Introduction

In the shady hollows and backwoods stream banks, in parks and wooded edges of farmland across much of eastern America, a graceful, humble little tree quietly grows that happens to produce the largest edible fruit in North America. This fruit is traditionally known as pawpaw, or, in botanical language, *Asimina triloba*. It's a hot topic right now among many diverse circles: horticulture, botany, gourmet chefs, market farmers, brewers, even medical researchers looking into the potential uses of the tree in cancer treatment. Interest in cultivating North American pawpaw is increasing rapidly in many temperate countries around the world, including Japan, South Korea, France, Germany, Ukraine, Austria, Australia, Germany, and Italy. Why is that? The answer is multifaceted: pawpaw trees are extremely cold-hardy and adaptable to a range of temperate growing conditions, perform well without the addition of chemical sprays, and produce a fruit that is exotic enough that you'd think it came out of the Amazon. The fruit also happens to be very delicious, nutritious, large size (up to one pound or more each), and produced in abundance when the trees are well grown. Farmers, processed food manufacturers, nurserymen, and chefs are always looking for an exciting, lucrative, and trendy new product, and pawpaw fits the bill quite well. So far, its elusive presence and short season have created a lot of mystique (but that may be set to change soon).

Even though currently you will not find pawpaws in nearly any standard US grocery store, they are becoming more commonly seen in many late-summer farmer's markets and health food stores; there

is even demand for mail-order fresh pawpaw fruit. Still, the question remains, why are pawpaws not found in stores and why are they so extremely rare? The answer basically boils down to lack of information, growers, and education; there's not a lot of resources and in-depth information for farmers and marketers to study to see if pawpaws might be a good product for them to grow and sell. The pawpaw industry in general is also brand-new, and so far, nursery production of high-quality trees has also been extremely limited.

Although demand for the fruit and the trees is rapidly increasing, as of this writing there has not been a *single book* written that describes the use, marketing, and cultivation of pawpaws in *full detail* aimed to assist commercial and market growers. Mostly the only resources have thus far been a small number of university publications, brief online articles, glossy hypes in magazines, and (usually very brief) mentions of pawpaws in various fruit-growing books. The focus of most of the current information has been on describing the fruit itself and explaining how to grow a few backyard pawpaw trees. Any information geared toward farmers has been relatively short and not comprehensive. In the past, and sometimes still, pawpaws were considered so minor as barely worth mentioning as a mere novelty species with a few named varieties out there in the nursery trade somewhere. A short book about cultivating pawpaws was published years ago in Canada, but the book was not widely printed, not applicable in much of the US, and is very difficult to acquire. This book sets out to change that situation and to provide a comprehensive, detailed, yet easy and fun-to-read book for the market farmer, rare-fruit grower, backyard grower, and potential pawpaw farmer alike.

I met my first pawpaw around 2003 at church camp in rural central Indiana. One afternoon while walking along the edge of the woods near the pond, I came across a curious small tree upon which hung an odd, lumpy green fruit cluster. Intrigued, I asked one of the camp counselors if she knew what this was. The counselor, being a rural Hoosier herself, knew right away, and told me (the suburbanite teenager) that these were called "pawpaws," and they were in fact edible

and even tasty. My question was answered, but my curiosity was thus piqued. That following autumn, I got a few close friends together, and bent on getting some pawpaw fruit, we were soon rummaging through the bushes and trees of our local Cherokee Park in Louisville, Kentucky, trying our darnedest to locate even one ripe fruit. Pawpaws actually grow abundantly in this park, so we were finding fruit, but it was still rock hard and underripe. At the tail end of our several hours' long journey through the backwoods of the park, a little discouraged and about ready to give up, I found a tree with a few golf ball-sized fruits dangling from the branches. You can imagine my excitement when, upon squeezing them, I discovered they were soft and ripe for the picking! We all feasted on them right there on the spot. They were sweet, soft, and delicious, with big, hard, shiny black seeds. After that experience, I was sold: pawpaws were really cool!

Now, many years later, pawpaws are a hot topic, in part due to their "exotic yet local" mystique, luscious tropical flavor profile, raving

'KSU Benson' pawpaw fruit cut in half.

reviews, and fleeting annual appearance and disappearance. People want pawpaws. Growers want to grow pawpaws. Marketers want to market pawpaws. Chefs want to cook with pawpaws. Brewers want to brew with pawpaws. However, there is scant fruit supply and historically very little information to help make this happen. This book contains the in-depth information that eco-conscious and organic growers need. I believe organic agriculture is the future of most agriculture, and pawpaws being so easy to grow organically, why not do it this way anyway?

Indeed, there's something oddly curious and mysterious about the North American pawpaw, including a strange effect they seem to have on certain individuals. Some develop such an intense liking for pawpaws that they become obsessively engrossed in the growing, propagating, and eating of the fruit. Others are off-put by them and want nothing to do with them in any form. Pawpaws seem to create both diehard fans and dissenters. We'll explore why this is, and how to facilitate more positive pawpaw experiences, especially for marketing purposes. If you're reading this book, you want to know how to grow great pawpaws and possibly how to market them. Therefore, the main purpose of this book is to encourage and empower people who wish to grow pawpaw trees and educate them to do so effectively, including marketing fruit profitably if that is their goal.

This book emphasizes choosing excellent cultivars, proper siting of an orchard, effective planting, seasonal tree maintenance, and harvesting. Pollination, fertilization, insect, pest and disease control, as well as some basic nursery propagation practices are all covered in detail.

What Is a Pawpaw?

If you are reading this book, you probably already know exactly what a pawpaw is. But, in case you do not or seek to learn more, the pawpaw is a tree species categorized in botany by the Latin name *Asimina triloba*, pronounced "Ah-sim-ih-nuh try-lobe-uh." We'll start with the pawpaw's current status and briefly go back in time to review its colorful past.

Healthy pawpaw foliage in early summer.

Pawpaws, until recently an overlooked small tree quietly growing in the wilds of the understory forest, are currently being bred and developed to be more appropriate and marketable for commercial fruit growing. This breeding and improvement is being conducted privately, as well as by at least one university (Kentucky State University), with the goals of producing bigger, better-tasting fruits with fewer seeds on highly productive trees that resist disease. There are also other goals, such as breeding fruits low in acetogenins, a compound found in *Asimina triloba* that is very bioactive and not currently well understood (more on that later). Wild pawpaw fruits tend to be small, weighing only a few ounces, nearly half being large seeds, making the fruit not very marketable. Currently, pawpaw fruit is showing up more often in farmer's markets, trendy local food stores, gourmet restaurant menus, micro-brewed beers, wines, jams, and specialty ice cream. They are generally considered a hot item when available in their brief peak season, mostly within the areas where they are grown and recognized. By the way, pawpaw ice cream is *heavenly*.

Pawpaws have a rich but quiet history among rural Americans, being enjoyed by many a backwoods child as well as the millions of deer hunters (who of course spend a lot of time in the woods in September and October, and know a good deer bait tree). In the early 1900s, they were sold in many local produce markets, but gradually slipped into near obscurity, pushed out of the picture by more marketable and useful fruits with better storage capabilities, such as apples. Eventually pawpaws became something that practically only rural dwellers appreciated, and usually quietly. Before that, pawpaws were

enjoyed for millennia by eastern Native Americans, and later early American colonists, explorers, and settlers.

The journal of Lewis and Clark tells us that the expedition was saved from starvation and death by Sacajawea and possibly other Native Americans who taught the explorers how to utilize the high-protein and high-sugar pawpaw fruits dropping along the wilderness trail.[1] The Native Americans knew the pawpaw quite well because they had eaten and appreciated them for millennia. The Native Americans were the first to cultivate the fruit in plots, likely finding good trees worthy of growing and planting the seeds, but also perhaps transplanting the young trees. Once I heard that archaeologists sometimes locate ancient Native American village sites by finding an abundance of pawpaw trees all within one isolated area, because they not only grew the fruit but also used the large shiny black seeds for game pieces, and some of these no doubt sprouted and took root. Thus the village became inundated with pawpaw trees, forming a nice symbiotic relationship with their human friends and benefactors.

The tropical-looking tree (and fruit) itself almost seems out of place in the temperate zones where it is native. Some people theorize that the pawpaw migrated gradually north from Central America, either on its own via the guts of animals such as deer, and even mastodons and giant ground sloths (how cool does that sound?), or by the work of Native peoples, who gradually planted it further and further north, and thus slowly pushed its cultivation (and adaption to the cold) northward. Theoretically, the hardiest specimens that survived the colder winters as it moved north had genetics that adapted to colder and colder conditions and passed that along to their offspring.[2] This theory has not been proven; however, we do know close relatives of *Asimina* in the *Annonaceae* family do indeed thrive in tropical Florida, Mexico, and Central America, namely, *cherimoya*, *guanabana*, custard apples, etc. Other related edible and nonedible species of *Annonaceae* grow in many other tropical regions from Jamaica to Africa, India to Malaysia. What we do know is that pawpaws have been present in North America for millions of years, based on fossil records

and their presence in pre-Columbus Native American culture. That is the history of pawpaws in a nutshell.

It is my personal theory that the primordial native forests of the US used to be much more biodiverse, awe-inspiring habitats with billions more bird denizens, such as the (now extinct) carrier pigeon, which no doubt heavily fertilized the forests via droppings and created massive food sources for vast hordes of insects, including carrion beetles and flies, which happen to also pollinate pawpaw. The carrier pigeon's habitat was huge thickets of river cane, a native plant of riparian areas which also typically is found near wild pawpaw groves. Thus, in primordial times, pawpaw patches, undisturbed and likely hundreds of years old, no doubt spanned acres of ground, slowly and gradually creeping along via underground suckers, which emerged to become new tree stems. Those same bird droppings mentioned earlier would have provided vast fertility as well as pollinator food sources, thus creating high-production and high-quality fruit stands. Whatever the case, we know that the pawpaw is currently experiencing a resurgence in its numbers due to human cultivation as well as its rebounding in the forest ecosystems of the eastern US. Thankfully, for pawpaw lovers, the US government no longer considers pawpaws a pest species and no longer encourages land owners to destroy any and all pawpaw trees, as they did in the past. Some foresters and biologists even wonder if pawpaw is not becoming somewhat invasive, or at least overly aggressive in its growth and domination of some forest under-stories.[3] This is in large part to the overpopulation of white tail deer that avoid browsing on pawpaw foliage but eat many other tree seedlings, thus giving pawpaws an advantage. Whatever the case, thankfully, pawpaw is here to stay and might be on the upswing.

Botany of Pawpaw

The pawpaw's native range is a massively large one, encompassing portions of 26 states, including most of the eastern and some of central areas of the US. Its range extends from Southern Ontario and Michigan into Indiana, Ohio, New York, Pennsylvania, and even the

southern tips of near-coastal Connecticut. The whole mid-Atlantic area is pawpaw country. The entire South down to northern Florida has pawpaws (except any sub-tropical areas; remember, pawpaw is a temperate species). They also eagerly established westward to most or all of Missouri, forested areas of Kansas, and even grow wild further west, including parts of Iowa, Oklahoma, Arkansas, and the Texas Panhandle. Humans have no doubt extended the pawpaw range even further into other Midwestern areas and more recently onto the West Coast.

To make botanical matters clear, we need to distinguish between the species *Carica papaya* (also called pawpaw) and North American pawpaws, *Asimina triloba*. In many tropical countries of the former British Empire, the papaya is often affectionately called "pawpaw," and sometimes other tropical fruits are also called "pawpaw." This causes confusion when people lacking knowledge about *Asimina triloba* make erroneous statements that North American pawpaw is related to papaya, mangoes, or even bananas! This is definitely not true in the botanical sense at all. Pawpaws are in the family *Annonacae*. Papayas are in the family *Caricaceae* and bananas in the family *Musaceae*. These are not considered even closely related to *Asimina triloba* and are completely different plant families and species.

Asimina triloba is what is now known as the pawpaw tree in modern popular culture. Still, be careful when researching "pawpaw" to make sure you're actually looking into *Asimina triloba* and not papaya or some other fruit. People in some rural places apparently still refer to them as "woods banana," or the "Indiana/Michigan/Kentucky/insert-state-name-here banana," and other obscure names have been printed, such as "false banana" or "banango," but I have really only ever heard them referred to as pawpaws, which is probably best. Who wants a "false banana" anyway?

Pawpaw Myths

There are some really hilarious and sometimes off-putting folklore and myths about pawpaws still in circulation, mostly simply handed down by people who have very little or no personal experience with

pawpaws. Some of these myths are so off-putting as to damage the image and desirability of pawpaw, and deserve to be immediately discarded so people stop repeating them. Here are the most common erroneous beliefs.

Belief #1: Pawpaws are a tropical fruit related to papaya (*Carica papaya*), bananas, or mango.
Fact: Pawpaws are not tropical plants, they are a fully temperate species and are not related to any of these species, botanically speaking (although the same common name is applied to both). As mentioned already, pawpaw is in the family *Annonaceae* and is therefore related to the "custard apples," such as sugar apple (sitapol), cherimoya, and soursop (guanabana). It is distantly related to the magnolias and is in the order *Magnoliaceae*. Interestingly it resembles Southern magnolias in leaf shape, flower construction, and dormant leaf buds, if observed closely.

Credit: publicdomainpictures.net

Also referred to as "pawpaw," causing some confusion, tropical papaya is completely different from *Asimina triloba*.

Belief #2: Pawpaws grow best in the forest (or in deep shade).
Fact: Wild pawpaws are usually found as understory plants growing seemingly unaffected by dense shade. However, they perform much better and produce drastically higher fruit yields when grown in full-sun conditions. They can grow and survive in either dense shade or full sun. Dense shade reduces fruit yields dramatically. Pawpaws often need sun protection the first couple of seasons, which may have led to this myth. This is all explained in great detail in later sections on cultivating pawpaw.

Belief #3: Pawpaws are only good to eat when they've been exposed to frost in autumn and/or have turned black.
Fact: The vast majority of pawpaws, both wild and cultivars, ripen weeks or even months before the first frost occurs in their native

growing range. By the time autumn frosts typically occur within their range in October/November, depending on location, most pawpaw trees are losing leaves, going dormant, and the fruits are completely gone for the season, having mostly ripened in September. In the far northern limits of their range, the fruit may ripen around the time of the first frost, but this is not common in the vast majority of their native range. Frost does not assist ripening or enhance fruit quality in any way and will actually damage the tender fruit. Pawpaws that have turned black are often still good to eat but at this stage are often considered past the prime for most people's taste preferences. How many people prefer black bananas? Frost and/or cold temperatures are also not a ripening factor whatsoever. Frost will likely damage or destroy pawpaw fruit that is still hanging in the trees, and such an event only *ever* occurs on those that have late-season ripening fruit and only in the far northern (and not optimal) range of pawpaw growing territory. People that repeat this belief are probably confusing pawpaw with persimmon (*Diospyros virginiana*), another native fruit worthy of improvement and marketing, and humorously, the frost-ripening effect is not true for them either. Persimmons can and do often fully ripen weeks before the first frost, and frost does not remove astringency in the fruit or assist ripening whatsoever. They do tend to ripen around frost time, though, explaining the misconception.

Belief #4**:** Pawpaw trees are immune to or unaffected by pests and diseases.
Fact: If only that were true! This misconception (sometimes lie) is mostly an oft-repeated marketing ploy that is used to sell more pawpaw trees to new uneducated growers. While *certainly* much less burdened by the plethora of diseases and insect pests that plague our apples and peaches, pawpaws are by no means immune to diseases and insect pests, and in their native range are actually susceptible to quite a number of damaging organisms. When trees are maintained and well grown on favorable sites, they are often remarkably unbothered. However, they do have their share of "plant karma" and issues to contend with, which tend to become increasingly intense and con-

centrated in monoculture plantings, as well other stressful environments pawpaws are not adapted to, or on poor soil, and generally unfavorable cultural or site conditions. This will be covered in much detail in chapter 9. That being said, most urban backyard growers will rarely experience much noticeable disease or insect pressure, and pawpaws are definitely one of the easiest fruit trees to successfully grow organically. This makes them very attractive to the niche market farmer, organic grower, or anyone looking to diversify into unusual or specialty crops. However, remember that all species of life are susceptible to diseases, insects, and parasites. Also important to note is it seems in my experience that pawpaw trees grown in rural areas in their native range are likely *much more* plagued with insects and diseases than those grown in the urban jungle, where pawpaws are in tiny isolated plantings, tucked away from their native (and other) pests.

Credit: commons.wikipedia.org

Lovely spring pawpaw flowers just shy of being in full bloom.

Belief #5: Pawpaw flowers smell like rotting flesh (or otherwise disgusting/bad/off-putting) and will stink up your entire yard.
Fact: *No, they certainly do not!* The flowers have a *very faint* unusual smell, somewhat yeasty and musky. Although pollinated by flies, the trees do not exude a horrible smell, or hardly any scent at all. The only way to even smell any aroma is to stick your nose directly up to the flower, so they will absolutely not stink up your yard, but exude an almost unnoticeable yeasty fragrance for a short time. This one has been repeated occasionally by our nursery customers and online in a very negative connotation. This one myth really has to go, and fast![4]

With the falsities now behind us, let us begin with fundamentally where pawpaws are to be found in the wild: in the deep forests and parks of eastern North America!

1

Foraging for Wild Pawpaws

We'll start off this pawpaw journey the same way I began my relationship with this most curious, elusive, and desirable of trees…searching for them in the wild. That search has not been a disappointment in any way. It has been extremely enjoyable and complex, owing to the species' very diverse and colorful past and promising future as an important multi-purpose temperate fruit tree.

Why would one want to forage for wild pawpaws? There are a number of reasons. First, it's often fun and educational, and you can see how these trees grow naturally. Second, many wild trees produce good-quality fruit that can be harvested. Third, there is much genetic potential in the wild pawpaws within their native range, and trees worthy of propagation and introduction definitely exist out there. They can also provide seed for growing trees or rootstock.

It's worth noting the eight other species of *Asimina* that grow in eastern North America. These similar but much less desirable (for fruit production) cousins of *Asimina triloba* typically do not produce desirable or even edible fruit, yet they may have characteristics to contribute to breeding experiments and are worthy of protection. Others are possible future native landscaping trees and are quite beautiful. For instance, *Asimina pygmaea*, found in South Georgia and Florida, is very dwarf[1] in stature (around 12 to 24 inches tall at maturity) but produces small fruit with little to no eating value. Breeding *Asimina pygmaea* with a large-fruited *Asimina triloba* cultivar could possibly produce a dwarf-sized tree that produces good large fruit. I came across *Asimina pygmaea* or possibly *Asimina parviflora* many years

ago in a forested area near Savannah, Georgia, and thought they were *Asimina triloba*. I could not figure out why they were so small (around 2 feet tall), until later when I learned they were a different species altogether. So, we have to first make sure we are searching in the correct areas and for the correct species. There are other native subspecies that produce bigger blooms and other characteristics, but none come close to the quality and size of the delicious edible fruit produced by *Asimina triloba*. Neal Peterson has successfully hybridized different *Asimina* species with novel results (larger flowers, etc.).[2]

Unknowingly, I grew up right in the heart of the pawpaw's native range. Kentucky is known by researchers to be a prime area for locating, researching, and growing premium-quality pawpaws. Most native forested environments in Kentucky contain sizable populations of wild pawpaws. The very best habitat to find them is in moist lowland, riparian zones: the river bottom areas and muddy shores and slopes of small rivers and streams. Often they are on the sunnier east, west, and southern slopes of hills, especially in *well-draining* areas above waterways. They can also be found growing thick among the sunnier stretches of cleared trails and roads in parklands. Edges where moist meadows meet the forest are also suitable habitats. Contrary to what some people think, pawpaws do not grow in mucky, poor-draining, swampy, or wetland areas! They must have good drainage and soil aeration. You'll never find pawpaws growing in a swamp, although possibly nearby, uphill a bit on better draining land, no doubt. They cannot handle continual wet feet, meaning, having the roots immersed in water like a cypress tree. Being a species of riparian zones, they are adapted to occasionally having their roots submerged for a few days or a week with no negative repercussions. See the color photos section for a nice shot of an older wild grove in Louisville, Kentucky, growing in a riparian zone that occasionally floods.

Nowadays pawpaw trees are becoming more common in native plant gardens, urban settings, edible landscaping, and some reforestation projects. Make sure to ask permission before foraging for pawpaw fruit growing on someone else's property! Although pawpaw trees are commonly and sometimes abundantly found in natural areas within

their native range, the tricky part is finding the elusive fruit. You will often find lush stands of trees but nothing more than green leaves and branches, with zero to very little fruit yield. Why is that?

To answer, pawpaw trees in the wild (and those left unchecked in your garden) do not grow into a single-trunk form akin to trees such as most pines, oaks, and maple. Their growth habit is more colonial and expansive, forming the proverbial pawpaw patch. First, pawpaw seeds inside fruit dropped in autumn overwinter in forest litter and then germinate in spring, quickly sending down a deep 12+" taproot that soon expands into a full root system. About 6 to 12 weeks later, the plant sprouts a single stem that eventually becomes a single trunk and a year later forms branches, etc., much like any tree. However, like wild plum trees (*Prunus americana*), pawpaw roots soon sprout forth many shoots, called suckers, from their horizontally growing roots, on trees between about 5 to 7 years old. These emerge from underground to eventually form a clonal stand of genetically identical tree-like suckers, all joined underground by a single root system. All of these suckers can grow to tree size (15 to 20 feet tall, 6 to 12 inches in diameter). Thus, the pawpaw tree becomes a thicket of its own that appears to be many trees closely spaced together (3 to 6 feet apart usually) but is actually only one—an original "mother tree" surrounded by a thicket of tree-size sucker "trees" of various ages and sizes. A pawpaw thicket of one specimen can sometimes span a large area, with suckers forming 10 to 20 feet or more away from the original mother tree, with dozens of tree-like shoots, creating the impression of a stand of many trees growing together. However, being that pawpaw trees are rarely self-fertile, meaning that without the nearby presence of another genetically different specimen in flower at the same time, there will be almost no cross-pollination, and thus zero to scarce fruit set. Add that to the fact that shaded trees produce few flowers each spring, that also happen to utilize an unusual pollination strategy, and you will often find yourself disappointed with the lack of fruit to be harvested from even large pawpaw stands found in the wild. Adding further uncertainty to the situation, the fruit quality in the wild varies greatly from amazing to "spitters" (fruit so bad, you

just gotta spit 'em out!). In my foraging trips, I have found about 25% of the wild fruit in Kentucky to be of decent good-eating quality, 50% to be marginally edible, and the other 25% to be spitters.

You can also identify pawpaws by the bark which is very smooth, silver-gray and may often be spotted with holes left by sapsuckers. The twigs and leaves when crushed release an acrid odor I liken to the sulfurous smell of common Fourth of July fireworks.

When you do find good wild pawpaw fruit it is often *really* good and worth the effort. Foragers that take to the waterways via canoe in rich pawpaw territory tend to come back loaded with buckets of fruit and the least tired. Just keep in mind that pawpaws are only in season for about 4 to 6 weeks, from late August to late September within their main range and September to October in the northern fringe (Michigan, New York, Pennsylvania, Northern Ohio, etc.). Old-timers in Kentucky say that they used to follow the fluttering zebra swallowtail butterflies all the way to the wild pawpaw patches. Whether they are speaking poetically or factually, this might actually be useful, as will be explained later.

Wild pawpaws are easiest to identify when blooming around mid-late April. With no leaves on the trees, the purple-black bell-shaped blooms, an inch or two across, are very conspicuous against the somewhat sparse vegetation around them. Insects will also often be abuzz around the trees. No, you will not smell anything objectionable!

When you do find a good pawpaw patch, rejoice in the abundance and goodness of the pawpaw. Tread lightly, leave no trace, and do not damage the trees or attempt to climb their weak, brittle branches, as this can severely damage the trees. Shaking the branches violently will dislodge many underripe fruit that will never ripen properly. Just check underneath the trees for fruit or give them the slightest gentle shake to dislodge them. Consider helping the patch by planting some genetically different pawpaws nearby, planting pawpaw seeds, maybe cutting down a few invasive trees nearby, or removing some litter. Excellent wild specimens can be propagated via sucker removal or grafting, as will be explained in the propagation section of this book.

2

Description of North American Pawpaw Fruit

By now you know the botany and how to identify wild pawpaws. Worth mentioning is that the North American Pawpaw Growers Association has decided to start using the term "North American pawpaw" when describing *Asimina triloba*. This may be appropriate sometimes because, as explained earlier, in many tropical regions the unrelated papaya (*Carica papaya*) is also called "pawpaw," resulting in a fair amount of confusion. However, for simplicity's sake, we will assume by now you know this book is about *Asimina triloba* and not something else, and the term "pawpaw" is what we will call the fruits and trees of the species.

It can be challenging to describe what a pawpaw fruit tastes like unless you are a gourmet cook or unusual fruit enthusiast. It's fair to say "a pawpaw tastes like a pawpaw." That's true. After all, how would one effectively convey the unique flavor of a banana, watermelon, or peach? Like these, pawpaw is unique in and of itself. Most people tend to say they taste like banana, and that is a fair enough ballpark description, but we can get more much in-depth and descriptive. The fact is, many pawpaws don't taste at all of banana. Pawpaw has many possible flavor combinations, and the nuances are rich and plentiful. However, unlike most fruits, the flavor changes dramatically at the stage of soft ripe to the still edible but quite different overripe stage, with black or brown skin color.

Common positive flavor descriptions of various cultivars include: banana, mango, strawberry, vanilla, persimmon, chocolate, cocoa butter, pumpkin, anise, coconut, Mexican flan, pineapple, citrus/orange, cantaloupe, cherimoya, caramel, honey, marshmallow, nutty…that's quite a large range of variation! Few (if any!) fruit species in existence would generate such a varied and rich list of possible delicious flavors. In fact, that's downright impressive. It's possible that only Durian fruit (*Durio zibethinus*) would have such a long and varied comparable potential flavor list.

Common positive texture descriptions include: custard, marshmallow, creamy, thick, avocado-like, chewy, buttery, smooth, juicy, refreshing, moist, melting, pudding-like, soft, and silky.

Common negative flavor descriptions include: bitter skin or seeds, bland, nasty, cloyingly sweet, off-flavor, bad aftertaste, acrid, sulfurous, or just "too weird!"

The plump, ripe fruits of 'Nyomi's Delicious', a superior pawpaw from Berea, KY.

Common negative texture descriptions include: watery, slimy, pasty, goopy, gelatinous, loose, hard, rubbery, gritty, unpleasant, and gross.

In my evaluations of pawpaw cultivars compiled at the end of this book, negative textures and off-flavors of different cultivars are listed and taken seriously as strong deterrents to growers looking to grow quality pawpaws. See chapter 11, Pawpaw Cultivars for many in-depth descriptions of all known pawpaw cultivars.

A challenge with marketing pawpaw in the US is that most 21st century Americans tend to prefer crunchy or firm fruit, even now preferring crunchy peaches.[1] Mostly this preference has been dictated by decades of conditioning by commercial growers, supermarkets, and universities that have bred and marketed commercial fruit cultivars that are so hard and firm you can pick them mostly ripe off the tree, ship them 2,000 miles, hold them in storage for months, and still sell them rock-hard and unbruised, and possibly even play tennis with them. Gone are the dripping sweet with ambrosial nectar fruits of old (at least not on supermarket shelves). American tastes are accustomed to temperate fruits that tend to either be crunchy, juicy, or somewhat soft (think banana) but not *custardy*. Pawpaw is a custardy fruit, meaning the texture leans toward a soft pudding-like consistency (think whipped ripe avocado). Custardy fruits are almost entirely of the tropical sort, and rarely, if ever, found in American markets. So, when introducing people new to North American pawpaw, you should prepare them for a gustatory experience very different from apple. This has been one of the challenges of introducing pawpaws to the American customer: their exotic custardy texture seems too odd and for some, off-putting. Those texture people can be hard to please! However, I think framing pawpaw texture as similar to creamy avocado yet sweet like tropical fruit could appeal to many and prepare people for a positive introduction.

To be clear, we must understand that many, if not most, pawpaw fruits are very mediocre eating, just like some mangos or apples are mediocre eating. To have outstanding pawpaw fruit, you must have access to high-quality, genetically superior trees. Fruits also need to

be very ripe, always. That being said, pawpaws that are excellent far exceed any expectations of temperate-zone fruit and can take the adventurous person to taste-bud ecstasy. Many people love them immediately from the first few bites. Many first-timers say they taste exactly like a prepared desert, such as flan or chiffon. That may be a good way to introduce or describe them to people.

Typically, two main types of pawpaws have been described in literature based on pulp color, but I am proposing there are three main varieties: yellow, orange, and white. Although there are no hard and fast rules, the orange-fleshed tend toward being stronger flavored, often with a heavier banana/honey/persimmon/pumpkin flavor profile. Yellow-fleshed, being the most common, tend toward a lighter banana/cocoa butter/Mexican flan/nutty/marshmallow/caramel, very sweet flavor, sometimes with a very pleasing tropical fruit, light citrus, pineapple, cantaloupe, or strawberry aroma. White-fleshed varieties are rare and tend to be more on the mild flavor side, with vanilla/lightly banana/cantaloupe/coconut/tropical fruit (pineapple/mango/cherimoya) and with a high sugar content. All three types can be excellent, with the yellow- and white-fleshed types likely appealing to more people. All three types are described in chapter 11, Pawpaw Cultivars. Some of the very best pawpaws I've had have been white-fleshed. Individual cultivars differ, and there are good and poor examples of all three varieties. Color can be an attractive feature in different recipes and for different purposes. For instance, white pawpaws would not turn a product yellow, whereas orange or yellow pawpaws would impart a distinct orange or yellow color.

The best pawpaws tend to have a creamy, thick, dense texture that is not especially juicy, goopy, loose, or at all watery. An excellent pawpaw, cut open and on a plate, should hold together and should not start oozing or melting out on the plate or in your hand. You can't drink excellent pawpaws; you spoon them up or lightly chew them. Some people may like goopy fruit, but it's almost guaranteed most customers would find that totally off-putting. Excellent pawpaw texture is similar to firm Greek yogurt or ripe avocado, very soft, yet thick

and pleasingly creamy, with a very sweet flavor and fragrant aroma. Poor-quality fruits tend toward a loose texture like watery cottage cheese or juicy banana mush, or they simply remain overly firm and hard like an underripe avocado without ever getting pleasingly soft and edible. Excellent pawpaws have agreeable "exotic" fruity, caramel, or nutty flavor(s) and fruity or perfumed aroma, with little to no bitterness or unpleasant aftertastes. The best pawpaws also tend to have a very low seed-to-pulp ratio of less than 10% seed weight to edible pulp weight. Some modern high-quality cultivars are even as low as 3 to 6% seed/pulp weight, which is impressive. Wild pawpaws can be very high in seed weight, sometimes exceeding 50 to 75% in seed-to-pulp ratio, and this is of course not very pleasant to eat and not profitable to cultivate.

The very best ones I've eaten nearly all weighed close to one pound each, were exceedingly sweet, thick, and creamy, and contained very low seed weight. Most pawpaws contain large seeds about the size of fava beans (around 2 to 3 inches long) that are black/brown, shiny, hard, and inedible. The better-quality pawpaws tend to have smaller seeds, some as small as black beans (about 1 inch long). There are some cultivars, such as 'Sunflower', that are still considered very high quality but do contain large seeds, but despite that they have excellent texture and flavor with plenty of pulp. Some pawpaw fruits have seeds that are easily removed from the fruit; when fruits are halved lengthwise, the seeds can be removed before eating. This is a very nice feature that we'll call "freestone." Others have a tiny gelatinous sack (called an aril) firmly clinging around each seed that complicates easy removal and also limits pulp extraction when processing the fruit (yet still does not make

A superior cultivated pawpaw (*top*) compared to an inferior wild fruit (*bottom*). See the difference?

the fruit unpleasant to eat). We can call this "clingstone." Some growers say the age and ripeness of the fruit might factor into the removability of seeds and presence of the arils. Others claim refrigeration of the fruit makes the seeds easier to remove, but I have not found this to be the case. Cultivar differences are also at play. Some cultivars, like 'Susquehanna', are always freestone and never have arils. Both freestone and clingstone pawpaws could be considered good or excellent to eat. Some report that the aril may contain bitter flavors, depending on the cultivar, so it is probably best to avoid mixing them into the pulp when processing pawpaws, if you are able to.

Complaints About Some Cultivars

Of course, pawpaws *would* have some weird quirks to them, including the potential of strange aftertastes and even possible nausea from eating them. One common complaint with some cultivars (even some considered good cultivars) is a lingering bitter or slightly unpleasant aftertaste. I have not found a slight bitter aftertaste to be off-putting, but some people are more sensitive to this. Recently, most newer pawpaw cultivars considered to be excellent have been selected to be free of bitter aftertaste. However, if some pawpaw cultivars are said to have strange or poor aftertaste, they are best avoided in order to prevent customer rejection. 'Sunflower' cultivar pawpaws are sometimes accused of having a slightly bitter aftertaste, but otherwise are still considered very good-excellent.

Nausea from consuming pawpaws is a rare but real concern. A very small percentage of people simply cannot tolerate eating the fruit, and it might make them feel mildly sick or nauseous, even to the point of vomiting! Two different men have told me they love pawpaws but cannot eat them because they are allergic to pawpaw skin/rind. In my early foraging days, when I naively picked and ate firm, slightly underripe fruit, I experienced mild nausea afterward, as did the other person I was foraging with who also ate a lot of them. It's best to never eat, process, or offer someone underripe pawpaws! If selling the fruits in the firm–ripe stage, which is usually best because they are more

durable, let customers know they usually require ripening at room temperature, like an avocado or green banana, for a day or two until slightly soft and fragrant. Let people know they are not edible until soft. Some only like pawpaws when they are "dead ripe" to the point of being black-brown in skin color, similar to overly ripe bananas.

If a customer, family member, or friend eats pawpaws and experiences nausea, they likely won't eat (or buy) them ever again, so make sure they're good and ripe; if someone starts to feel queasy, don't give them more pawpaws! It's important to note here that some people cannot tolerate *cooked* pawpaw, even though they love fresh pawpaws. I am apparently one of those people. My wife used to make us pawpaw bread and even this thick, silky, luscious pawpaw custard pie, which we relished, until a few pies later, even the smell of it cooking started to make us both feel queasy. Scientists have not identified the cause behind that. Some people think mixing and eating pawpaw with grains (such as a wheat crust on a pie) can lead to nausea. So, unfortunately some people might experience this negative side effect as well. I think it's best not to mention it because any pawpaw side effects are rare, not dangerous (just unpleasant), and bringing it up might create a placebo effect in people who are anxious, food-neurotic, or skeptical about pawpaws and other exotic foods in general. If someone gets nauseous because of eating pawpaws, they'll realize it on their own.

Now, what about the pawpaw "buzz/euphoria"? My goal is to cover all aspects of pawpaws, even strange or controversial ones. Well, this is not mentioned much, but some folks do actually claim that consuming pawpaws can make one feel a little on the "very mildly intoxicated" side very temporarily. A local man and fellow pawpaw enjoyer, as well as my wife and I, have experienced this independently numerous times, and sometimes eating pawpaws makes me feel sleepy and/or extremely relaxed, which I find very pleasant. This very brief side effect seems to pose no danger or problem, and most people might find this very appealing, or not experience it at all. There is no scientific data on why this may occur. It's probably best not mentioned to customers as it may either scare them away or disappoint

them if it does not occur. Most people do not experience or do not notice any such mild side effects, either positive or negative. However, I wouldn't recommend a pawpaw feast on your first date with a special someone. These uncommon side effects are all just potential aspects of the pawpaw experience. For the vast majority of people eating pawpaws, they'll only experience eating a delicious fruit and have no surprise side effects whatsoever.

A warning: Never make, sell, or eat pawpaw fruit leather! Pawpaw fruit leather is a toxic product and causes temporary yet serious gastrointestinal distress. In case you do not know, fruit leather is a term for mashing fruit, spreading it very thin, and dehydrating it. This thin, translucent, leathery fruit product, similar to packaged fruit snacks for kids, is wonderful when made from berries but toxic when made from pawpaw. Neal Peterson says 5 or 6 people became nauseated from pawpaw fruit leather in his research. If consumed, it makes most people very nauseous and ill for approximately 24 hours.[2] Symptoms include nausea, vomiting, and diarrhea. Not fun! Don't do it. The reason is unknown but could be bacterial contamination, or oxidation of compounds such as fatty acids going rancid during the drying process.[3]

Acetogenins

Finally, what are acetogenins? In a nutshell, these are not very well understood, yet very bioactive, fatty-acid compounds found to varying degrees in pawpaw fruit, leaves, and twigs and in other species of *Annonaceae*. Some pawpaw cultivars are high in acetogenins, some low in them. KSU is currently breeding fruit to be low in acetogenins and also breeding for fruit high in acetogenins.[4] It's not totally clear if these compounds are beneficial or potentially harmful. There is evidence of anti-tumor and anti-cancer activity[5] yet also evidence of potential links of acetogenins to Parkinson's disease.[6] However, the likelihood of developing health problems by eating a few dozen pawpaws for a month every year seems very unlikely, as any tests done showing possible links to adverse health effects were done researching con-

sumption of a different species of acetogenin-containing *Annonacae* fruit (guanabana/soursop)[7] and is based on regular, ongoing daily consumption. I wouldn't worry much about it. Just make sure you're not eating pawpaws or pawpaw products every day, or gorging on huge amounts of them. That being said, it is my opinion that pawpaw breeders and researchers should be breeding and selecting fruit low in acetogenins in case more substantial evidence comes out that these are potentially harmful to health.

Physiological Characteristics of Pawpaw

Botanically speaking, the pawpaw itself is a hypogeal, dicotyledonous, shrub-like tree of the family *Annonacae* in the order *Magnoliaceae*. Its native habitat is the understory and stream/river banks of moist, humid, temperate deciduous hardwood forests of eastern North America. The tree is typically extremely cold hardy to –20°F, which collaborates with USDA Hardiness Zone 5. It produces the largest edible tree fruit in North America, and is technically a berry.[8] Pawpaw fruits can weigh over 1.5 pounds (24 ounces), but very rarely exceed or reach 2 pounds (32 ounces). More breeding work could create trees that regularly produce 2- to 3-pound fruits (yet this could prove to be overwhelmingly large for most US customers). Typical pawpaw fruits weigh from 3 to 12 ounces; those in the 7- to 10+-ounce range are considered suitable for marketing.

Pawpaw fruits are born in clusters, attached to a single peduncle,[9] composed of 1 to 8 individual fruits (rarely more), usually 2 to 6. When mature, these clusters resemble hands of bananas, all radially emerging in a spherical shape from the single peduncle attached to the branch. The peduncle is brown, short (around ½" to 1"), slightly fuzzy, and attaches firmly from the twig of the branch to a bulbous stem base that is attached to the top of each fruit. The amount of fruit per peduncle depends on the success of the flower pollination and genetics of the cultivar. Some cultivars tend toward producing single fruits per peduncle (and less effective pollination also can lead to one fruit per peduncle). One fruit per peduncle is now considered

A multi-clustered pawpaw here with 6 individual fruits on 1 peduncle. Delicious and impressive, yet not ideal for marketing due to the tear in the flesh to separate them, which will quickly start to ferment within 1 to 2 days.

a positive trait for marketing purposes, as each fruit does not need to be torn off separately at the peduncle (which prevents exposing the flesh to the open air where it can begin to rapidly rot). This will be elaborated on in the chapter on pawpaw harvesting.

Pawpaws are small trees, sometimes considered more a large shrub than a small tree. Maturing to around 20 feet tall and 18 to 20 feet wide in full sun, they are definitely a small tree when compared to oaks and maples. However, the ultimate height and shape of a pawpaw tree varies greatly depending on the amount of light the tree receives. When growing in the shady forest understory, where pawpaws are usually found, the tree takes on a reaching, stretched, and limber form, with large branch angles, larger leaves stretched out more parallel with the forest floor, reaching 30 to 40 feet tall after many years. In such a forested shady situation, pawpaw usually produces relatively few flowers and fruits, and the trees are of a much taller, open form. However, when cultivated in an open area in full sun or if a chance wild tree grows in a more sunny location, the tree takes on a much more densely branched, squat, pyramidal form with more acute and tightly aligned branches, shorter stature, and slightly smaller, darker leaves that droop protectively down to the ground, making for a very attractive specimen. When grown in full sun, the amount of flowers produced and the potential yields of fruit are much, much higher.

The exotic attractive flowers resemble velvety, crimson-purple orchids or banana flower petals. They are considered “perfect” flowers, meaning they contain both male pollen-producing anthers and female pollen-receiving pistils. They appear first as swollen, black fuzzy buds on the trees in autumn the size of a BB. The nonflowering leaf buds appear as tiny flat black-brown fuzzy crescent-shaped buds along the stems and twigs. In early spring, usually in mid-March or early April, the flower buds quickly enlarge, swell, and soon open up into mature flowers. The rubbery, blackish-purple bell-shaped flowers hang down, protecting the delicate pollen-studded anthers and awaiting sticky pistils from the frequent and very heavy spring rains, effectively shedding the rain and allowing pollination to continue un-

Credit: Cliff England

A top pollinator of pawpaw is the common fly. Attracted by the faint yeasty odor of the abundant flowers and the protein-rich pollen, the fly soon finds itself covered in pollen and moving it from tree to tree.

The attractive, smooth silver-grey bark of pawpaw is recognizable all year round. It never turns patchy or scaly with age. Native Americans utilized the tough, stringy inner bark to make very strong rope.

abated. The flowers are pollinated by a number of odd forest denizens and not by honeybees or bumble bees. Pollination will be covered in more detail later. Flies, fruit flies, carrion beetles, and other shady creatures attracted to the musky, lightly acrid scent of the flowers are solely responsible for moving about the pollen from ripe anthers on one flower to awaiting sticky stigmas on another. Pawpaw flowers are non-self-pollinating due to the fact that the anther's pollen is usually ripe only after the pistil is receptive. This is common in many plants and prevents self-pollination or, in other words, inbreeding. Humorously, some people deride the pawpaw pollinators as being "ineffective" at their job, even though they have obviously succeeded in very effectively pollinating *Asimina triloba* as long as the trees have existed, probably millions of years.