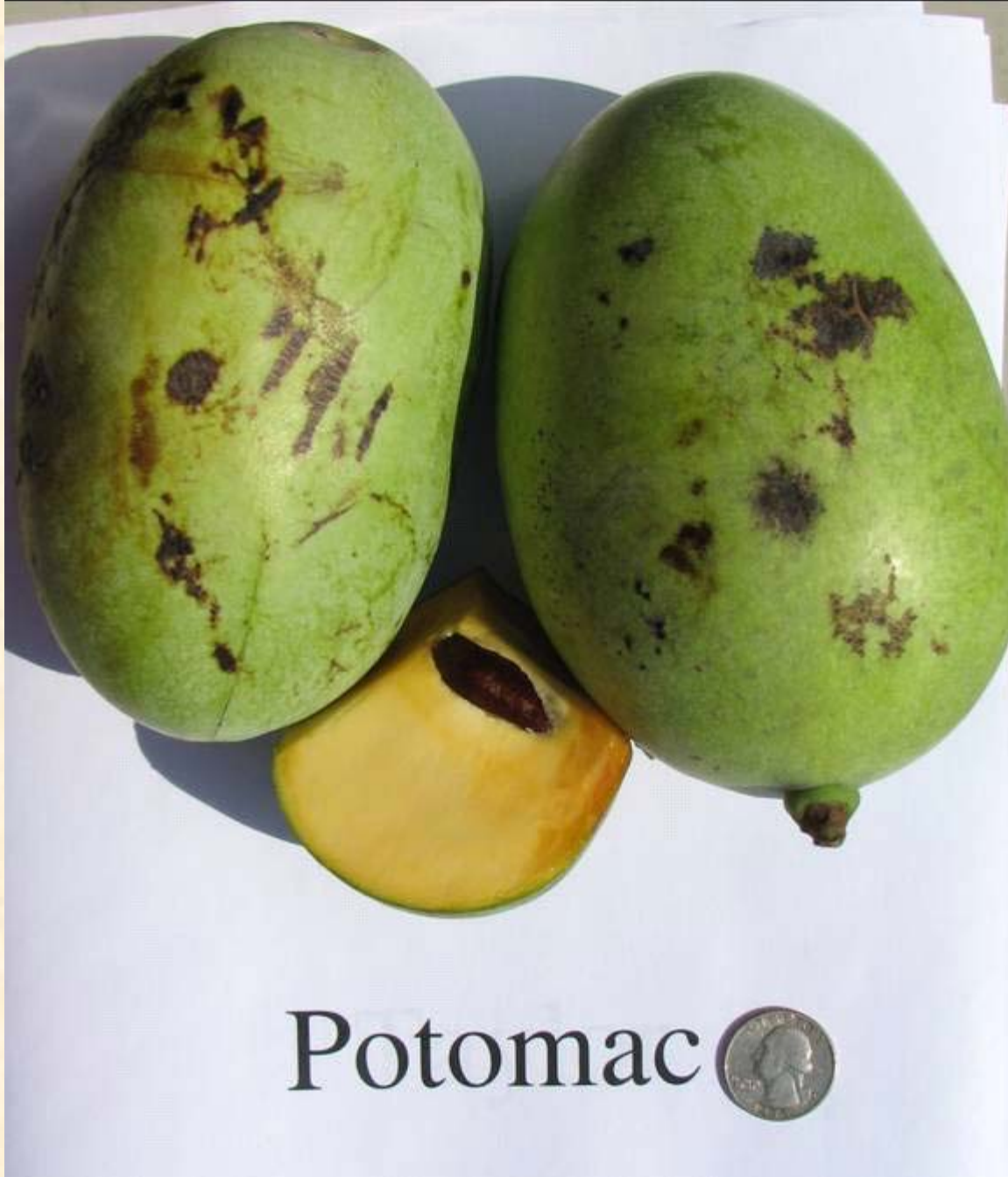
- Fruit weight: 157 g
- Number of fruit/tree: 40
- Good flavor
  - (melon)
- Available from many commercial nurseries

Sunflower

- Fruit weight: 165 g
- Number of fruit/tree: 63
- Mild flavor
- Available from many commercial nurseries

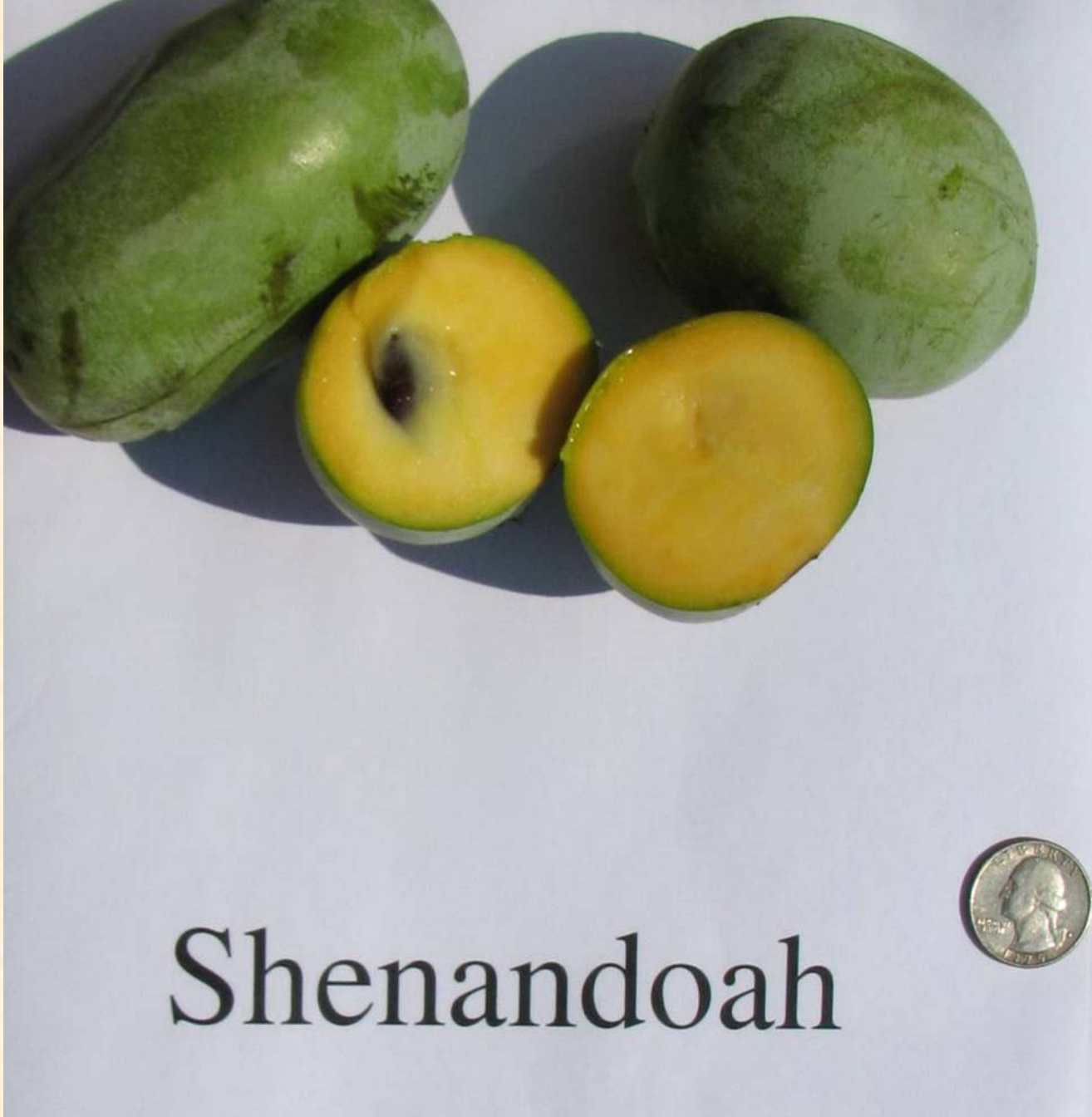
Potomac

- Fruit weight: 244 g
- Number of fruit/tree: 31
- Good flavor
- Fruit cracking?
- Peterson Pawpaws
  - Limited availability



Shenandoah

- Fruit weight: 157 g
- Number of fruit/tree: 61
- Mild flavor
- Peterson Pawpaws
  - Limited availability



Wabash

- Fruit weight: 183 g
- Number of fruit/tree: 51
- Dark flesh
- Cracking issues
- Peterson Pawpaws
  - Limited availability

Pawpaw RVT Overview

- There is great variation in fruit size, yield, and quality among the pawpaw selections examined
- About 4 to 5 years to come into production
- A number of pawpaw selections in the trial show promise for production in Kentucky [Potomac, Wabash, Overleese, Shenandoah, NC-1, and Sunflower] can be recommended.

Rootstock and Training System Trial

Pawpaw Propagation and the Nursery Industry

- High tree prices are limiting development of an industry
  - Seedlings $5-$10
  - Grafted trees $15-$30
- Our goal is to identify seedling rootstocks that would enhance pawpaw scion growth, improve tree establishment, and promote precocity.

Pawpaw Training and Pruning

- Tend to form narrow-angled weak branches at the trunk.
- Therefore, pawpaws are prone to wind damage.
- A central leader training system would develop a strong framework and a desirable form for harvesting.
  - Will pruning dwarf a young tree and delay bearing in pawpaw?
  - Will fruit suffer sunburn?

Objective

- To determine if cultivar, rootstock, and training method would influence early flower bud production in pawpaw

Materials and Methods

- The rootstock trial was planted on May 10, 2004.
  - Rootstocks: 5 seedling rootstocks
  - Scions: ‘Sunflower’ and ‘Susquehanna’
  - Two pruning systems: minimal pruning versus central leader
- 8 replicate blocks with each treatment combination for a total of 160 trees (2 x 5 x 2 x 8= 160).

Why Did We Choose These Selections?

- Scions:
  - ‘Sunflower’
    - Noted to flower and produce fruit in 4th year in Princeton, KY trial.
  - ‘Susquehanna’
    - Slow to flower and to come into production.
- Seedling rootstocks:
  - Cultivars vigorous: Sunflower and PA-Golden
  - Cultivars lack vigor: Susquehanna and K8-2
  - Commercial mixed seed: RVT
- Studies with seedlings in containers
  - Seed size and genetic background important


End of 2004
9/21/04


End of 2005
3/03/06

End of 2006


End of 2007
1/28/08


Central leader


3/23/07
Minimal pruning


Central leader


1/28/08
Minimal pruning


8/31/08


8/31/08

2008 Growing Season

Scion	Percent of Trees Flowering	Survival	TCA	Flower Density	Number of Clusters
Susquehanna	94%	68%	14.3	1.6	3.7
Sunflower	100%	82%	14.3	6.0	7.0
P-value	0.04 *	0.06 NS	0.64 NS	0.0000***	0.011 *

Rootstock	Percent of Trees Flowering	Survival	TCA	Flower Density	Number of Clusters
RVT	96%	77% a	13.8	3.8	4.1
Sunflower	96%	90% a	14.0	4.2	5.6
PA-Golden	100%	84% a	15.7	4.1	6.3
K8-2	95%	73% a	14.0	3.5	3.4
Susquehanna	100%	52% b	13.7	4.7	7.1
P-value	0.63 NS	0.005 **	0.32 NS	0.13 NS	0.2041 ns

2008 Growing Season

Training Method	Percent of Trees Flowering	Survival	TCA	Flower Buds Per Tree	Number of Clusters	Number of Fruit
Minimal Pruning	98%	72%	17.4	63	6.8	14.7
Central Leader	97%	79%	11.5	50	4.4	9.3
P-value	0.63 NS	0.20 NS	0.0000***	0.015 *	0.0093 **	0.003 **

- No evidence of sun scald on fruit

Rootstock and Training System Conclusions

- Genetic background of seedling rootstock did not influence scion precocity or growth.
  - Survival of Susquehanna seedling rootstock was poor.
- Sunflower was more precocious than Susquehanna.
- Central leader training tended to reduce vigor (TCA) and the number of flowers/tree.

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Photograph of pawpaw flower taken on May 5, 2009. Photo by Jeremy Lowe.

***pawpaw.kysu* provides information on how to grow and use fruit from the North American pawpaw tree.**

Pawpaw News

- Pawpaws Gain Standing as Kentucky Crop (6/28/09)
- Pomper and Crabtree win Shepard Award for Pawpaw Research (6/18/09)
- From Novel Fruits (pawpaw), a Lush Landscape in NY Times (5/20/09)
- Pawpaw article in Northern Nut Growers Association Nutshell Newsletter (5/13/09)
- Summaries of recent KSU pawpaw research projects (5/06/09)
- KSU Student wins award for pawpaw research project (see page 7) (5/06/09)

- Over 200,000 visitors since 2003!


Questions?