

FRUIT AND VEGETABLES**Pawpaw – A “Tropical” Fruit for Temperate Climates**

by Guy K. Ames

Introduction

The pawpaw (*Asimina triloba*) has great potential for commercial development. It has always been a delicious and nutritious native American fruit, but history, cultural prejudices, and difficulty in storing and shipping have relegated it to the obscure backwoods of American cuisine. However, several factors seem to be coming together to bring the pawpaw to the attention of the American public—at least, to the “foodie” segment of the public. These include recent improvements in available cultivars (with even better flavor and fewer seeds), production research at Kentucky State University, breeding programs both private and public, international interest, a renewed interest in America’s food system and diet, and a nascent effort by growers and aficionados to publicize the virtues of the pawpaw.

Though the pawpaw’s only near relatives are tropical, and pawpaws look like mangos and taste like bananas, they are not tropical but are native to most of the eastern United States and even parts of Canada. The pawpaw grows best in areas with hot summers and cold winters (USDA Plant Hardiness Zones 5 to 8). It is hardy and relatively pest-free, and its tolerance to shade makes it suitable for intercropping with certain other trees. In addition, the pawpaw has genetic variability that can be used to improve the plant.

A major research effort centered at Kentucky State University and involving a few other universities (including Cornell, Clemson, Purdue, Ohio State, Iowa State, and Oregon State) should contribute significantly to the commercial development of this crop (Pomper et al., 1999). These universities have established identical plots of pawpaws, which they hope will identify the best cultivars and best management techniques. They are breeding for the following desirable traits: yellow to orange flesh; fruit size 10 ounces or larger; seeds small and few; fruit of uniform shape and free of external blemishes; and mild, sweet flesh with no unpleasant aftertaste.

The KSU program has delivered results. In 2016, KSU-Benson™ joined Kentucky State’s 2010 release, KSU-Atwood™, from their pawpaw breeding program. With a flavor combining those of banana, pineapple, and mango, KSU-Atwood shows promise as a commercially available cultivar (Pomper et al., 2011).

Culture

The pawpaw is native to most of the humid eastern United States. It is hardy to USDA Zone 5. Pawpaws thrive in moist, fertile, well-drained soils having a pH of 5.5 to 7.0. Although the pawpaw tolerates shade, it produces best in full sunlight, as long as it receives enough water and is protected from high winds. It is true that pawpaw trees grow readily in the forest, but fruiting is compromised in full, dense shade. Permaculture enthusiasts promote the idea of pawpaws under trees like black locust (*Robinia pseudoacacia*), which cast sparse, dappled shade, but there is not yet research to evaluate this practice. Growers with commercial ambitions should probably choose to provide some shade during the first one or two growing seasons and later remove the shade apparatus when the tree seems well established.

Pawpaw trees will grow from 12 to 25 feet tall and should be spaced from eight to 15 feet apart.

Although pawpaws flower in the spring, they bloom after apples, peaches, and pears, so are less likely than those fruits to lose a crop to late frosts. Nevertheless, it is possible to lose a crop to frost, so commercial plantings should probably avoid low-lying areas that can become “frost pockets.”

According to Dr. Kirk Pomper of Kentucky State University, weed control around trees, with straw or woodchip mulch, is important to increase tree survival rates. Pomper notes that voles that might be attracted to these mulches do not damage pawpaw trees as they would apple trees.

Planting: Seedlings vs. Grafted Trees

There are a number of cultivars that produce superior fruit.

An unbiased description of most of these cultivars is available at Kentucky State University’s pawpaw website: <http://www.pawpaw.kysu.edu/reports.htm>. Grafted trees of these named cultivars can be relatively expensive—up to \$35 for a single potted tree; wholesale quantities would presumably cost less per tree—so prospective growers might be tempted to plant ungrafted seedlings. Although seedlings are much cheaper than grafted trees, there is enough genetic variability in the pawpaw that commercial-scale growers will be taking a significant gamble if they plant ungrafted seedlings, and they will not know the outcome of their bet for around five to seven years because it can take that long for seedlings to begin bearing (grafted trees usually start bearing in three to four years).

If you live in an area where pawpaws grow wild, you might be tempted to transplant from the wild, but wild pawpaws have long taproots, which are very easily damaged. Often, pawpaw trees in wild patches are rootsuckers from a single original tree. With poorly developed root systems per individual shoot, these rootsuckers do not transplant well. Even nursery-grown pawpaws can be difficult to transplant. They have fleshy, brittle roots with very few fine root hairs, which inevitably get damaged when transplanting. Experimentation has shown that, to be successful, transplantation should be done in the spring, at the time when new growth commences or soon after. If many roots are lost, it may be desirable to prune the top to bring it into balance with the remaining roots.



‘Fayetteville’ pawpaw.

Photo by Robyn Metzger, NCAT

Propagation

Separate the seeds from the fruit and store the seeds in a plastic bag with moist (not wet) peat moss or some similar medium. Never allow the seed to dry out or freeze, as either will kill the seed. The bagged seed should be held under refrigeration for three to four months to satisfy the seed’s need for a cold period. Sow seed the following spring into pots or field about an inch deep. Most pawpaw nurserymen employ deep pots to allow for important tap root development).

Compared to apples and pears, “trueness to seed parent” is high for pawpaw; that is, seedling plants are somewhat likely to resemble their female parent. In other words, seed from high-quality fruit has a moderate chance (around 50%) of producing plants that also produce high-quality (but not necessarily identical) fruit. Nevertheless, only vegetative propagation will produce trees that can be relied upon to produce the highest-quality fruit.

Vegetative propagation for pawpaws is a matter of budding or grafting. Micropropagation by tissue culture to produce hundreds or thousands of clones at a time remains a desired, but stubbornly elusive, goal for pawpaw researchers, though progress is being made (Stanica, 2016). Budding (chip only; “T” budding has proven ineffective) or grafting should be done using dormant scionwood and actively growing seedling rootstock. Dormant scionwood should be collected in mid- to late winter and held in plastic bags under refrigeration until the seedling rootstocks are showing growth and the ambient temperatures are consistently warm. Kentucky State University recommends early June for budding and grafting, the important variable here probably being temperature: it should be consistently warm to al-

low for adequate callus growth and subsequent knitting together of tissues from the rootstock and the scion/bud.

Pollination

The slightly foul-smelling pawpaw flowers are fly and beetle-pollinated, and that may be one of the reasons that fruit set is so inconsistent in the wild. An old recommendation to hang road kill in your trees to attract fly pollinators (Black, 2009) might actually be helpful if you have only a few trees, but Sheri Crabtree at Kentucky State University says that hand pollination is probably more effective... and less objectionable. She also offered that at Kentucky State’s relatively large research orchards, pollination has not been a major issue, probably because the presence of so many trees is simply that much more attractive to pollinators (2016). More detail about hand pollination of pawpaw is available at a Virginia Cooperative Extension Web page (Bratsch, 2009).

Pests and Diseases

Pawpaws have very few pest problems. There are a few lepidopteran pests (caterpillars), the principal one being the pawpaw peduncle borer. The peduncle borer (*Talponia plummeriana*) burrows into the pawpaw flower and causes it to drop. Usually, however, so little damage is done that this is not considered a serious problem.

The asimina webworm, *Omphalocera munroei*, is a moth of the Pyralidae family. Larvae web, roll, and fold leaves as they feed. Feeding also can extend to twigs and stems, and occasionally a stem can be girdled from feeding. It can be found throughout the range of the pawpaw but seems to be a nuisance only sporadically, according to Sheri Crabtree of Kentucky State. Some growers in Arkansas, Kentucky, and Maryland have reported problems with the asimina webworm (Crabtree, 2016). The author has a consistent year-to-year problem with the webworm in his Arkansas planting, requiring manual removal of the webs and larvae and/or sprays of *Bacillus thuringiensis* or spinosad-containing pesticides.

Other reported pests include earwigs, slugs, San Jose scale, and tent caterpillars. To discourage earwigs and slugs, Ray Jones, a California pawpaw grower, ties a three-inch band of aluminum foil around each trunk and paints the middle two inches of the foil with Tanglefoot® (Pyle, 1992). San Jose scale can be controlled with dormant oils. Tent caterpillars can be physically removed from the tree by cutting out the “tent” or the branches holding the tent.

Phyllosticta and flyspeck or greasy blotch (*Zygothiala jamaicensis*) can be problems of pawpaw. This occurs only during periods of high humidity and frequent rainfall. Dense foliage and lack of proper ventilation contribute to this condition, so proper spacing and pruning can reduce it. *Phyllosticta* can infect the leaves and the surface of the fruit; it can also cause the fruit to crack when it expands, reducing quality and storability.

There appears to be some variation in susceptibility among varieties, but nothing comprehensive has yet been published in this regard.

Harvest and Postharvest Handling

Pawpaws ripen very quickly and bruise easily, which limits shipping time. Though the fruit of some cultivars will exhibit a slight color shift from green to yellow, Dr. Pomper’s research shows that skin color is a poor indicator of ripeness. Pomper claims that the best indicators are a slight softness when gently squeezed and the ease with which the fruit releases from its stem when gently pulled. Since one of the very best indicators of ripeness is that the fruit has fallen from the tree, and because the fruit is easily bruised, some growers have taken to piling a few feet of straw or hay under the trees to cushion the fall of those perfectly ripe fruit (Moore, 2015). Chris Chmiel of Integration Acres has planted ground ivy under his trees for the same reason (Moore, 2015).

Similarly, because of its tenderness and susceptibility to bruising, pickers will want to pick into something that will cushion and protect the fruit. Pawpaws in harvest totes or boxes should not be stacked more than two deep.



Young pawpaw under temporary shade provided by tomato cage and window screen.

Photo by Guy K. Ames, NCAT

Fruits picked just before they are fully ripe, but after they have begun to soften, will ripen indoors at room temperature or slowly in a refrigerator. Already-ripe fruit will last only two to four days at room temperature, but refrigerated fruit will last up to three weeks. Research is being conducted to determine the effectiveness of using modified atmosphere shipping and ethylene-control sachets to extend shelf life (Galli, 2007).

Pawpaws are not suited for certain value-added products like jams and jellies. Heat-

ing pawpaws changes their flavor, so pawpaws would be best used in foods such as ice cream. Recipes using pawpaws are available from several sources, including the Kentucky State University website www.pawpaw.kysu.edu/Recipes.htm.

Iowa State scientists are researching mechanical pulp extraction and freezing techniques. Because cooking destroys important flavor components, and shelf-life of fresh pawpaws is so limited, such research could be crucial to the commercialization of the pawpaw (O'Malley, 2010).

Dennis Fulbright of Michigan State University has adapted an Italian machine for processing chestnuts to separate pawpaw seed from pulp (Moore, 2015). However, the fruit still has to be skinned by hand.

Marketing

Given the fragility and short shelf-life of the fruit, the uncertain status of processing pawpaw pulp, as well as the simple novelty of the fruit itself, the enterprising pawpaw marketer should have a good sales plan before hitting stores, restaurants, or farmers markets. Careful handling, of course, is a must because the fruit is so easily bruised. There are a few commercial-scale growers in Kentucky and Ohio leading the way, including Chris Chmiel, who successfully processes and sells thousands of pounds of frozen pulp every year (2016).

In general, the pawpaw direct-marketer would be well-advised to have some printed material (posters or hand-outs) to acquaint the consumer with the fruit and its uses. If you have a cultivar that tastes like banana or

mango or custard, tout that in a very visible way because most consumers won't have any idea what a good pawpaw tastes like. Because it is so nutritious, nutrition information might be a good sales tool and can make good poster or blackboard text, as long as you don't overwhelm the reader with too much (shoppers are at stores or farmers markets to shop, not read; emphasize the high points: one of the highest protein contents of any fruit; high in potassium, vitamin C, riboflavin). Consult www.pawpaw.kysu.edu/pawpaw/cooking.htm#Nutritional%20Information for more detailed nutrition information. Lastly, recipes for the buyer to take home can be another inducement for the consumer to make that first purchase of a new food. Go to www.pawpaw.kysu.edu/Recipes.htm for recipes.

The North American Pawpaw Growers Association (www.NAPGA.com/AboutUs.html) (spun off from the Ohio Pawpaw Growers Association) has many members around the country. This organization can also help individuals in pawpaw marketing efforts.

Plant Extracts as Anti-carcinogens and Insecticides

Dr. Jerry McLaughlin of Purdue University, now retired, found that pawpaw is a source of phytochemicals called acetogenins with powerful anti-carcinogenic properties (Moore, 2015). An herbal extract made from pawpaw is on the market. For more information on pawpaw as an anticarcinogen go to www.pawpawresearch.com/.

Dr. McLaughlin also isolated a botanical insecticide, asimicin, from pawpaw twigs and bark (Anon., 1999); however, without finan-




A chip-budded pawpaw will have a "dog leg" where the bud was inserted. In two to three years, this feature will disappear and it will be difficult to tell where the bud or graft union was.

Photo by Guy K. Ames, NCAT

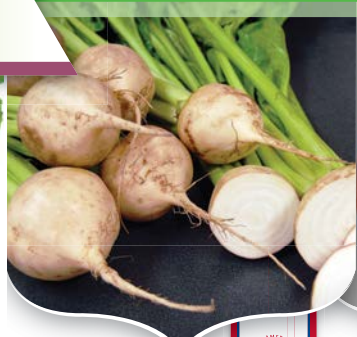
cial backing to shepherd it through the regulatory process, it is unlikely to be on the market anytime soon (Bratsch, 2009).

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