

Our Native Pawpaw: The Next New Commercial Fruit?

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***Asimina triloba* can add a distinctive look to your garden and a tropical taste to your table.**

If someone told you about a tree bearing fruits that are delicious and exotic in flavor, custard-like in texture, and larger than any other native to the United States, you would probably assume that this fruit was already popular in the marketplace. If you learned that this same tree possessed large, highly ornamental, dark-green leaves that turned a brilliant gold in the autumn, you would suspect that you had probably seen it in many yards. You would, however, be mistaken in both cases. The tree in question is the native pawpaw, *Asimina triloba*. But why is a fruit with such potential not already a commercial crop? How can the pawpaw benefit from what we know of the commercial development of other fruit crops?

Species and Taxonomy

The genus *Asimina* has the northernmost range within the primarily tropical family, the Annonaceae. It includes eight species and one named hybrid, all native to temperate North America. Each of the eight species and one hybrid of *Asimina* are briefly described below and in Table 1. Either deciduous shrubs or small trees, *Asimina* species produce flowers in the spring, often before the alternately arranged leaves have

emerged. The flowers are protogynous, that is, the stigmas in a given flower mature before the stamens. Flower petals are arranged in two whorls of three (or more rarely, four). The fruits are cylindrical, many-seeded berries, usually ranging in length from 2 to 9 centimeters (1-4 inches), although some specimens of *A. triloba* bear fruit as long as 15 centimeters (6 inches). Table 1 provides a comparative list of *Asimina* species, their synonyms, flowering and fruiting times, and other plant characteristics.

The most recent taxonomic study of the genus *Asimina* was carried out by Kral (1960). His treatment is widely followed, except for one species that Kral calls *A. speciosa*, but that is more commonly referred to in the literature as *A. incana* or *A. incarnata*. We believe *A. incarnata* to be the legitimate name of this species. Detailed distribution maps for species in the genus *Asimina* are provided by Callaway (1990).

Species in the Genus *Asimina*

Asimina incarnata, a small shrub with obovate leaves and white flowers, is native to sandy ridges and old fields from central Florida north to southeastern Georgia.

Table 1. Description for species of *Asimina* native to the United States

Species	Synonyms	Time of Bloom	Plant Height (m)	Fruit Length (cm)	Flower Width (cm)	Flower Color
<i>A. incarna</i>	<i>Asimina incana</i> <i>Asimina grandiflora</i> <i>Asimina speciosa</i> <i>Pityothamnus incanus</i>	March-May	1.5	8	4	white
<i>A. longifolia</i>	<i>Asimina angustifolia</i> <i>Asimina pygmaea</i> <i>Pityothamnus angustifolius</i>	April-July	1.25	7	6	white
<i>A. obovata</i>	<i>Anona grandiflora</i> <i>Asimina grandiflora</i> <i>Asimina secundiflora</i> <i>Orchidocarpum grandiflorum</i> <i>Pityothamnus pygmaeus</i> <i>Porcelia grandiflora</i> <i>Uvaria pygmaea</i>	March-June	2.5	7	8	white
<i>A. parviflora</i>	<i>Orchidocarpum parviflorum</i> <i>Porcelia parviflora</i> <i>Uvaria parviflora</i>	April-May	2	2	1.5	maroon
<i>A. pygmaea</i>	<i>Anona pygmaea</i> <i>Asimina secundiflora</i> <i>Orchidocarpum pygmaeum</i> <i>Pityothamnus pygmaeus</i> <i>Porcelia pygmaea</i> <i>Uvaria pygmaea</i>	April-June	0.3	4	2	maroon
<i>A. reticulata</i>	<i>Asimina cuneata</i> <i>Pityothamnus reticulatus</i>	—	1.5	5.5	5	white
<i>A. tetramera</i>	<i>Pityothamnus tetramerus</i>	May-August	2	9	3	maroon
<i>A. triloba</i>	<i>Annona pendula</i> <i>Annona triloba</i> <i>Asimina glabra</i> <i>Orchidocarpum areitinum</i> <i>Porcelia triloba</i> <i>Uvaria triloba</i>	March-May	10	5.5	3.5	maroon
<i>A. x nashii</i>		March-May	—	7.5	5	white



The attractive foliage of *Asimina triloba*. Photo by Al Bussewitz.

A. longifolia, a small shrub with narrow leaves and white flowers, is native to flatwoods and sand ridges from northeastern Florida to southeastern Alabama.

A. obovata, a shrub or small tree with obovate leaves and white flowers, is native to dry sand ridges, coastal dunes, and hammocks throughout most of peninsular Florida.

A. parviflora, a large shrub or small tree, with oblong leaves and maroon flowers, is native to rich woods, lime sinks, and alluvial soil of coastal hammocks from Florida to southeastern Virginia, west to Tennessee and eastern Texas.

A. pygmaea, a dwarf shrub with obovate or oblanceolate leaves and maroon flowers, is native to flatwoods and savannahs from central Florida to southeastern Georgia.

A. reticulata, a shrub with oblong or elliptic leaves and white flowers, is native to most of the Florida peninsula.

A. tetramera, a shrub with oblanceolate or elliptic leaves and maroon flowers, is native to coastal sand dunes in the area of Martin and Palm Beach counties, Florida.

A. x nashii, the only named *Asimina* hybrid, is a naturally occurring cross between *A. incarna* and *A. longifolia*. Described by Kral as occurring where the ranges of the two parent species overlap, it is a shrub with white flowers; its leaves are intermediate in size between the two parents. Although other *Asimina* hybrids were discussed by Kral (1960), only *A. x nashii* was named.

Asimina triloba, by far the most widespread and northernmost species of *Asimina*, deserves special attention. A shrub or small tree with maroon flowers, it is native to most of the eastern half of the United States from Florida to Ontario, west to Nebraska and Texas (see range map). The fruit of *A. triloba*, unlike that of most of the other species, is palatable, large, and deserving of commercial exploitation.

Horticulture of *Asimina triloba*

Because of transplanting difficulties, pawpaws are best started as seedlings in deep containers and grown to a height of 0.6 to 0.9 meters (2-3 feet) before they are transplanted to the field. Seedlings should be protected from direct sunlight for the first year of growth because of their sensitivity to ultraviolet light. In their second and subsequent years, however, plants should be placed in full sun for best fruit production (Willson and Schemske, 1980). The limited cultural



Growing in the understory of a forest in South Carolina, the alternate arrangement of the foliage of the pawpaw is both obvious and distinctive. Photo by Peter Del Tredici.

information available for pawpaw is summarized by Callaway (1990, 1993).

Diseases and Pests

Diseases of *Asimina* include flyspeck (*Zygophiala jamaicensis*) and a leaf spot caused by a complex of pathogens (*Myco-centrospora asiminae*, *Rhopaloconidium asiminae*, and *Phyllosticta asiminae*) (Nasu and Kunoh, 1987; Peterson, 1991). None of these diseases cause significant damage to the fruit. Insect pests include two leaf feeders, *Eurytides marcellus* and *Omphalocera munroei* (Damman, 1986), and one peduncle borer, *Talponia plummeriana* (Allard, 1955). *T. plummeriana* may cause serious

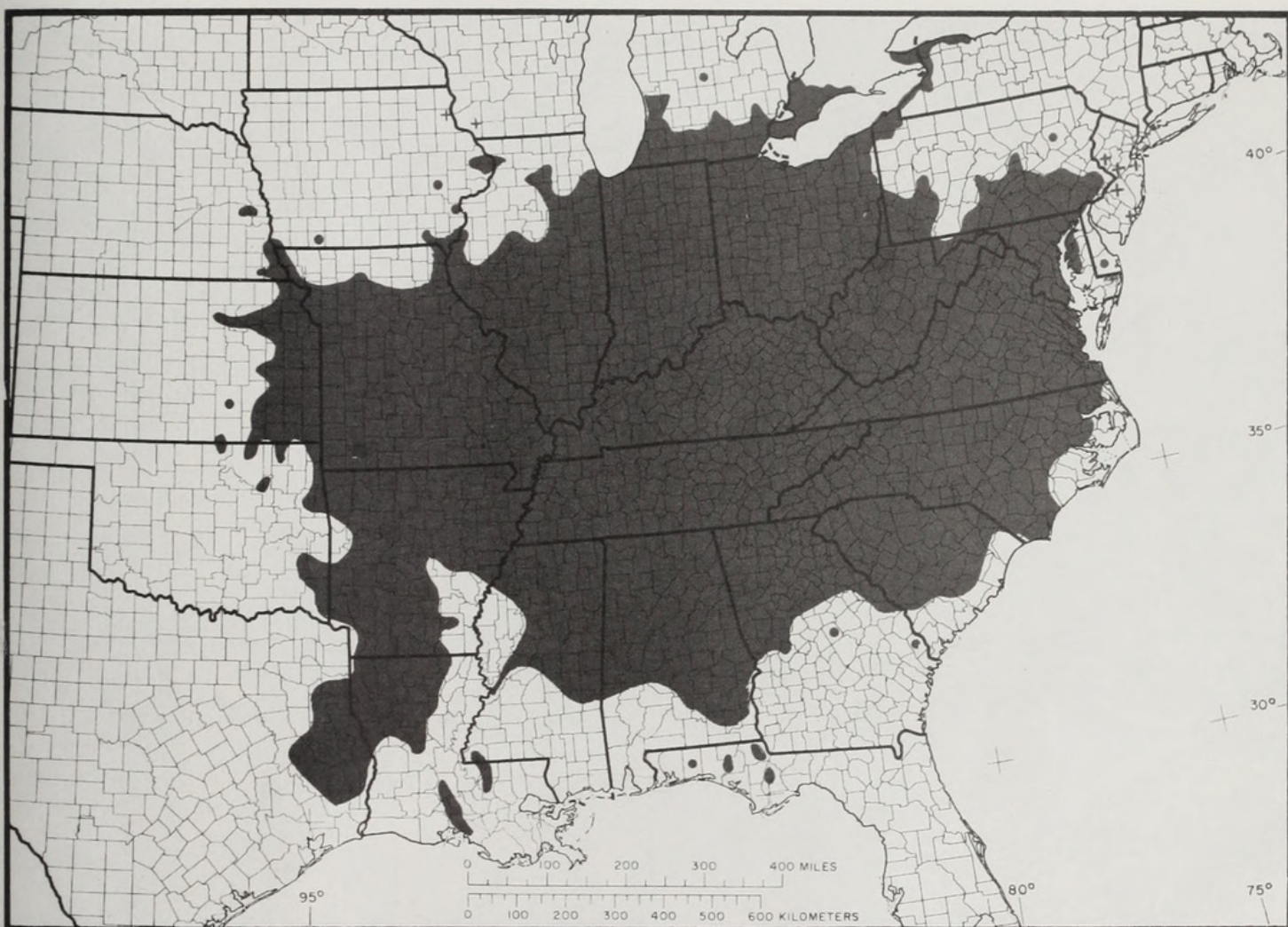
flower loss in some years. A number of vertebrates (foxes, opossums, and squirrels) are known to eat pawpaw fruit.

Propagation

Pawpaw seed should not be allowed to dry out before planting. Small quantities are placed in polyethylene bags containing damp sphagnum moss. Cold stratification at 2 to 4 degrees Centigrade (35-39°F) for 60 to 100 days is recommended (USDA, 1948). Rate of germination is improved by bottom heat (27 to 30 degrees C [80-86°F]) and shading (Callaway, unpublished; Evert and Payne, 1991; Peterson, 1991). The most reliable method of vegetative propagation is chip-budding. Root cuttings have also been successful (USDA, 1948). Tissue culture and softwood propagation methods have not been satisfactorily developed.

Varieties

Compilations of information on past and present varieties of *Asimina triloba* have appeared in reports by Callaway (1990, 1993) and Peterson (1991). Much of the information available on varieties is subjective and of questionable value. Many so-called varieties are trees that were named by their owner and reported in the literature of various fruit-grower societies, but never propagated for distribution. However, until properly conducted variety trials are carried out, these are the best sources of information available. Of the sixty-eight varieties listed by Callaway (1993), commercial suppliers are known for nineteen. However, only 'Sunflower' is listed by more than two nurseries. (It is listed by six.) Eight are listed by two nurseries and 10 by only one. 'Davis', 'Overleese', and 'Sunflower' are probably the most widely grown varieties. 'Overleese' and 'Sunflower' are generally considered among the best selections currently available. Selected from the wild around 1950 in Rushville, Indiana, 'Overleese' bears fruit weighing approximately 350 grams (12.3



The range of *Asimina triloba*, the pawpaw. From Atlas of United States Trees, Vol. 4, Minor Eastern Hardwoods. 1978. USDA Misc. Publ. 1342.

ounces) and ripens about the first week of October in Michigan. 'Sunflower' fruits, somewhat smaller, weigh approximately 250 grams (8.8 ounces) and ripen in Michigan at about the same time as 'Overleese'. 'Sunflower' originated in Chanute, Kansas.

Utilization and Prospects

Currently, pawpaws are primarily consumed as fresh fruit. They may also be processed into ice creams, juices, and other products as are their *Annona* relatives. In addition to food uses, scientists at Purdue University have isolated compounds from vegetative parts of the pawpaw that exhibit highly effective pesticidal and anti-tumor proper-

ties (Alkofahi et al., 1989; Rupprecht et al., 1986; Rupprecht et al., 1990). Pawpaw also develops into a very handsome ornamental plant. In the open, trees assume a pyramidal form. Throughout the summer they are adorned with large, drooping, dark-green leaves which turn brilliant golden in the fall.

Despite the fact that pawpaw is native to the United States, its commercialization is apparently more advanced in other countries, such as Japan and Italy. We are aware of only one commercial planting in the United States and their plants are still too small to bear fruit. Fortunately, this lack of interest seems to be changing. Pawpaw plants have recently been selling briskly in the nursery



The fruit of Asimina triloba hanging from a tree at the Arnold Arboretum. Photo by Al Bussewitz.

trade, particularly grafted varieties, and none of the nurseries selling pawpaw varieties have been able to meet the demand for plants within the last two years. Although adequate assessment of market demand for new crops is quite difficult, recent trends indicate that the prospects for successful commercialization of this fruit appear to be improving.

Difficulties in New Crop Introduction

Asimina triloba was widely used by Native Americans before European settlement. Although early settlers also used pawpaw, they also brought fruit—such as apples, peaches, and pears—with them from Europe.

In the Old World, superior varieties of these fruit had been selected over several centuries and propagated widely by grafting. Therefore, these improved fruits were more widely grown than unimproved native fruits.

Although exceptional specimens of pawpaws can be found in the wild, the proportion of superior plants, as with any wild fruit (apples, peaches, and pears included), is small. Historically, many years are required for exceptional specimens to become widely distributed. Early efforts at collecting exceptional specimens were made by the American Genetic Association (Anonymous, 1916, 1917) and by a few individuals, most notably Dr. G. A. Zimmerman (1938, 1940, 1941) of



A selection of *Asimina triloba* producing exceptionally large fruits. Photo by Brett Callaway.

Harrisburg, Pennsylvania. Unfortunately, many specimens identified during this period were lost during World War II. In recent years renewed efforts by a few individuals have led to a resurgence of popular interest in pawpaws.

The improvement of crops through breeding is particularly slow for tree crops because of the long intervals between generations. Often a breeder is only able to evaluate five or six generations in an entire career. When one considers that a corn breeder can evaluate three generations a year, the comparative difficulty of developing new varieties of fruit crops from trees or shrubs becomes obvious. However, there have been successes.

Domestication of the blueberry (*Vaccinium* spp.) has taken place entirely in the twentieth century (Galleta, 1975). The first commercial plantings were established in Florida in the late 1800s (Lyrene and Sherman, 1979) and breeding work began in the early 1900s. 'Tifblue', probably the most widely grown rabbiteye type of blueberry (*V. ashei*) is derived from parents collected from the wild (Austin, 1985). Kiwi (*Actinidia chinensis*) is another example of a recently developed fruit enjoying commercial success. Therefore, *Asimina* germplasm collections made in recent years by Peterson (1986) and Callaway (1991), and a number of superior varieties collected from the wild (listed by

Callaway, 1993), provide the foundation for pawpaw breeding work to begin.

Lessons from Other Crops

Important lessons are to be learned from the early efforts at commercialization of blueberries. Between 1921 and 1925, a boom in the Florida blueberry market took place. Hundreds of thousands of plants were dug from the wild and planted in commercial fields. The extreme variation in fruit quality from these wild plants (as would be the case for any wild fruit) led to a decline in demand for the Florida fruit and caused the industry to shift to more northern parts of the U.S. where superior varieties were clonally propagated and grown (Lyrene and Sherman, 1979). The great demand for pawpaws in recent years has led to a shortage in plants of superior varieties. Customers are placed on waiting lists, sometimes for years. Under these conditions, as in the boom years of the Florida blueberry industry, the temptation to plant seedlings of variable quality is great. However, this practice is shortsighted and can potentially destroy a nascent industry.

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