



# Wild Harvesting and Cultivating Pawpaw in Georgia

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## INTRODUCTION

Pawpaw fruits are nutritious, delicious, and provide a suite of social, economic, and ecological benefits. Although eight species of pawpaw are endemic to the southeastern United States, two species (common pawpaw and small-flowered pawpaw) are considered a delicacy and have long been foraged (wild harvested) due to their large size and unusual tropical flavor. In fact, common pawpaw is North America's largest native edible fruit. Advancements in breeding have supported the cultivation of common pawpaw in several states today. This publication provides an overview of pawpaw natural history and historical uses, species identification, wild harvesting recommendations, and propagation.

## PAWPAP NATURAL HISTORY AND HISTORICAL USES

Pawpaw species date back 34 million years ago in the fossil record (Berry, 1916), a time when glaciers and, later, large mammals (megafauna) played a critical role in the species' distribution. Several glacial periods during this time forced the range of pawpaw to the East and Southeast on the North American continent (Moore, 2015). And because of their size and appetite, now extinct megafauna like ground sloths and the woolly mammoth could ingest large quantities of pawpaw fruit, excrete the seeds, and reestablish the plant in areas where glaciers retreated (Guimarães et al., 2008; Moore, 2015). Animals also played an important role in pawpaw pollination. The rotting smell of pawpaw flowers was developed to attract flies and beetles for pollination, rather than bees.

Approximately 11,000 years ago at the end of the last ice age, pawpaw adapted to a rapidly changing post-glacial environment and the extinction of one of its main seed distributors: megafauna. Pawpaw seeds germinated near the parent plant and reproduced vegetatively through root sprouts, creating a colony of genetically identical plants (Fig. 1). Native Americans valued the pawpaw fruit for food and may have also played an important role in transporting it to new geographic areas.

Historically, pawpaw played an important role in Native American culture. Along with other fruits and berries, Iroquois women and children gathered fresh pawpaw to eat and possibly to dry into cakes for breads, sauces, or stews (Moore, 2015; Waugh, 1916). Cherokee and Shawnee peoples gathered pawpaw for food, and the Cherokee made rope and string from the inner bark fiber of the trees that they then used to string fish, mend clothing, and weave baskets (Hamel, 2002; Moore, 2015). Native Americans in the Mississippi Valley were also observed growing pawpaw trees (Brode, 2020). Several indigenous place names as well as archaeological sites were found to contain large quantities of pawpaw seeds, which suggest pawpaw was used for food and in cultural events (Moore, 2015; Wyatt, et al., 2021).



**Figure 1:** Pawpaw grove (noted with red arrow). The root sprouts in this grove may be part of the same plant. Credit: Lisa Furman

European and African Americans also relied on pawpaw fruit as a food source. The first written record of pawpaw occurred during the 1541 Hernando de Soto expedition of the southeastern region of what is now the United States (Hormaza, 2014). Early European Americans depended on pawpaw as a valuable food, especially during harvest failure (Brode, 2020). Despite pawpaw adaptability and low maintenance, most colonists cultivated less hardy non-native fruit trees (Little, 1905; Moore, 2015), preferring to wild harvest the species instead. Some limited interest in pawpaw cultivation, however, did occur early in our nation's history. Presidents George Washington and Thomas Jefferson cultivated pawpaw trees at their farms. Enslaved Africans also relied on the fruit for food and to lure game (Moore, 2015). Pawpaw fruit proved to be a valuable emergency food. Just days from the end of their expedition, the September 18, 1806 entry in the Journals of Lewis and Clark reports, "our party entirely out of provisions subsisting on poppaws" (DeVoto, 1953).

From the mid-nineteenth to the early twentieth century, gardening societies encouraged horticulturists to improve and domesticate pawpaw for commercial production. A few plant breeders and researchers responded, but their efforts abated, and interest was lost (Moore, 2015). Later, in 1980, pawpaw enthusiast Neal Peterson tracked down the remaining improved cultivars from the previous century and reinitiated pawpaw breeding and cultivation. In 1981, he planted an 800-tree experimental pawpaw orchard at the University of Maryland (UMD) Wye Research and Education Center. Seven years later, he began evaluating the trees for productivity, superior taste, and a low seed-to-pulp ratio. From the data collected, eighteen advanced selections were made and planted in a second orchard of 600 trees (Moore, 2015) which yielded six named pawpaw cultivars (Peterson, 2003). Around this time, other universities also researched pawpaw. Programs at Kentucky State University and The Ohio State University focused on breeding and growing pawpaw, while Ohio University investigated the fruit's food value and use.

Pawpaw has several ecological, social, and health benefits in addition to being a delicious fruit. The trees are the only host plant for the zebra swallowtail butterfly (*Protographium marcellus* Cramer), who feed on the leaves during the caterpillar stage. As well, the Virginia opossum, foxes, squirrels, raccoons, coyotes, and birds all feast on the fruits. Each fall, people gather for pawpaw festivals and events in Ohio, Pennsylvania, Virginia, West Virginia, North Carolina, Kentucky, and other states. The flesh of pawpaw fruit is a valuable source of dietary nutrients, including protein, fat, carbohydrates, Vitamin C, potassium, calcium, iron, zinc, sodium, and several essential amino acids (Jones & Layne, 1997; Nam et al., 2018b; Brannan et al., 2021). Lastly, research studies suggest that pawpaw fruit, leaf, and twig tissue contain polyketide molecules called acetogenins that may inhibit the growth of certain cancer cells, have high antioxidant age-delaying activity, and can be used as an antimicrobial agent (Nam et al., 2018a; Nam et al., 2018c).

## IDENTIFICATION & HABITAT

One of the most important steps in wild harvesting plants is accurate identification. Knowing a plant's morphological characteristics (e.g., leaves, bark, etc.), as well as its natural habitat, are important in correctly identifying a species.

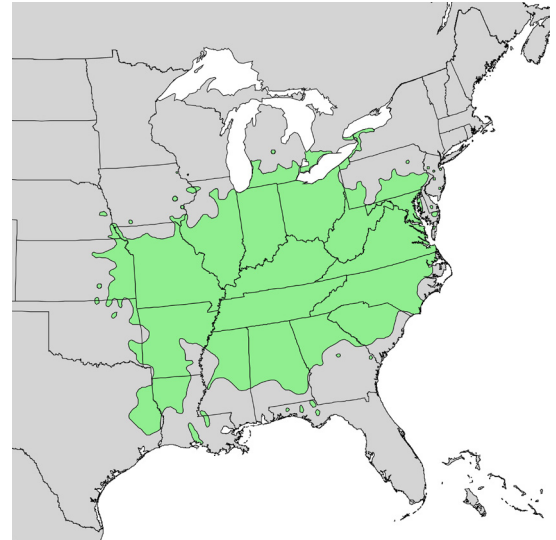
Pawpaw belongs to the Annonaceae family, a mostly tropical family that includes several genera used for medicine, perfume, flavoring, and food due to its large fruits and/or aromatic compounds (Kirkman et al., 2007). Eight species of pawpaw are endemic to the southeastern United States, where most of these species are classified as rare or uncommon due to habitat loss. Less common pawpaw species are found in the Coastal Plains of Georgia and Alabama and throughout Florida. These include slimleaf pawpaw (*Asimina longifolia*), netted pawpaw (*A. reticulata*), woolly pawpaw (*A. incana*), bigflower pawpaw (*A. obovata*), dwarf pawpaw (*A. pygmaea*), and the federally endangered four-petal pawpaw (*A. tetramera*). Two of the most frequently occurring pawpaw species in Georgia include common pawpaw (*A. triloba*) and small-flowered pawpaw (*A. parviflora*). These latter two species are the focus of this publication because they are commonly wild harvested for their fruit.

### Common Pawpaw (*Asimina triloba*)

Common pawpaw is widely distributed in the eastern half of the United States and southern Canada (Fig. 2). In Georgia, common pawpaw is endemic to the mountains, Piedmont, and Upper Coastal Plains, where it prefers sites with moist, rich well-drained soil. It can be found growing in floodplains of the Piedmont and Upper Coastal Plains and in moist forests of the north Georgia mountains. Though usually an understory tree, common pawpaw tolerates heavy shade to full sun. The species is described as a large shrub to single stem tree and can grow up to 30 feet (ft.) in height with a 2-6 inch (in.) trunk diameter. As mentioned previously, common pawpaw readily sprouts from the roots, creating the appearance of a grove of individual pawpaw stems (Fig. 1).

Common pawpaw has several identifying characteristics (Fig. 3). Of these characteristics, the most distinctive growing season and dormant season characteristics can be found in bold print below.

- Leaves:** deciduous, simple leaf, **6 - 12 in. long and 2 - 3 in. wide, obovate to oblong shape with a tapered leaf tip and base**, short petiole (leaf stem), top of leaf is green and underside is a paler green, leaf edge lacks “teeth” or serrations, young leaves have pubescence (“hair”) on the leaf surface and underside but are glabrous (smooth and lacking pubescence) as they age, **leaf smells like “green bell peppers” when crushed**, alternate leaf arrangement along branch, from a distance **leaves appear wilted or seem to “droop” from twig**
- Flower:**  $\frac{3}{4}$  - 2 in. long petals with  $\frac{1}{2}$  in. long flower stalk, six petals initially green then turning purplish-brown, musky odor, flowers March to April in Georgia prior to leaf emergence
- Fruits:** **2 - 7 in. long berry**, fleshy, oblong to cylindrical in shape, green when young turning yellow to dark brown when mature, fruit contains brown shiny seeds shaped like beans, sweet edible flesh, matures late summer to autumn in Georgia
- Bark:** grey-brown and smooth with raised warty lenticels (gas exchange structures)
- Twigs & Buds:** young twigs are brown, narrow, and covered in reddish-brown pubescence, older twigs are stout,  **$\frac{1}{2}$  in. long terminal bud found at the tip of twig lacks scales (naked) and is pointed and triangular**, lateral vegetative buds found on the side of twig covered in reddish-brown pubescent scales and triangular in shape, round flower buds appear in early spring, leaf scars found under the lateral buds are horseshoe-shaped, twig pith is aromatic and diaphragmed when cut



**Figure 2:** Native range of common pawpaw (*Asimina triloba*). Data: Little, 1971. Map: USDA Forest Service



**Figure 3:** Common pawpaw ID characteristics (clockwise from upper left): unripe fruit, flowers, stem bark with warty lenticels, leaf, and terminal bud (noted by red arrow). Credit: Holly Campbell

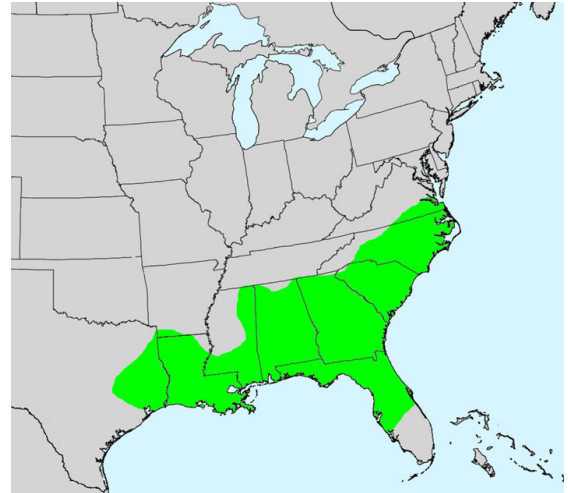


### Small-flowered Pawpaw (*Asimina parviflora*)

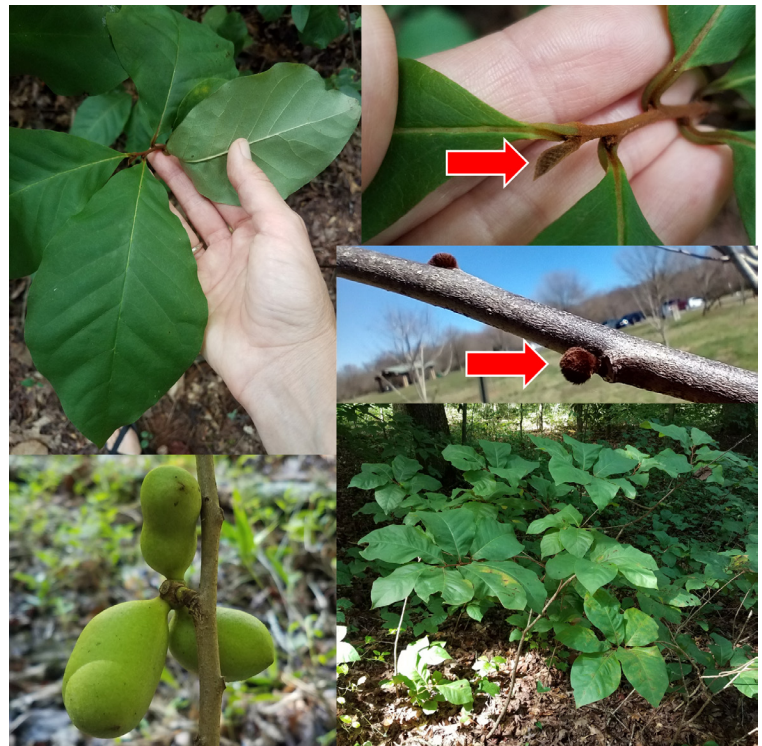
Small-flowered pawpaw has a smaller, more southern range in comparison to common pawpaw (Fig. 4). In Georgia, small-flowered pawpaw is found throughout the state, from the mountains to the coast. The species prefers moist, well-drained soil, but is often found growing on more upland (and slightly drier) sites than common pawpaw. Small-flowered pawpaw is an understory shrub that grows up to 8 ft. in height, usually growing in full to part shade. Like common pawpaw, small-flowered pawpaw sprouts readily from the roots and several stems of the same plant may cover an area.

Small-flowered pawpaw is a smaller version of common pawpaw in nearly all aspects. The species has several identifying characteristics (Fig. 5). Of these characteristics, the most distinctive growing season and dormant season characteristics can be found in bold print below.

- Leaves:** deciduous, simple leaf, **3 - 8 in. long and 1 - 2 in. wide, obovate to oblanceolate shape** with a pointed tip and tapered base, short petiole, young leaves have pubescence on the leaf surface and underside and leaf becomes glabrous as it ages, the leaf edge is smooth and not serrated, **leaf has “green bell pepper” smell when crushed**, alternate leaf arrangement along the stem
- Flower:**  $\frac{3}{4}$  in. long petals with a flower stalk less  $\frac{1}{2}$  in. long, 6 petals initially green then turning purplish-brown, musky odor, flowers March to April in Georgia prior to leaf emergence
- Fruits:** **1 - 3 in. long berry**, fleshy, round to cylindrical in shape, green when young and yellow to dark brown when mature in late summer to autumn, fruit contains brown shiny bean-shaped seeds, sweet edible flesh
- Bark:** grey-brown, smooth, raised warty lenticels
- Twigs & Buds:** brown, narrow twigs covered in reddish-brown pubescence,  **$\frac{1}{2}$  in. long naked terminal bud is pointed and triangular**, lateral buds covered in reddish-brown pubescent scales and triangular in shape, round flower buds appear in early spring, leaf scars found under the lateral buds are horseshoe-shaped, twig pith is aromatic and diaphragmed



**Figure 4:** Native range of small-flowered pawpaw (*Asimina parviflora*). Data: Little, 1971. Map: USDA Forest Service



**Figure 5:** Small-flowered pawpaw ID characteristics (clockwise from upper left): Leaf top and underside, terminal bud (noted by red arrow) and twig, flower bud (noted by red arrow), cluster of single-stem plants, and un-ripe fruit.

Credit: Holly Campbell and Heather Kolich



**Figure 6:** *The skin color of pawpaw fruit may vary (as seen in the images above). Unripe pawpaw skin color is green (left image). Ripe pawpaw fruit skin is usually a light green to yellow-green color (right image) and may also have brown spots.* Credit: Heather Kolich and Connie Barlow

### WILD HARVESTING PAWPAP

Prior to harvesting pawpaw, review wild harvesting best practices on page 7.

In Georgia, pawpaw plants ripen from late summer to autumn. Fruit skin color and fruit softness are used as indicators of ripeness, but, of the two, the softness of the fruit's flesh is a better indicator of ripeness. Ripe, harvestable pawpaw skin can vary from light green to yellow with brown spots (Fig. 6) and harvestable fruit will be soft like a ripe avocado (Thayer, 2017). Gently press the side of the fruit to gauge ripeness. A slight indentation will occur on ripe fruits (Blake et al., 2022).

Fruits fall to the ground when they are fully ripe and can be harvested from under the tree, but ripening fruit that is still attached to the tree can also be harvested. To dislodge ripening pawpaw, gently shake the tree, taking care to avoid being hit by falling fruit. Be aware that overripe fruit may burst when hitting the ground. To minimize fruit damage, place a thick blanket under the tree to cushion the fall and keep the fruit intact. Any crushed fruit simply needs to be processed and consumed more immediately. Pawpaw can also be harvested following weather events since precipitation and windy weather causes ripe fruit to fall from the tree. Though the best tasting fruits are reportedly tree-ripened, one can harvest pawpaw early when the fruit is mostly ripe (or slightly under-ripe fruit if accidentally harvested) and continue the ripening process indoors for a few days until the fruit has softened (Thayer, 2017). Gently twist the stem of less ripe fruits to remove them from the tree without damaging the twig or use hand pruners to remove the fruit, cutting along the fruit stem.

### WILD HARVESTING BEST PRACTICES:

- Research a plant prior to wild harvesting (e.g., identification, what to harvest, when and how to harvest, etc.)
- Practice ethical and sustainable wild harvesting. Avoid harvesting threatened and endangered plants and only harvest what you can reasonably use. Wildlife depend on several wild harvested species for their survival. Additionally, other wild harvesters may collect from the same location, so leave some for others
- Identify plant with complete certainty, especially prior to consumption
- Be careful when consuming a wild harvested plant for the first time. Consume a very small quantity to assess an allergic reaction or sensitivity prior to consuming more
- Understand that some jurisdictions (county, state, and federal lands) prohibit wild harvesting or require a permit to wild harvest certain plants
- Obtain permission from a landowner to wild harvest on private land. Avoid trespassing
- Protect yourself when wild harvesting. Wear protective clothing, gloves, sun protection, and insect repellent. Be aware that venomous snakes, biting insects, or poison-ivy may be present in heavy vegetation. Wild harvest with a friend or let someone know exactly where you are going. Wild harvested plants may be in remote areas
- Avoid wild harvesting edible plants near roadways, along railroad tracks, and other areas susceptible to pollution or pesticide application
- Bring appropriate harvesting tools to avoid damaging the plant you are harvesting (e.g., hand pruners, shovel, loppers, etc.)
- Assist a plant in regenerating itself following wild harvest. Properly prune branches and roots. Leave flowers to fruit and leave sufficient dropped fruit on the ground for animal distribution and natural reseeding. Plant seeds of harvested plant

Gently harvest ripe fruit into a clean container and place in a cool location (on a kitchen counter at room temperature or in the refrigerator) shortly after harvest. Harvest sustainably, only taking what you can use while leaving fruit for wildlife and other wild harvesters. Pawpaw trees growing in full sun will generally produce the most fruit (Thayer, 2017; Blake et al., 2022), so seek out groves that receive more sunlight or individual trees that are on the edge of a forest. Harvest yield varies year-to-year depending on climatic conditions, available light, pollinators, and harvest by wildlife.



### USING YOUR HARVEST

Only consume pawpaw when they are fully ripe. To prepare pawpaw fruit for use, first rinse the skin to remove any dirt or debris. Next, carefully cut the fruit in half, taking care not to damage the seeds (if you want to germinate them). Ripe pawpaw inner flesh should be cream to yellow or yellow orange in coloration and have a custard-like consistency (Fig. 7). The inner flesh is the only part of the fruit that is eaten, so the final step in preparation is separating the inner flesh from the skin, darker band of outer flesh (located just under the skin), and the seeds (Thayer, 2017) (Fig 8). This can be accomplished using a strainer, spoon, or your hands. Pawpaw has a sweet, tropical flavor that has been described as mango, banana, citrus, melon, pineapple, and berries.

Though seasoned foragers report that ripe, fresh fruits have the best flavor (Thayer, 2017), pawpaw is also used in baked goods and desserts such as breads, ice cream, cookies, sauces, and cake. Even wine and beer can be made from pawpaw. The fruit also serves as a banana replacement in recipes. See Additional Resources below for links to recipes.

### STORING YOUR HARVEST

Pawpaw continues to ripen after harvest and will last about 3-4 days at room temperature before becoming over-ripe (Jones and Layne, 1997). If ripe fruits are not used immediately, they can be stored in the refrigerator for up to 3 weeks (Layne, 1995). Slightly under-ripe fruit can also be stored in the refrigerator to slow ripening and then placed in a room temperature location to fully ripen. Pawpaw pulp can be stored in the freezer (Thayer, 2017) or preserved through recipes.

### PRECAUTIONS

Humans have consumed pawpaw for millennia, but some individuals may be less tolerant of the fruit's chemical compounds, so precautions should be taken when first consuming the fruit. Though unlikely, it is possible an individual can have a severe allergic reaction (anaphylactic shock) after eating ripe pawpaw fruit; whereas, symptoms of a minor allergic reaction include stomach irritation, nausea, diarrhea, skin rash, and vomiting (Peterson, 1991). When ingesting any new food, only try a small quantity to gauge a potential allergic reaction before consuming larger quantities. Lastly, pawpaw seeds should not be consumed since they contain alkaloids which can cause vomiting (Blake et al., 2022).



**Figure 7:** *The cream to yellow inner flesh of a ripe pawpaw, with seeds removed. The red arrow is pointing to the outer flesh, located just below the skin. Avoid consuming the outer flesh, skin, and seeds. Credit: Holly Campbell*



**Figure 8:** *Pawpaw seeds with fleshy pulp seed coat removed. Seeds should not be eaten but can be easily germinated to propagate new trees. Credit: Heather Kolich*

## GROWING PAWPAW TREES

Pawpaw trees, especially common pawpaw, have attractive landscape and foodscape features. Although naturally an understory tree, when grown in full sun common pawpaw develops a conical form, can grow to 30 feet, and has increased fruit production. The large leaves, twigs, and bark produce compounds that naturally reduce pest issues and deer browse (Matthews, 2016; Blake et al., 2022) and the leaves of common and small-flowered pawpaw turn a striking golden color in autumn. Moreover, planting pawpaw trees helps restore native biodiversity in developed areas and is an important food source for several animals.

For fruit production, plant at least two genetically different pawpaw trees for cross pollination. Seedlings harvested from a grove of pawpaw may be genetic clones, and they are difficult to establish once removed from the root system of the parent plant. As a result, growing plants from seed ensures genetic diversity sufficient for fruit production, but the quality of the fruit will vary. Purchasing improved cultivars from a nursery that specializes in native plants provides the best assurance of high-quality fruit. Blake et al. (2022) and Krewer et al. (2022) provide several recommended cultivars (See References below).

Pawpaw trees will begin producing fruit 4-5 years after planting nursery grown trees or 5-8 years after planting seeds. Flies and beetles pollinate pawpaw. Since these insects are less efficient pollinators than bees, fruit production may vary from year to year.

**Seed Propagation.** Pawpaw seeds have hard seedcoats, making germination a slow process. To get started, gently clean the pulp from seeds of fresh, fully ripe fruit. Immediately after cleaning the seeds (germination success is reduced if the seeds dry out), place them in a lidded plastic container or closed plastic bag surrounded by a moist soil media of equal parts sand and peat moss or just sphagnum moss (which helps limit fungal pathogens). Next, place the container with seeds in the refrigerator for 70-120 days for the cold stratification process necessary to break seed dormancy. Keep the seeds moist throughout cold stratification by periodically checking the moisture level. After the stratification period, plant seeds 1 in. deep in moist, well-drained potting soil (ph: 5.5-7) in a tree pot or other deep pot ( $\geq 10$  in. depth) since pawpaw has a long taproot. Place the pots in a warm (75-85° F) location until they germinate in 2-3 weeks (Jones et al., 1998; Blake et al., 2022). After germination, the shoot will emerge in approximately 2 months. Note that the emerging shoot is hypogeal (embryonic leaves, or cotyledons, remain below the soil surface) and the first true leaves will emerge slowly from the young shoot (Fig. 9).

## CONCLUSION

Common pawpaw and small-flowered pawpaw have long provided important ecological services and a unique food source for humans. And in more recent history, they are a popular wild harvested food and cultivated specialty crop, providing economic opportunities. The fruits are a nutritious and delicious snack that can be used in a variety of recipes. Pawpaw are also a valuable wildlife food and an aesthetic landscape specimen. Whether wild harvested or grown in your own backyard, pawpaw is a species worth discovering.



**Figure 9:** *Pawpaw seedlings following germination.* Credit: Holly Campbell



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### ADDITIONAL RESOURCES

- Growing Pawpaw: <https://vtechworks.lib.vt.edu/handle/10919/55307>
- Kentucky State University Pawpaw Research:  
<https://www.kysu.edu/academics/college-ac/school-of-ace/pawpaw/>
- Ohio's Pawpaw Trees Video: <https://www.youtube.com/watch?v=DljFebMEjoE>
- Pawpaw Recipes: <https://www.hort.purdue.edu/newcrop/ksu-pawpaw/cooking.html>
- Pawpaw Use as an Anti-carcinogenic and Pesticide:  
<https://smallfarms.cornell.edu/2018/01/pawpaw-a-tropical-fruit/>
- Pawpaw Cultivars Suitable for Georgia:  
<https://extension.uga.edu/publications/detail.html?number=B992&title=minor-fruits-and-nuts-in-georgia>
- Pawpaw Publications: <https://www.kysu.edu/academics/college-ac/school-of-ace/pawpaw/list-of-pawpaw-publications-available-through-kentucky-state-university-via-download-or-snail-mail.php>
- Pawpaw Nurseries: <https://www.kysu.edu/academics/college-ac/school-of-ace/pawpaw/licensed-propagators-for-kentucky-state-university-trademarked-pawpaw-cultivars.php>

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