



Organic Production of Pawpaw

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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-AtwoodTM', 'Sunflower', 'Overleese', 'NC-1', 'SusquehannaTM', 'PotomacTM', 'WabashTM', and 'ShenandoahTM'. Pawpaws flower in mid-April and have a maroon flower with a slight fetid odor. Fruit set usually requires cross pollination, which requires at least two genetically different pawpaw trees or cultivars, and the presence of pollinators (flies and beetles). Depending on the variety, fruit ripen in late-August to early-October. Fruit ripen on the same tree over about a 2 week period, which reflects an extended spring flowering period. Pawpaw fruit are ripe when they begin to soften and can be gently pulled off a tree in a manner similar to ripe peaches. Fruit have a 5-7 day shelf life at room temperature; however, fruit can be stored under refrigeration for up to 3 weeks to maintain a good eating quality. Pawpaw fruit and products are mainly sold at farmer's markets, directly to restaurants, and via entrepreneurs on the Internet. Local delicacies made from the fruit include pawpaw ice cream, compote, jam, and wine.

What is Organic? In 2002, the U.S. Department of Agriculture put in place a set of national standards that food labeled 'organic' must meet, whether it is



Photograph of 'KSU-AtwoodTM' fruit.

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 natural ones. Organic crops are produced without using most synthetic products, including chemical fertilizers, synthetic pesticides, bioengineering; or ionizing radiation; the standards also exclude fertilizers made with sewage sludge. Many people who believe that they are growing their fruits and vegetables organically because they are using reduced chemical inputs and sustainable agricultural practices do not meet the Federal requirements for food or produce sold as organic.

The organic standards. The National Organic Program (NOP) Standards are confusing, but if you want to grow a crop and sell it as 'organic' you must follow the NOP standards. The standards are

quite complicated (see the USDA site at <http://www.ams.usda.gov/AMSV1.0/NOP>), but a wealth of detailed, readable, and useful information for growers on organic certification, organic production of vegetables, fruits, flowers and livestock, organic pest management, organic fertility management, and organic marketing can be found at Organic Farming Resources from the National Sustainable Agriculture Information Service at: <http://attra.ncat.org/organic.html> and the Organic Association of Kentucky (OAK) web site at: <http://oak-ky.org>. Before a product can be labeled 'organic,' a government-approved certifier inspects the farm where the food is grown to make sure the farmer is following all the rules necessary to meet USDA organic standards. Organic producers should verify with the appropriate certification bodies that their practices and any materials they intend to use are compliant with applicable standards for their intended markets. In Kentucky, the Kentucky Department of Agriculture has established an organic certification program (<http://www.kyagr.com/marketing/plantmktg/organic/index.htm> contact: Mike Fitzgerald at 502-564-4983 or michael.fitzgerald@ky.gov). To have a growing area certified as organic, detailed records must be kept for at least three years prior to certification, and after certification, on all organic and conventional growing practices. No synthetic fertilizers, herbicides, or other restricted items can be applied at least 3 years before certification. A farm management plan covering all aspects of agricultural production or handling must be agreed to by the producer or handler and the certifying agent. Crop rotation is required. A buffer zone must exist between organically and conventionally grown crops and must be sufficient in size or other features (e.g., windbreaks or a diversion ditch) to prevent the possibility of unintended contact by prohibited substances applied to adjacent land areas with an area that is part of a certified operation. The certifying agent determines if conventional water runoff, pesticide drift, etc., are far enough away from the organic area to prevent contamination. The standards contain a list of certain synthetic substances allowed for use in organic crop production and nonsynthetic



Photograph of 'WabashTM' fruit.

substances prohibited for use in organic crop production. The Organic Materials Review Institute (OMRI) provides certifiers, growers, manufacturers and suppliers an independent review of products intended for use in certified organic production, handling, and processing (<http://www.omri.org>) based on the NOP standards. The OMRI Products List represents OMRI's recommendations regarding the acceptability of brand name products for organic production, processing, and handling.

During production, all equipment and tools must be cleaned when they are moved from a conventional field to an organic area. After harvest, physical contact, or commingling, between unpackaged organically produced and conventionally produced products must be prevented. If an operation knowingly sells or labels a product as organic that is not, it can be subject to a civil penalty of up to \$10,000 per violation.

The standards and the small pawpaw grower. So how does this all relate to the small pawpaw grower who wants to sell organically grown pawpaws? There is an exception clause that states that: "A production or handling operation that sells agricultural products as 'organic' but whose gross agricultural income from organic sales totals \$5,000 or less annually is exempt from



Pawpaw fruit at farmers' market in Frankfort, Kentucky.

certification...but must comply with the applicable organic production and handling requirements." Products from such operations cannot be used as ingredients in processed organic products produced by another handling operation. So growers who have small pawpaw operations whose gross agricultural income from organic sales totals \$5,000 or less annually can sell organically grown pawpaws at farmers' markets, to restaurants, and via the Internet without going through the certification process, but must still comply with the organic production and handling requirements. Wild pawpaws labeled and sold as organic must be harvested from an area that has had no prohibited substance in the standards applied for a period of 3 years preceding harvest. The wild pawpaw fruit must be harvested in a manner that will not be destructive to the environment and will sustain continued growth and production.

Organic pawpaw culture. The main problems faced in organic production of pawpaw are: weed control, nutrient management, and to a lesser extent, disease and pest control. Pawpaw is a unique native tree fruit that is resistant to many diseases and insect pests, making this crop attractive to organic growers. Here are some items to keep mind before you start planting your trees:

Establishing an orchard. An orchard site that would be suitable for growing pawpaw or other tree fruits

includes good air drainage for frost protection, a deep, fertile, well-drained soil, with a pH 5.5-7.0, and a water source for irrigation. Low areas should be avoided, since cold air will pool in these areas and increase the risk of spring frost damage to flowers and vegetation. Site preparation is extremely important for any organic operation. The presence of certain weed species is of particular concern to the organic grower. Bermuda grass, Johnson grass, quack grass, Canadian thistle, and several other species can be serious problems to growers and are difficult to control with organic methods once an orchard is established. It is important that organic orchard sites are chosen that do not have these weed species at the start. If these weed species are at your orchard site and you do not want to resort to conventional approaches prior to beginning a three year transition period, there are several options. One organic option is soil solarization. Soil solarization is using transparent plastic on moist soil and sun light to capture solar heat energy. Solarization takes 4 to 8 weeks to heat the soil to a temperature



Use of tree shelters with pawpaw trees.



Weed control using weed badger around trees in the University of Kentucky pawpaw planting.

and depth that will kill harmful fungi, bacteria, nematodes, weeds, and certain insects in the soil. Solarization can be effective in areas such as Kentucky with many sunny days and high temperatures, but it is not effective where lower temperatures, clouds, or fog limit soil heating. Another option to eliminate weeds in fields before they are used in organic production is the use of repeated cultivation and cover crops. More information on this approach can be found at the Appropriate Technology Transfer for Rural Areas (ATTRA) web site at <http://www.attra.org>.

Planting stock. According to the NOP standards, nonorganically produced planting stock is considered organic after it has been maintained under a system of organic management for a year. It usually takes about 4 years for grafted pawpaw trees to produce fruit. We presently recommend that trees be planted at a spacing of 8 feet within rows and 12 to 18 feet between rows. For the first two years, top growth is slow as the root system establishes itself, but thereafter it accelerates substantially given proper fertility and soil moisture. Shading of small pawpaw trees in the field the first

year is recommended and can be accomplished by installing translucent double-walled polyethylene “tree-tubes” around each tree, securing them with bamboo stakes. However, trees taller than 45 cm at planting do not require shading. During warm summer temperatures (>35°C), the tubes should be removed from the trees, otherwise foliage within tubes can become heat-stressed and desiccated.

Weed control. Weeds and grasses can easily out-compete pawpaw trees for resources. Weed control is especially important during the first years of tree establishment and continues to be important after this period; this will optimize fruit production from mature trees. There are a number of organic weed control approaches within rows around trees that are options for a pawpaw planting. In organic farming, it is important to try to take a holistic cultural approach. The goal is not just to control weeds, but to improve the soil organic content. Cultivation around trees from the drip line to the trunk can be used to control weeds; however, cultivation must be shallow (< 4 inches) to avoid damaging roots. The Weed Badger is an excellent tractor attachment for weed control (www.weedbadger.com).



Flame cultivation for weed control around pawpaw trees.

Wood chip mulch, straw, and hay (6-8 inch depth) can be used to mulch around trees for weed control and are usually effective method one to two years. Make sure that the straw or hay does not contain large quantities of weed seeds. For larger plantings, unroll round bales of hay in rows and use for mulching (6-8 inch depth). This method has been very effective in weed control and the hay degrades to add organic matter to the soil. Vole damage can be a problem with other fruit trees when using straw/hay mulch around the trunk; however, voles do not damage pawpaw trunks. This is likely due to the presence of acetogenin compounds in the bark. Flame cultivation can be used for weed control with pawpaw; especially around large trees. Flame cultivators, such as the Red Dragon Home & Garden Flamer, are commercially available; usually they consist of a torch like attachment connected to a LP gas tank. With flame cultivation, the flame is passed over the weeds just long enough to rupture the cells of the plant and kill the weeds. Be careful not to linger too long over weeds with the flame and start the weeds on fire! Additionally, do not direct the flame at the foliage or the tree trunk; the bark can be damaged and foliage killed. Flame cultivation is not a good method with straw or hay mulch or during periods of low rainfall because of increased fire danger.

Crop Rotation. NOP standards require that a grower implement a crop rotation in the orchard including but not limited to sod, cover crops, green manure crops, and catch crops that provide the following functions that are applicable to the operation: maintain or improve soil organic matter content; provide for pest management in annual and perennial crops; manage deficient or excess plant nutrients; and provide erosion control. With fruit trees, rotation of alley cropping, intercropping, and hedgerows are used to introduce biological diversity in lieu of crop rotation. Often permanent sod is used in the alleyways for the life of the tree and areas surrounding the orchard are rotated in a manner that increases biological diversity in the orchard. Crop rotation can be utilized in the alleyways with legume cover crops to increase the



Round hay bale mulch pawpaw trees.

nitrogen available to trees. Unfortunately, there is not any scientifically derived information concerning the best cover crops (e.g. vetch, fava beans or lupins, etc.) to grow with pawpaw and not over compete with the trees. Cover crop recommendations may also vary by location in the U.S. There is additional information available at <http://www.sarep.ucdavis.edu/ccrop/CCPubs/SelectingCoverCrop.html> that may help guide growers in cover crops to try with pawpaw.

Nutrient management and irrigation. In organic production of pawpaw, nitrogen must be applied to trees for excellent growth (16 to 24 inches of shoot extension per year in establishing trees and about 6 inches in mature trees) and optimal fruit production. Organic feather, meat, bone and blood meal (such as 10-2-8 from NatureSafe®) fertilizer can be broadcast under pawpaw trees before budbreak in early spring at 1 oz. N/tree the first year after planting, 3-4 oz. N/tree (about 50 lbs/A at 295 trees per acre) in years 2-5, and 5-6 oz. N/tree in year 6 and beyond. Compost is difficult to incorporate if woodchip or straw mulch is used around trees for weed control. Compost containing

animal manure must meet specific temperature standards during production (see the NOP standards). Use of legume cover crops in alleyways can help provide additional nitrogen to trees. Growers should conduct a foliar analysis in July to monitor your fertilization program. Irrigation during establishment improves tree survival rates and in mature trees it will improve fruit size. Irrigation requirements will vary by soil type and soil depth. A soil depth of at least 3 feet will help provide a water reservoir for the tree.

Pest and disease control. Pawpaw pest problems are limited and usually do not require control measures. Pawpaw leaves can exhibit leaf spot, principally a complex of *Mycocentrospora asiminae*, *Rhopalocnidium asiminae*, and *Phyllosticta asiminae*. Especially during wet years, fungal spot (*Phyllosticta* species) on leaves and the surface of fruit can lead to problems; infested fruit can split during development. The pawpaw peduncle borer (*Talponia plummeriana* Busck) is a small moth larva, about 5 mm long, that burrows into the fleshy tissues of the flower causing the flower to wither and drop. Usually, the great abundance of unaffected flowers on trees does not require control of this insect. The zebra swallowtail butterfly (*Eurytides marcellus*), whose larvae feed exclusively on young pawpaw foliage, will damage leaves, but this damage has been negligible. The larvae of the leafroller (*Choristoneura parallela* Robinson) may damage flowers and leaves but



Fungal spot (*Phyllosticta*) on fruit leading to cracking.

damage is negligible. Japanese beetles (*Popillia japonica* Newman) can damage young leaves on pawpaw trees, but once again, the damage is usually not severe. The Asian ambrosia beetle can attack pawpaw trees. The beetle bores into the tree trunk and limbs and carries with it a *Fusarium* fungus that clogs the vascular system of the tree. Large wood piles should not be stored near pawpaw orchards that can serve as a breeding ground for beetles.

For additional information check out these articles:

1. The Kentucky State University Pawpaw Information Website: (<http://www.pawpaw.kysu.edu>).
2. The University of Kentucky Extension Service: Organic Certification Process (<http://www.uky.edu/Ag/NewCrops/introshhets/organiccert.pdf>).
3. ATTRA Tree Fruits: Organic Production Overview (<http://attra.ncat.org/attra-pub/fruitover.html>).
4. Selecting the Right Cover Crop (<http://www.sarep.ucdavis.edu/ccrop/CCPubs/SelectingCoverCrop.html>).
5. Washington State University Tree Fruit Research and Extension Center Organic & Integrated Fruit Production Home Page (<http://organic.tfrec.wsu.edu/OrganicIFP/Home/Index.html>).
6. Disease Management Guidelines for Organic Apple Production in Ohio (<http://www.caf.wvu.edu/Kearneysville/organic-apple.html>).
7. National Organic Program Standards (<http://www.ams.usda.gov/NOP/NOP/standards/FullRegTextOnly.html>).
8. Organic Materials Review Institute or OMRI (<http://www.omri.org>).

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