

Cornell Cooperative Extension

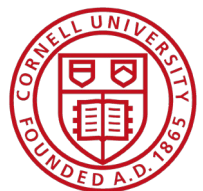
Pawpaws in New York

A Guide on How to Grow and Care for Pawpaws



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Contents

| | |
|---|----|
| Introduction | 2 |
| Site Selection for Pawpaws | 3 |
| How to Plant Pawpaw Seeds..... | 3 |
| How to Greet Pawpaw Sprouts..... | 4 |
| How to Transplant Pawpaw Sprouts | 5 |
| Caring for Grafted Pawpaws..... | 6 |
| How to Fertilize Pawpaws | 7 |
| How Do Pawpaws Make Fruit?..... | 7 |
| How to Eat and Store Ripe Pawpaw Fruit..... | 8 |
| How to Harvest and Store Underripe Pawpaw Fruit | 9 |
| Nutritional Value of Pawpaws | 9 |
| Other Observations About Pawpaw Trees | 9 |
| Genetics of Pawpaws in the Lansing Orchard..... | 10 |
| Named Varieties in the Orchard..... | 10 |
| Advanced Selections in the Orchard | 11 |
| References | 11 |
| Presentations | 11 |
| Books..... | 12 |
| Research Articles..... | 12 |
| Websites | 12 |

Introduction

The pawpaw (*Asimina triloba*) is a fruiting tree native to the eastern United States, growing from the Florida lowlands up to the Southern Tier in New York. It is believed that the pawpaw's range is as large as it is because Indigenous Peoples cultivated this tree. Pawpaws have great value as a food crop. They contain 7 of the 9 essential amino acids and are an excellent source of iron and manganese.

Pawpaws used to be a widespread food crop throughout eastern and midwestern states. They were eaten by many during the Great Depression (1929 - 1939). At this time pawpaws gained the nickname "poor man's banana". Pawpaws became less popular in the 1950's, as grocery stores became the place where most people purchased food. Produce buyers for grocery stores showed preference for crops that could withstand shipping over large distances. Marketing by large corporations, such as Chiquita Bananas, made other fruits more popular.

The pawpaw patch in Lansing has attracted much interest due to the large, flavorful fruits and strong trees that grow there. Pawpaw trees grow up to about 35 feet tall. Pawpaws need around 5 to 6 years to begin growing fruits and flowers. Their maroon-colored flowers open between March and May, and fruit become ripe from August through October.

Compared to pawpaws that grow in the wild in the Midwest, some of the fruits of the Lansing pawpaws can be 2 - 5 times larger.

This guide shares practical information on how to grow and care for pawpaws, based on conversations with growers and researchers in New York State and the information provided by the references cited.

Site Selection for Pawpaws

Planting a pawpaw is a long-term commitment. Transplanting a pawpaw is generally not recommended because they grow tap roots many times longer than the aboveground stem.

The authors studied a commercial pawpaw planting in Lansing, NY (Tompkins County) to understand how pawpaws can grow in a densely-planted area. The Lansing Orchard is planted approximately 1.5 miles away from Cayuga Lake, on a steep a steep (12-20%) slope. The Lake serves as a temperature buffer, absorbing heat on hot summer days and absorbing cold during winter. Pawpaws grow very well in mild, Midwestern climates, so having a large body of water close by seems to help them weather extremely hot and cold days.

In the wild pawpaws grow in floodplains and lowlands, in territories where soil drainage is good because there is a lot of rich organic matter. The soil type in the Lansing Orchard is a Hudson-Cayuga silt loam. This soil is relatively low in organic matter, but it drains well because of the extremely steep slope. The soil pH in Lansing is 6.0. Pawpaws can grow in soils that are slightly alkaline, but it is very important to plant the trees in a spot where water will not pool.

It may also be helpful to have a forest close to the pawpaw patch. We know that insects pollinate pawpaws, but pawpaw insect pollinators are not yet fully described. The forest is a home to many insects.

When you are selecting a site for pawpaws, choose an area where you have room for several medium-sized trees. Fruit set is improved when there are different varieties to exchange pollen.

Pawpaws adore growing near black walnuts! If you have a site that already has a healthy overstory of black walnut trees, you are in luck and can plant pawpaws mixed throughout. They appreciate the dappled shade and are completely compatible with the chemicals black walnuts create.

How to Plant Pawpaw Seeds

Planting seeds is one of the most straightforward ways to grow pawpaws. Pawpaw seeds are most likely to sprout if they undergo a cold period. Pawpaw seeds need moisture while they are stored: letting the seeds dry out can desiccate their jellylike center.



From left to right: Sprouting end of pawpaw seed, immature pawpaw seed with an orangey-tan shade; mature pawpaw seeds with a dark chocolate brown color; pawpaw seed cross section. The white center is jellylike. If a seed dries out, the jellylike substance pulls back from the edges and shrinks into the center of the seed before disappearing completely.

If you already have a location in mind for a pawpaw tree, you can plant a ripe fruit several inches below ground. Place the fruit horizontally into the earth to give the many seeds inside a good vantage point to grow from. To keep seeds for planting in the springtime, take the following steps:

- 1) Obtain a soft, ripe fruit. The best candidates are the ones that have fallen from the trees on their own.
- 2) Wash the seeds thoroughly and pull off any pieces of pulp.
- 3) Place the seeds in an airtight container with some sand or peat moss. Label the container with the date.
- 4) Place the container in a refrigerator for 60 - 100 days. Do not place into the freezer. Check seeds every 2 weeks to make sure they are moist.
 - a) Keeping seeds moist is critical for their survival.
 - b) If you place seeds in a damp paper towel, change the paper towel weekly to avoid mold growth. If mold gets into the seeds, they will be less likely to grow well in spring.

If you would like to plant a greater number of pawpaw trees, you can create a special pawpaw nursery bed. A bed like this is dug deep and filled with compost— this will make it easy to transplant seedlings that are 1 - 2 years old. A 4' x 8' bed can grow hundreds and hundreds of seedlings easily as they don't need much room when young (even 1" between seeds is more than enough).

Once you have created the bed, the easiest way to put seeds in is to mash up fallen, rotting pawpaws and spread the resulting mush in a layer across the bed. Do this in October, then cover the fruits with an inch or so of compost. Put several inches of wood chips or shredded leaves on top of the compost to trap in moisture and protect the fruits from curious wildlife that may be attracted to the smell.

How to Greet Pawpaw Sprouts

After the seeds have been buried, labeling the spot where they are planted will be quite useful. One trait that most domesticated crops have been bred to possess: uniform, timely germination. Pawpaws are not domesticated crops, and their sprouting behavior can come as a surprise.

Pawpaw seeds will come out of the ground anytime from July through late August. Some seeds will stay in the ground for years before emerging. Keep the bed weeded and watered all spring and early summer and be patient.

Young pawpaw sprouts are sensitive to sunlight and will suffer if placed in a bright, open area. The pawpaw patch in Lansing needed shading in the first year that it was planted. One way to provide shade to young pawpaws is to plant them underneath an old, large tree that the pawpaw is likely to outlive.

Another way is to use tomato cages covered in old bedsheets, so that the circle at the top lets in light but the sides are all shaded. On the second year most pawpaws will outgrow their tomato cages. At this point they will no longer need to be shaded from the sun.

After the first year of emergence, pawpaws continue to be unhurried and unpredictable in their emergence from dormancy. Young pawpaw saplings will stand barren long into May and June without any signs of sending out leaves. Continue watering these saplings and protecting them from the sun. Keep the ground around them weeded and mulched.

One way to check if a pawpaw seedling is alive is to gently bend the thin stems with your fingers. Dead wood is brittle, while living wood will be supple as it bends. Another way to check if the seedling is alive is to gently scrape back a little of the bark and look for green or white tissue.

However, scraping the bark away can make it easier for the pawpaw to get infected by bacteria and fungi.



Pawpaw sapling in first year of emergence. The sapling is less than a foot tall and is shaded on all sides by a white cloth draped over a tomato cage. Mulch is put all around the sapling to keep the soil moist and prevent weeds from growing.



Pawpaw sapling in second year of emergence. The sapling is branching and is close to outgrowing the tomato cage. This sapling is only shaded from the west to block the most intense sun but would likely be fine even without this shading.

How to Transplant Pawpaw Sprouts

The first months of emergence are a good time to transplant pawpaws, especially if they are growing in unamended, heavy soil. This is because their tap root will still be relatively small, and as it grows larger it can get pinched and torn if removed from the ground. It may be helpful to place some of the soil that the pawpaw was growing in back into the new planting hole. If the pawpaw was growing alongside beneficial soil fungi, this will ensure that the fungi will continue helping the pawpaw at the new planting site.

If you have grown pawpaw seedlings in a deep bed with soft, rich soil, then you can transplant them later in their life. Seedlings that are 1 - 2 years old can be dug up when dormant in winter. The ideal transplant window is later winter and early spring. Avoid fall planting with pawpaws. Keep the main taproot intact, and the seedlings will not need any other assistance when being transplanted. If the main taproot is broken, the likelihood of survival is reduced. A generous mulch applied around the plants help keep soil cool and moist and reduce competition. It is very worth adding.



Pawpaw seedlings in first months of emergence. The nodding head of the seed will rise above the ground before eventually being pushed by leaves that grow out from the embryo.

Caring for Grafted Pawpaws

Some nurseries offer grafted pawpaws for sale. Grafted pawpaws are a combination of two trees, with one tree growing branches for fruit, and one tree forming the base and the root system. Grafted pawpaws are most certain to produce a particular quality of fruit, while seed-grown pawpaws are each unique and will be unpredictable in the tree and fruit behavior.

Because pawpaws that grow in forests today tend to have very small fruits, purchasing a grafted pawpaw may be worthwhile if you are concerned that the seed parents will produce small fruit.

Some gardeners have said that grafted pawpaws they have bought tend to be feebler than seed-grown pawpaws and die more often. One explanation for this is that the area where the trees are grafted together can be a site for bacteria, fungi, and insects to attack. On occasion, upper tree does not survive but the bottom does, and eventually sends up new suckers and branches. Sometimes both trees do not make it. Be sure to check both trees for signs of life before pulling them out or deciding to no longer water them.

Chip budding is a grafting method that works well for pawpaws according to a study by Corwin Davis. Davis researched pawpaws in Michigan in the mid-20th century. The authors have no experience doing this themselves.

Chip budding attaches a single dormant bud onto a well-formed tree. If the bud survives, then the pawpaw will grow to have one branch that produces one type of fruit—hopefully a kind that you are very fond of and want more of— while the rest of the branches will produce a different type of fruit. If the bud does not survive, you will still have a well-formed tree. If you are unfamiliar with how to graft in this way, ask someone who has successfully done it before for guidance. This process is best done in the wintertime and requires the right equipment for making the cuts and bandaging the grafted area, so it heals well.

How to Fertilize Pawpaws

The pawpaws in the Lansing Orchard receive no fertilizer. In general, mature pawpaw trees are not thought of as needing much fertilizer or pesticides. Saplings can benefit from some fertilizers, especially if grown in a poor soil without many amendments. Fish emulsion is recommended in mid-summer.

After fertilizing, watch for new branches and leaves to emerge over the course of two weeks. Mulch young saplings with unsifted, well-cured compost in the early spring to suppress weeds and provide nutrition to the sapling. Avoid fertilizing after mid-July to slow down growth as the season turns to autumn. New branches that form need time to develop thick bark. If they begin growing too late in the season, they will be much more vulnerable to hard frosts.

As pawpaws are forest trees, they are well accustomed to slow-release fertilizers such as decaying leaves and well-rotted fruits. The authors have not heard of synthetic fertilizers being applied to pawpaws and have spoken to many growers who have never needed to use them.

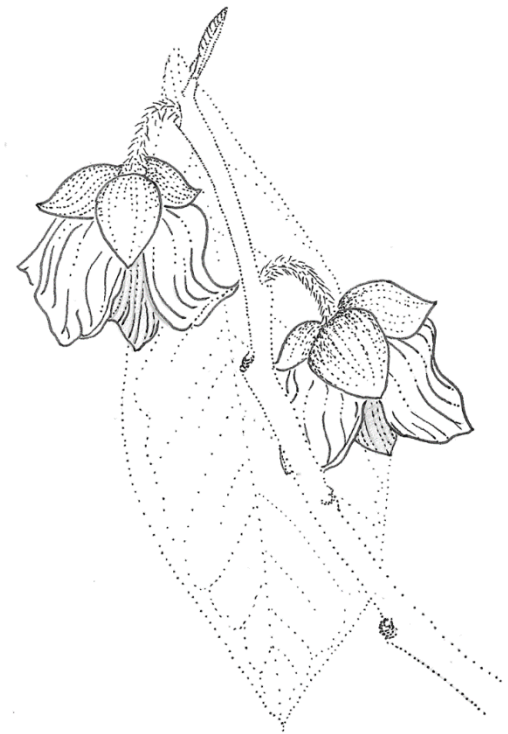
How Do Pawpaws Make Fruit?

Pawpaw flowers emerge in the middle of spring. They grow on last year's new branches and face downwards. One pawpaw tree will have two kinds of flowers: male flowers make pollen, and female flowers receive pollen.

Pawpaw flowers will open throughout the springtime. The researchers working at the Lansing Orchard have noticed a little march fly called *Bibio femoratus* carrying pollen around from tree to tree. There are likely many more unknown pollinators of pawpaw.

In South America, where custard apples—relatives of pawpaws— are grown in commercial orchards, people will walk around with a long paintbrush to manually put pollen into the female flower's receptors.

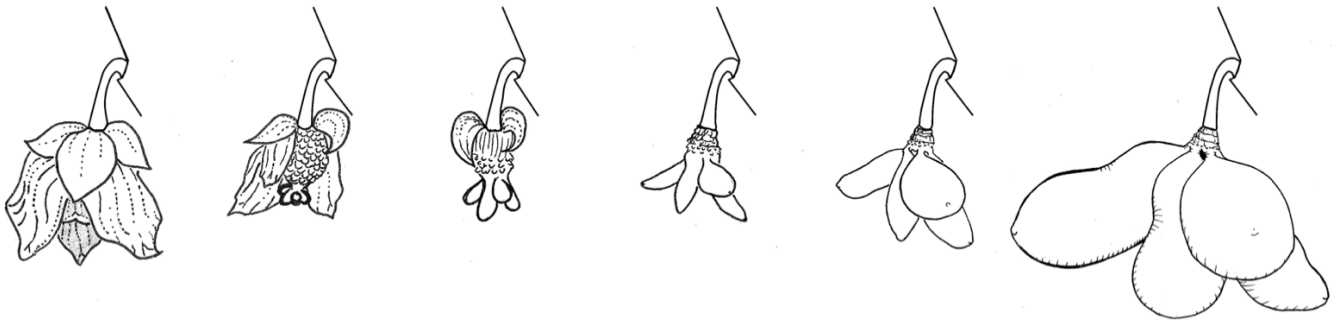
In research orchards and gardens, some pawpaw growers have found better pawpaw pollination when something stinky is close to the pawpaw patch. This is because the pollinators of pawpaw are suspected to like rotting smells, and even the flowers have a somewhat savory and pungent aroma. If there is not a large population of insects living in a nearby woodland, some pawpaw growers think it can be hard for the insects to



Pawpaw flowers growing on a young twig.

find the pawpaw patch. To increase insect pollination, these growers will intentionally put something smelly amongst the blooming trees. Some examples include yard waste and compost piles with food scraps.

The male flowers will wilt and die off after they are finished blooming. After a female flower is pollinated, some of the chambers inside of the flower will harbor the pollen and begin to grow into fruit. Each cluster of fruit arises from a single flower! So, even though an individual pawpaw is a berry, because multiple berries originate from a single flower, the pawpaw is technically an aggregate fruit – analogous to a raspberry.



Formation of pawpaw fruit cluster from a flower. One flower can give rise to a single fruit or as many as nine.

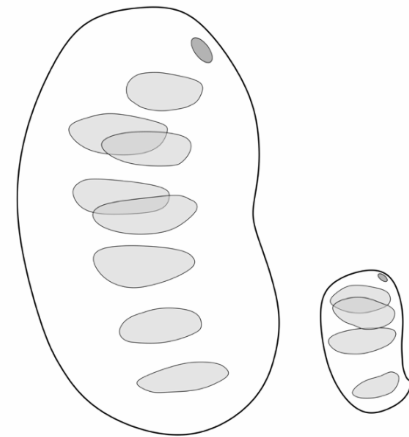
How to Eat and Store Ripe Pawpaw Fruit

To eat a pawpaw within 24 hours, pick a fruit off the ground. Choose fruits that are soft as a dead-ripe peach and have a strong smell.

Because there is always a risk of bacteria, particularly salmonella, getting into fruits that have fallen onto the ground, it is not advisable to sell fruits that were harvested off the ground. However, pawpaws that are picked green will not have as strong a flavor as those picked off the ground.

Fruits that are under-ripe will be firm to the touch and may taste starchy, like an uncooked plantain. They will still have a tropical smell, but it won't be as strong, and you may have to bend down and sniff the cut-open fruit to pick it up. Unripe pawpaws should not be eaten, because they can cause stomach upset and even induce vomiting in sensitive individuals.

The proportion of seeds to fruit pulp can vary quite a bit. It can be surprising to find few seeds in giant fruit, and many seeds in tiny fruit.



Pawpaw fruits were cut in layers to record number and placement of seeds. Image not to scale: large pawpaw fruit was 5 inches long (12.7 cm) and small fruit was 1.5 inches long (3.8 cm). The oval at the top-right corner of each fruit is the spot where fruit were attached to the fruit cluster.

How to Harvest and Store Underripe Pawpaw Fruit

Pawpaw fruits are similar to bananas in their ripening process. Green fruits are rather firm and take a long time to ripen. Once pawpaws start to turn yellow and soften, their shelf life shrinks to less than a week. Some folks like the taste of extremely ripe, brownish-black pawpaws.

If you are harvesting commercial amounts of pawpaws, two major considerations are sequential harvesting and post-harvest storage.

Pawpaws will not ripen at the same time: plan for repeated harvests between mid-September and the end of October.

For commercial sale, pick green pawpaws off trees. Ladders are very helpful for this task. It is best to harvest a whole cluster at the big green stem so that fruit flies cannot start feeding at the hole where individual fruits attach to the fluster.

Harvest pawpaws into baskets or bushel bins that have holes for airflow along the sides and bottom. When they are green and firm, the pawpaws can be stacked a few layers high without bruising. Softer fruit should not be stacked in more than two layers.

Store green pawpaws in a refrigerator kept around 37°F, or 3°C. They will last four weeks with no reduction in quality. Ripen fruit by keeping them at room temperature for a few days.

Nutritional Value of Pawpaws

Pawpaws are rather nutritious fruits. This section is an overview of which elements 100g of pawpaw (3.5 oz, the pulp from a medium-sized fruit) can contribute in a 2,000-calorie diet.

This much pawpaw contains 56% of the recommended daily amount (RDA) of iron—7 milligrams. It will also contain 30% of the RDA of Vitamin C. Pawpaws are also a good source of magnesium (35% of RDA) and an excellent source of manganese (74.3%).

Most of the calories in a pawpaw come from carbohydrates, a mix of sugars (6%) and dietary fiber (10%). They also contain a little bit of fat (1.8%) and a little bit of protein (2.4%). Interestingly, pawpaws contain 7 of the 9 essential amino acids. Pawpaws contain between 8.5% - 10% of the RDA for isoleucine, leucine, lysine, threonine, and valine. They contain less than 5% of the RDA of histidine and tryptophan. They don't contain any methionine or phenylalanine.

To bolster the remaining essential amino acids in your diet using plant-based proteins, pair pawpaws with oats. Half a cup (78g) of uncooked oats will provide roughly 60% of the RDA for tryptophan, 40% of the RDA for histidine, 30% of the RDA for methionine, and 80% of the RDA for phenylalanine.

If you are cooking for a gluten-free diet, swapping brown rice for oats will provide between 10 - 20% of all the amino acids missing from pawpaws.

Other Observations About Pawpaw Trees

Pawpaw leaves, seeds, and bark contain biologically active compounds called acetogenins. These compounds can act as neurotoxins for many organisms, and likely protect pawpaw trees from insects who might like to eat the leaves and burrow in the bark. There is one insect that can eat the leaves, and that is the caterpillar of the zebra swallowtail butterfly (*Eurytides marcellus*). These butterflies are then protected from hungry birds by having the acetogenins in their bodies.

In nature, pawpaws often grow in floodplains and lowlands, especially those with rich forest soil. Pawpaws need shade as young saplings, so they are typically not the first trees growing in a meadow that is on the way to becoming a forest. They will grow about 4 years after other fast-growing, sun-loving trees (such as black walnuts) start to establish.

In the wild, pawpaws will send out root suckers prolifically, forming stands of trees that are all attached to the same root system.

Genetics of Pawpaws in the Lansing Orchard

The pawpaws in the Lansing Orchard were planted in April 1999. This was a research project led by Dr. Ian Merwin, a plant scientist at Cornell who currently runs Black Diamond cidery.

There are a total of 28 genotypes in the orchard: 10 named varieties and 18 advanced selections that are assigned numbers instead of names.

The pawpaws came to Lansing as grafted seedlings. Unlike the chip bud grafting method described above, these trees were all bench grafted. Bench grafting attaches the top half of a tree to the root system of a different tree. This means that the root systems, and any suckers that emerge from them, are different genetically from everything that grows from the main trunk.

Named Varieties in the Orchard

‘Middletown’: Wild-found seedling from Middletown, Ohio. Relatively high concentrations of insecticidal acetogenins. Fruit size is small. May bloom two times in spring, offering a crop even if first blossoms are killed by a late frost.

‘Mitchell’: Wild-found seedling from Iuka, Illinois. Very early ripening.

‘NC-1’: ‘Davis’ X ‘Overlessee’. Early-ripening variety with a high concentration of insecticidal acetogenins. Relatively low-yielding.

‘Overleese’: Planted from an open-pollinated tree in Rushville, Indiana. These trees produce relatively mild-scented fruits that are still quite sweet. Mid-season maturity. High production of insecticidal acetogenins.

‘PA-Golden’: Second-generation seedling from G.A. Zimmerman’s pawpaw collection. This tree has good survival and produces medium-to-large fruits.

‘Sunflower’: Wild-found seedling from Chanute, Kansas. ‘Sunflower’ is thought to be more self-fruitful than other pawpaw varieties, but still benefits from cross-pollination. This variety produced the greatest number of fruits, which were on average relatively large. Fruits may have a slight bitter aftertaste that is more pronounced on certain years.

‘Taylor’: Wild-found seedling from Eaton Rapid, Michigan. Mid-season variety. Thin-skinned.

‘Taytwo’: Wild-found seedling from Eaton Rapids, Michigan. Mid-season variety, mild flavor and large fruits. Very cold hardy.

‘Wells’: Planted from an open-pollinated tree in Salem, Indiana. Considered to be a late-maturing variety with relatively low concentrations of insecticidal acetogenins. Fruit size is small. May bloom two times in spring, offering a crop even if first blossoms are killed by a late frost.

‘Wilson’: Wild-found seedling from Cumberland, KY. Fruit mature late but bloom is early. Fruit size is relatively small.

Advanced Selections in the Orchard

Advanced selections in the orchard were developed by Kentucky State University between 1981 and 1993.

The acronym “GAZ” stands for the George A. Zimmerman collection in its original location in Linglestown, Pennsylvania. He collected these trees between 1920 and 1940.

The acronym “BEF” stands for an orchard called the Blandy Experimental Farm in Boyce, Virginia. “BEF” trees were a mix of seedlings from the GAZ collection and clones of trees from the GAZ collection. These trees were planted between 1925 and 1955.

The acronym “RS” stands for the Ray Schlaanstine collection, in West Chester, Pennsylvania. These trees were descended from the GAZ collection and planted in the 1960's.

1-7-1: Open-pollinated seedling of ‘Overleese’

1-68: Open-pollinated seedling of ‘Overleese’

4-2: Open-pollinated seedling of BEF-53

11-5: Open-pollinated seedling of BEF-53

8-20: Open-pollinated seedling of ‘Sunflower’

1-7-2: Open-pollinated seedling of BEF-30

9-58: Open-pollinated seedling of BEF-50

5-5: Open-pollinated seedling of BEF-54

10-35: Open-pollinated seedling of BEF-49

8-58: Open-pollinated seedling of BEF-30

3-11: Open-pollinated seedling of BEF-33

2-54: Open-pollinated seedling of GAZ-VA

7-90: Open-pollinated seedling of RS-2

3-21: Open-pollinated seedling of BEF-43

1-23: Open-pollinated seedling of BEF-30

11-13: Open-pollinated seedling of ‘Taylor’

9-47: Open-pollinated seedling of BEF-49

2-10: Open-pollinated seedling of BEF-30

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