Pawpaw 101

Kirk W. Pomper, Ph.D.
Principal Investigator of Horticulture/ Kentucky State University
Adjunct Associate Professor of Horticulture/ Univ. of Kentucky
The North American Pawpaw

- *Asimina triloba* (L.) Dunal.
- Slow growing, moderate sized tree; pyramidal in full sun
- Fruit:
  - Clusters of 1-13 fruit
  - Fruit up to 2 lbs.

K. Pomper
Native Range (Asimina triloba)

http://plants.usda.gov
Pawpaws in the Wild

- A. triloba is usually found in the forest understory in hardwood forests
- Clonal reproduction by root suckering
- You may not find many fruit (shade, self-incompatibility, lack of pollinators)
The Pawpaw Fruit

- Tropical-like flavor and aroma
  - banana, mango, and pineapple
- Nutritious and high in antioxidant activity
- Blended fruit drinks, ice creams, yogurt, etc.
Pawpaw Market Potential

- Farmers Markets
  - Fruit: $1 each
  - $2 to $3/pound

- Gourmet Market
  - Frozen pulp
  - Ice cream

- Restaurants

K. Pomper
The Potential of Pawpaw

- Fresh market-unique flavor
- Appearance-not unappealing
- Post harvest handling issues
  - Bruising
  - Short shelf-life of about 7 days at room temp
  - Storage for 2-3 wks under refrigeration
The Potential of Pawpaw

- Processing pulp
  - Hand processing
  - Labor intensive
  - Roma Sauce Processor
The Potential of Pawpaw

- Seed for Nurseries
  - $18+/pound
History of the Pawpaw

- In 1541 Spanish explorer Hernando de Soto found Native Americans growing and eating pawpaws in the valley of the Mississippi.
- Lewis and Clark recorded in their journal (18 Sept. 1806) how pawpaws helped save them from starvation.
- Daniel Boone and Mark Twain were pawpaw fans.
Pawpaw Tree Incident
(Marker Number: 2047)

County: Pike
Location: Near Buskirk, KY 1056

Description: This episode is result of August 1882 election-day fight. Tolbert, a son of Randolph McCoy, exchanged heated words with Ellison Hatfield, which started a fight. Tolbert, Pharmer and Randolph McCoy Jr. stabbed Ellison to death. Later the three brothers were captured by Hatfield clan, tied to pawpaw trees, and shot in retaliation. Presented by Pikeville-Pike County Tourism.

Hatfield family photo courtesy of McDowell County Historical Society
Domesticating Pawpaw

- In 1916, best pawpaw contest sponsored by the American Genetics Association
  - “intelligent breeding” would result in commercial quality varieties and an industry would begin (Popenoe 1916, 1917).
- An industry did not develop
- One reason for the failure of pawpaw to become popular could be rapid perishability of fruit
New Interest in Pawpaw

- From 1950 and 1985, interest grew nurtured by individuals in the Northern Nut Growers Association
- The PawPaw Foundation was founded in 1988, by R. Neal Peterson
- Ohio Pawpaw Festival (1999-present), Ohio Pawpaw Growers Association (2000), and Appalachian Pawpaw Growers Association (2008)
The Kentucky State University Pawpaw Research Program

Program Leaders:
- Brett Callaway (1990-1993)
- Desmond Layne (1994-1997)
- Kirk Pomper (1998-Present)

USDA National Clonal Germplasm Repository for Pawpaw; satellite of Corvallis, OR (1994)

2000 accessions from 17 different States; over 45 cultivars
Establishing A Pawpaw Orchard

- “Pawpaw Planting Guide”
- Site
  - air drainage (frost)
  - deep, fertile, well-drained soil, pH 5.5-7.0
- Weed control
  - Johnson grass
- water source for irrigation
Pawpaw Propagation and the Nursery Industry

- High tree prices are limiting development of an industry
  - Seedlings $5-$10
  - Grafted trees $15-$30

- Grafted trees (named cultivars) produce fruit sooner after planting and have a known fruit quality.
Pawpaw Propagation

- Seed Propagation
  - Seed requires stratification (3 months of refrigeration)
  - Desiccation sensitive (do not dry out)
  - Seed is killed by freezing

- Commercial clonal propagation of cultivars is via chip budding onto seedling rootstock

- Many nurseries grow pawpaw seedlings in containers

- Top working existing trees
What cultivars should I plant?
NC-1

- Fruit weight: 179 g
- Number of fruit/tree: 44
- Good flavor
- Available from many commercial nurseries
Overleese

- Fruit weight: 170 g
- Number of fruit/tree: 54
- Good flavor (melon)
- Available from many commercial nurseries
Sunflower

- Fruit weight: 155 g
- Number of fruit/tree: 74
- Mild flavor
- Available from many commercial nurseries
Potomac™

- Fruit weight: 235 g
- Number of fruit/tree: 44
- Good flavor
- Fruit cracking?
- Available:
  - Nolin River Nut Tree Nursery
  - Forrest Keeling
  - One Green World?
Shenandoah™

- Fruit weight: 156 g
- Number of fruit/tree: 78
- Mild flavor
- Available:
  - Nolin River Nut Tree Nursery
  - Forrest Keeling
  - One Green World?
Wabash™

- Fruit weight: 185 g
- Number of fruit/tree: 65
- Cracking issues
- Available:
  - Nolin River Nut Tree Nursery
  - Forrest Keeling
  - One Green World?
Susquehanna™

- Fruit weight: 184 g
- Number of fruit/tree: 39
- Great flavor
- Available:
  - Nolin River Nut Tree Nursery
  - Forrest Keeling
  - One Green World?
KSU-Atwood™

- Fruit weight: 120 g
- Number of fruit/tree: 150
- Medium flavor

Available:
- Nolin River Nut Tree Nursery (2011?)
- One Green World (2011?)
- Hartman’s Plants (2012)
- Hidden Springs (2012)
- Blossom Nursery (2012)
Establishing a Pawpaw Orchard

- Pawpaw will fruit in the shade, optimum yields are obtained in open exposure
- Grass and weed control!
- Shading recommended the first year
- Irrigation should be provided at least the first two years
Pawpaw Pruning
Field Planting Pawpaw

- 8’ between trees, 18’ between rows
- 295 trees/ac
- Tree seldom grow taller than 25 feet
Fertilization and Irrigation of Pawpaw

- **Trickle Irrigation:**
  - emitters (1 gal/hr) with 2 emitters/tree
  - about 240 gal/tree/yr.
- **Fertigation:** Peters 20-20-20 (3 times each yr.)
  - 0.6 oz N/tree/yr.
- **Granular (10-10-10)**
  - 1 oz N/tree/yr., 2 oz N/tree/yr. after two years
Pawpaw Flowering and Harvest

- Flowers: male and female parts in a flower
- Cross-pollinate (self-fruitful?)
- Pollinated by flies and beetles
- Ripe fruit-soft
- Color change not a reliable indicator of ripeness
- Harvest from the same tree over several weeks
Pawpaw Pests and Diseases
Phyllosticta Leaf Spot
Phyllosticta Leaf Spot
Talponia plummeriana
Pawpaw Peduncle Borer
Talponia plummeriana
Pawpaw Peducle Borer
Talponia plummeriana
Pawpaw Peduncule Borer
Talponia plummeriana
Pawpaw Peduncle Borer
Talponia plummeriana
Pawpaw Peduncle Borer

photos: Ron Powell
Pawpaw Pests and Diseases

- Japanese beetles
- Leaf rollers
- Zebra swallowtail butterfly—not necessarily a pest
Research Update from KSU

- Fruit thinning
- Roostock and Training trial
- New Cultivar development
Fruit Thinning to Increase Fruit Size
Average fruit weights of hand-thinned and unthinned pawpaw fruit in 2006 and 2008

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fruit weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2006</td>
</tr>
<tr>
<td>Hand-Thinned</td>
<td>129</td>
</tr>
<tr>
<td>Control</td>
<td>88</td>
</tr>
<tr>
<td>significance</td>
<td>**</td>
</tr>
</tbody>
</table>
Central leader

Minimal pruning

Planted spring 2004
Photo taken 1/28/08
## 2009 Growing Season

### Table 1: Scion Survival and TCA of clusters of Flower Buds of fruit per cluster, fruit wt (oz), and Yield (lb)

<table>
<thead>
<tr>
<th>Scion</th>
<th>Survival</th>
<th>TCA</th>
<th># of clusters</th>
<th># of Flower Buds</th>
<th># of fruit</th>
<th>fruit per cluster</th>
<th>fruit wt (oz)</th>
<th>Yield (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Susquehanna</td>
<td>61%</td>
<td>23.3</td>
<td>7.0</td>
<td>65</td>
<td>21</td>
<td>2.7</td>
<td>9.4</td>
<td>11.7</td>
</tr>
<tr>
<td>Sunflower</td>
<td>76%</td>
<td>22.1</td>
<td>17.0</td>
<td>136</td>
<td>36</td>
<td>2.1</td>
<td>6.7</td>
<td>15.2</td>
</tr>
<tr>
<td>P-value</td>
<td>NS</td>
<td>NS</td>
<td>***</td>
<td>***</td>
<td>*</td>
<td>***</td>
<td>(l)</td>
<td>NS</td>
</tr>
</tbody>
</table>

### Table 2: Rootstock Survival and TCA number of fruit, fruit weight (g), Yield (kg), and fruit set

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Survival</th>
<th>TCA</th>
<th>number of fruit</th>
<th>fruit weight (g)</th>
<th>Yield (kg)</th>
<th>fruit set</th>
</tr>
</thead>
<tbody>
<tr>
<td>RVT</td>
<td>73 ab</td>
<td>21.7</td>
<td>32</td>
<td>218 ab</td>
<td>6.3</td>
<td>15%</td>
</tr>
<tr>
<td>Sunflower</td>
<td>87 a</td>
<td>23.2</td>
<td>22</td>
<td>226 a</td>
<td>5.1</td>
<td>8%</td>
</tr>
<tr>
<td>PA-Golden</td>
<td>75 ab</td>
<td>25.3</td>
<td>33</td>
<td>235 a</td>
<td>7.2</td>
<td>17%</td>
</tr>
<tr>
<td>K8-2</td>
<td>57 bc</td>
<td>20.8</td>
<td>22</td>
<td>176 b</td>
<td>4</td>
<td>33%</td>
</tr>
<tr>
<td>Susquehanna</td>
<td>48 c</td>
<td>20.8</td>
<td>40</td>
<td>220 ab</td>
<td>8.2</td>
<td>13%</td>
</tr>
<tr>
<td>P-value</td>
<td>** NS</td>
<td>NS</td>
<td>*</td>
<td></td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Notes: NS = Not Significant; ** = P-value < 0.01; * = P-value < 0.05; *** = P-value < 0.001
## 2009 Growing Season

<table>
<thead>
<tr>
<th>Scion</th>
<th>Survival</th>
<th>TCA</th>
<th># of fruit</th>
<th>fruit weight (g)</th>
<th>Yield (kg)</th>
<th>fruit set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal Pruning</td>
<td>60%</td>
<td>28.5</td>
<td>35</td>
<td>7.4</td>
<td>7.3</td>
<td>25%</td>
</tr>
<tr>
<td>Central Leader</td>
<td>76%</td>
<td>17.8</td>
<td>25</td>
<td>7.9</td>
<td>5.3</td>
<td>10%</td>
</tr>
<tr>
<td>P-value</td>
<td>*</td>
<td>***</td>
<td>NS</td>
<td>(l)</td>
<td>NS</td>
<td>*</td>
</tr>
</tbody>
</table>
Further Germplasm Improvement

- Evaluation of:
  - Seedling populations from throughout the native range
  - Crosses from Neal Peterson
  - Hybrid material from Asimina triloba x A. reticulata
2011 Pawpaw Variety Trial

Hy3-120
aka ‘State Fair’
<table>
<thead>
<tr>
<th>row</th>
<th>tree</th>
<th>Name &amp; comments</th>
<th>Total # fruit</th>
<th>avg frt wt oz</th>
<th>yield lbs/tree</th>
<th>% frt &gt;3.5 oz</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>20</td>
<td>Salem, IN (late flowering)</td>
<td>272</td>
<td>3.1</td>
<td>52.6</td>
<td>28%</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>Ithaca, NY (coconut flavor)</td>
<td>92</td>
<td>6.0</td>
<td>34.8</td>
<td>89%</td>
</tr>
<tr>
<td>9</td>
<td>109</td>
<td>11-13 x 1-23 (large fruit)</td>
<td>254</td>
<td>7.2</td>
<td>114.8</td>
<td>93%</td>
</tr>
<tr>
<td>9</td>
<td>111</td>
<td>11-13 x 1-23 (high yield)</td>
<td>500</td>
<td>5.4</td>
<td>168.0</td>
<td>79%</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>2-9 x 10-35 (firm?)</td>
<td>148</td>
<td>4.2</td>
<td>39.0</td>
<td>65%</td>
</tr>
<tr>
<td>5</td>
<td>23</td>
<td>Ithaca, NY (early ripening)</td>
<td>139</td>
<td>5.7</td>
<td>49.8</td>
<td>82%</td>
</tr>
</tbody>
</table>
Organic Production of Pawpaw

Kirk W. Pomper, Ph.D., Shenil R. Crabtree, M.S., and Jeremy C. Lowe, M.S.

Kentucky State University Cooperative Extension Program

Introduction

The North American pawpaw is in the early stages of commercial production. Many people are interested in growing and marketing pawpaws organically. The ripe fruit has a strong, appealing aroma and an orange to yellow pulp with a flavor that is similar to a blend of mango, pineapple, and banana. Pawpaws are hardy to USDA growing zone 5 and when planted in full sun in an orchard setting, trees can produce large quantities of fruit. Based on variety trials at Kentucky State University (KSU) there are a number of large fruited, grafted (named) cultivars that can be recommended for growers in Kentucky including: 'KSU-Awwood™', 'Sunflower', 'Overleece', 'NC-Y', 'Susquehana™', 'Potomac™', 'Wabash™', and 'Shenandoah™'.

Grown in the United States or imported from other countries. Organic food is produced by farmers who emphasize the use of renewable resources and the conservation of soil and water to enhance environmental quality for future generations. The standards were developed to support a philosophy of creating agricultural ecosystems that mimic

Photograph of 'KSU-Awwood™' fruit.

Forest Production of Pawpaw

Kirk W. Pomper, Ph.D., and Shenil B. Crabtree, M.S.

Kentucky State University Cooperative Extension Program

Introduction

"Wha-ho, oh whoa-whoa. Nada-do, Nada-do. The pawpaw patch. This traditional American folk song was quite popular once, and fall hunting for pawpaws in the woods is still a cherished tradition for many families in Kentucky. In 1999, Kentucky State University (KSU) began a research project with the aim of developing pawpaw as a new tree-fruit crop for Kentucky. With a unique mango, banana, and papaya-like flavor, and a tropical fruit-like aroma, this fruit has fresh market appeal for farmers' markets and direct sales to restaurants, and processing potential for the orange-yellow pulp to be used as an ingredient in gourmet items such as ice cream, wine, and pies. Pawpaws are found throughout Kentucky's forests as a native understory tree, often along streams and rivers. The trees produce root suckers, forming large patches of clumps over 500 stems. Patches serve as important sites in ecosystems around rivers and streams, providing fruit and cover for animals (deer, raccoons, squirrels, etc.), reducing erosion, and enhancing biodiversity. Insect pollination and dispersal of pawpaw seeds depend on natural pollinators. If you are a woodland owner in Kentucky, you may want to consider either: 1) planting pawpaw seedlings to assist in erosion control, attract wildlife, and direct your current woodlands area, or 2) planting grafted pawpaw varieties in an orchard adjoining

Site Selection

For a woodland planting site, pawpaws will thrive in areas with well-drained soils that are often moist, especially near streams, but are not frequently waterlogged. Pawpaw orchards should be planted in well-drained soils in areas near woodlands or timber plantations which will serve as

Pawpaw Planting Guide

Kentucky State University Cooperative Extension Program

by Susan C. Jones, R. Noel Patterson, Sherri-Angelene Tarver, Kirk W. Pomper, Ph.D., and Desmond R. Layne, Ph.D.

This bulletin was created to meet the increasing demand for information on cultivation of the native American pawpaw, Asimina triloba. Very little scientific research has been done on pawpaw. The advice given here is based partly on research and partly on the experiences of many pawpaw growers. These guidelines should help you to become a successful pawpaw grower.

Climate

The pawpaw is a tree of temperate humid growing zones, requiring warm to hot summers, mild to cold winters, and a minimum 32 inches of rainfall spread evenly over the year, with the majority falling in spring and summer. It can be grown successfully in USDA plant hardiness zones 5-13 (F5=F6-C6-D6) through 8 (F9=F9-C9). Pawpaws grow well over a wide range of latitude, from the Gulf Coast plain to southern Michigan. However, the trees may not receive adequate chilling hours if planted too close to the Gulf Coast. Most named cultivars are organically grown in the Midwest, which is the northern portion of the pawpaw's range. A national regional center is underway to determine which varieties perform best in different parts of the country, and results should become available in the near future.

Soil, sites, and habitat

Although the pawpaw is capable of fruiting in the shade, optimum yields are obtained in open exposure, with some protection from wind (on account of the large leaves). Grafting seedlings, however, will not survive under those conditions because they are extremely vulnerable to full sunshine, which can kill them. (Containerized seedlings may be grown without sun, even in a greenhouse.) Shading for the first year, and sometimes the second, is normally required outside, and it is for the reason that pawpaws are almost always found as understory in an understory tree. The soil should be very slightly acidic (pH 5.5-7), fertile, and well-drained. Good drainage is essential to success. Pawpaws will not thrive in heavy soil or waterlogged soil. In habitat it is a small tree, seldom taller than 25 feet. Grown in full sun, the pawpaw tree develops a narrowly pyramidal shape with dense, drooping foliage down to the ground level. In the shade it has a more open branching habit with fewer limbs and horizontally held leaves.
pawpaw.kysu

Photograph of KSU-Atwood™ pawpaw fruit. The harvest has started and it is about two weeks ahead of our normal harvest season at Kentucky State University due to hot summer temperatures. August 26, 2010. Photograph by Kirk Pomper.

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

KSU Pawpaw Program

The pawpaw (Asimina triloba) fruit has both fresh market and processing appeal, with a tropical like flavor that resembles a combination of banana, mango, and pineapple. Kentucky State University has the only full-time pawpaw research program in the world as part of the KSU Land Grant Program. Pawpaw research efforts are directed at improving seed and clonal propagation methods, developing orchard management recommendations, conducting regional variety trials, understanding fruit ripening processes, developing fruit storage techniques, and germplasm collection and characterization of genetic diversity.

San Francisco climate not the best for pawpaw
(San Francisco Chronicle; 8/15/10 - note that it should be KSU not UK in article)

Reaching for the Right Pawpaw
(State-Journal; 7/20/10)

Three Nurseries To Sell New KSU Pawpaw Cultivar - KSU-Atwood
(KSU; 7/11/10)

Native paradise: Some unusual plants thrive in Kansas soil
(JLWorld.com; 6/27/10)

May look exotic but pawpaw is native (The Windsor Star, 5/29/10)

Slow food movement-pawpaw (Green Matters, 5/21/10)

Four native fruit trees that could add beauty and tastiness to the garden (Winnipeg Free Press, 5/5/10)

The native pawpaw tree: The Division of Forestry and Kentucky State University have

Questions?