

HYBRIDS OF THE AMERICAN PAPAWE

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THE American papaw continues to be an horticultural orphan. The virtues of this interesting plant were called to the attention of plant lovers in a contest sponsored by this Association in 1916 to find the largest papaw, tree and fruit, growing in the United States. In that contest this largest wild fruit in North America did fairly well, for the winning papaw weighed twelve ounces, and was of delicious flavor. Reliable accounts of fruits a third heavier than this were reported. The plant grows over the entire eastern United States, except New England and Florida, and its culture is not difficult. In spite of these rather challenging possibilities it continues to be ignored.

The experiments in hybridization and selection of the papaw here reported appear to be one of the few projects which trace to the Association's contest of a quarter century ago. The results obtained to date suggest that this botanical Cinderella is quite capable of blossoming into a princess of our gardens with very little attention on the part of horticulturists.

Botanically, the papaw is somewhat of an anomaly. First of all, it is no relative of the tropical papaya (*Carica papaya*) which is also sometimes called "papaw". Among its relatives are to be found some of the outstanding tropical fruits of the world, — the Annonas which include the cherimoya, the custard apple, the sweetsop and the Javanese keppel. The genus *Asimina* to which the papaw belongs is a temperate zone representative of a tropical group. The nine or ten other species of the *Asiminas* are not promising fruit bearers of themselves, but as reported below they do offer excellent possibilities for hybridization with the papaw.

Through the encouragement of Dr. David Fairchild the writer has continued his interest in the papaw ever since the contest in 1916 brought the plant to his attention. In the intervening years he

has gathered at his home at Picketown, Pa., all of the recognized varieties and many unnamed selections. Together with seedlings of the best ones, his collection comprises probably sixty or seventy varieties in all. Many of these selections are for breeding purposes only. In fact the ultimate goal of this venture is the production of hybrids between the *Asiminas* and the *Annonas*. This collection has been derived from an area extending from Ontario to Florida and from California to Massachusetts. (The plants from California, however, I believe were introduced there from the Central West.) The best types have come from the river bottoms of the Susquehanna, the Potomac and the Ohio. One of them, the Fairchild, a seedling of the papaw that took first prize is still, I consider, the best. The Ketter, the first prize winner, is a close second. I might just add here that for many years the Ketter produced very poor fruit when grafted on native wild stock but in recent years since the top has had time to overcome the root system the fruit is showing up as the delicious product it really is. This collection is large enough to furnish ample variations for the breeding work which has been begun. The pleasing and valuable qualities of some of these fruits have far exceeded expectation. The collection includes not only the papaw itself, *A. triloba*, but nine other species of *Asimina* or their hybrids, from Florida or Georgia. These are of value for crossing because they bring with them the fragrance so lacking in the *triloba*, a touch of delicate flavor to the fruit and the beauty of gorgeous flowers not met with in the north.

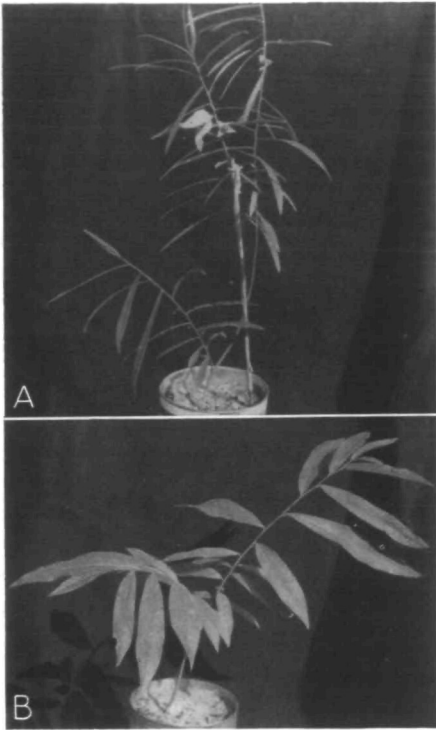
There is a wide variation in the fruit of the *triloba* but it will suffice to divide them into two classes: a large, yellow fleshed, highly flavored, early ripening type; and a white fleshed, mild flavored, late or very late ripening fruit. These are variable in size: some are very large. The



HYBRID TREES PRODUCE ABUNDANT FRUIT

Figure 1

Three "trilobovata" hybrids (*triloba* × *obovata*) growing at Pikestown, Pa. Like the native papaw, these produce fruit if hand pollinated but otherwise very few fruits develop. *A*—shows a branch which was hand pollinated with its own pollen. *B*—is a small tree hand pollinated with Taylor papaw pollen and *C* shows two limbs of a hybrid tree hand pollinated with its own pollen.



PARENT AND HYBRID

Figure 2

A—a small plant of *A. angustifolia*. This bore three flowers, which were pollinated with *tetramerus* pollen. Three fruits set; two fell off and one matured, having two seeds. These have germinated and are now growing. *B*—is a "Trigustifolia" hybrid (between *angustifolia* and *triloba*). This hybrid has proven hardy at Pikestown, Pennsylvania, though this specimen was grown in the greenhouse.

light fleshed varieties are as a rule a little too mild in flavor, while some of the yellow fleshed fruits are too highly flavored. Some of them are really delicious while others are fit only for the hogs who are not quite so fastidious. The selected varieties have rather large fruit and mild, delicious flavor. Eaten with cream and graham wafers they make a delightful breakfast dish. They are also excellent in pies. Their food value is largely in carbohydrates. They are reputed to have medicinal value, but this is negligible if any at all. They are also reputed to make some people sick but this may be due to personal idiosyncra-

ties, just as in the case with strawberries and tomatoes.

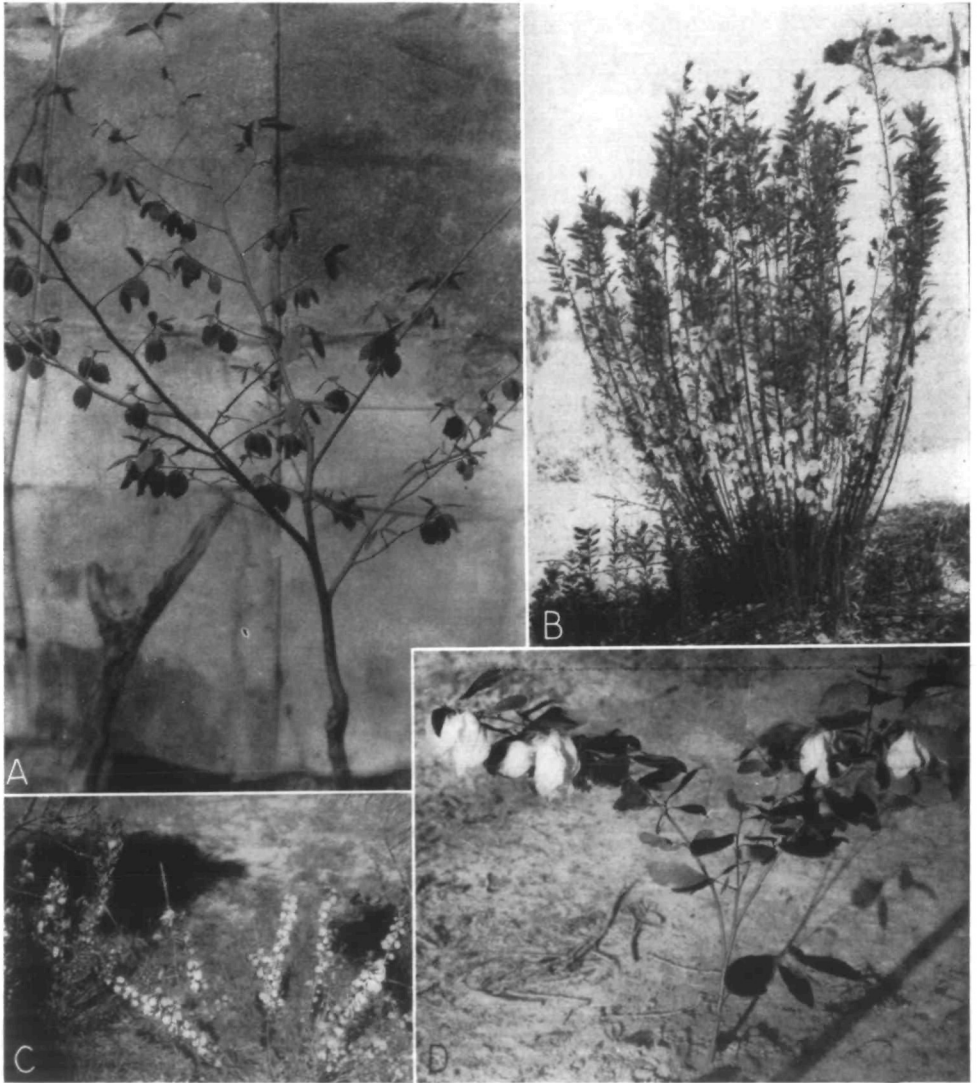
Further interesting discussions on *Asimina triloba* will be found in this JOURNAL for July 1916 and January 1917.

Varieties

The varieties of today will probably be replaced by other and better ones. But a few that deserve note at this time are: (early varieties) Fairchild, Ketter, Hope's August; (later and very late varieties) Gable, Taylor, Tiedke, Jumbo, Shannondale, Osborne, Buckman, and Martin. Martin, although rather small and not of very good flavor, is interesting in that it seems able to resist cold better than any other I have seen. Contrary to popular belief, papaw fruit will not stand low temperatures. A cold wind for a few days with temperature under fifty will turn the fruit black and spoil its flavor. This is not surprising considering the tropical relationship of the papaw.

Propagation

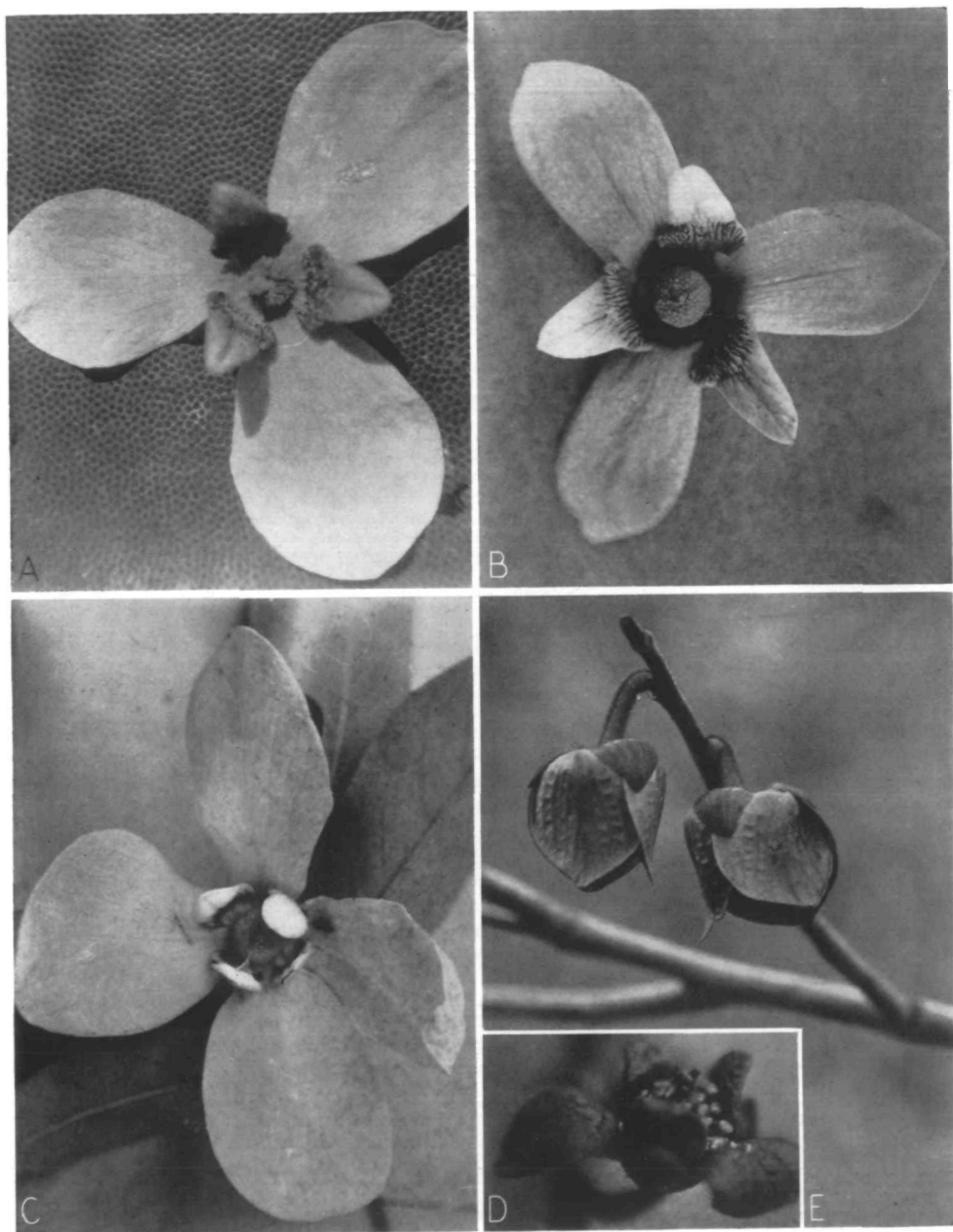
Contrary also to popular belief, propagation is easy. Papaws graft very readily on any native stock. Any of the methods used in nut culture are satisfactory, and the scions make excellent growth. They must, however, be grafted a little earlier than persimmons or hickories. In the latitude of Harrisburg, Pa., any time in April or early May is best. Seeds of selected *Asiminas* will give a large percentage of trees bearing excellent fruit. I have been able to handle seed best by placing them in moist sand in a can immediately after collecting, closing the can and placing in a cellar or cave. About February they begin to sprout. As the weather gets warm enough the sprouted seed can be picked out and planted, either in their permanent places, or in nursery rows a foot apart to be transplanted later when they are about a foot high. Larger plants transplant with considerable difficulty. A stake should be driven and a little shade afforded them for a year or two. The sprouted seed will grow about six inches the first year, a little more the second and after that quite



PAPAW RELATIVES AND A HYBRID

Figure 3

A—Plant of the "trilobovata" hybrid in flower. The flowers when fully opened are slightly over three inches in diameter. The plant is growing at Pikestown, Pennsylvania, and is fully hardy. B-C—Plants of *Asimina reticulata* in flower in eastern Florida. The large fragrant flowers are more than three inches across. Photograph by Dr. Buswell. C—shows small plants of *reticulata* covered with blooms. This shrub is found growing over most of the state. The flowers of *A. obovata* (D) are six inches in diameter. This Florida species has the largest flowers of any member of the genus.



FLOWERS OF ASIMINA SPECIES

Figure 4

A—The large flower of *incana (spectiosa)*. This species occurs in two varieties, one with pink petals, and the other with white petals tinged with yellow, of a heavier structure. *B*—the flowers of some plants of *reticulata* are fragrant as well as showy. *C*—The largest-flowered species of the genus, *obovata*, has flowers as much as six inches across. Nearest relative of the papaw, *parviflora* (*D*), has a small foul-smelling flower. The papaw itself has an inconspicuous inflorescence (*E*) shown here somewhat enlarged. (Photograph courtesy of the U. S. Department of Agriculture.)



HAND POLLINATION NECESSARY TO PRODUCE FRUIT

Figure 5

In the large orchard of papaw trees at Pikestown, Pa., very few fruits are produced unless the flowers are pollinated by hand. This illustration shows details of three trees which have produced abundant fruit as the result of hand pollination. *A*—is a Taylor tree hand pollinated with Taylor pollen. In the ten preceding years not a half dozen fruits have been borne on this tree unless it is artificially pollinated. The small tree (*B*) has abundant fruit on three branches as a result of hand pollination. No fruit appears on the rest of the tree. A limb of the Shannondale papaw (*C*) heavily covered with fruit as a result of hand pollination. Here again no fruit was borne on the rest of the tree.

rapidly, depending of course on the fertility of the soil and the water supply. Moist but not wet ground is best. Seedlings from good seed are desirable, for papaws are usually rather short lived. Thus they are inclined to die back every now and then and if the trees are seedlings the stumps will soon sprout and make nice trees again. But with grafted trees the varieties would be lost and the trees have to be regrafted. They should be pruned a little from time to time to force new bearing wood. I have had very little experience with fertilizers but it appears that some lime in acid soil districts improves the trees.

Allied Species and Hybrids

According to Small there are ten species of *Asimina*: *triloba*, *parviflora*, *obovata*, *tetramerus*, *incana* (*speciosa*), *angustifolia*, *reticulata*, *pygmaea*, *pulchellus* and *rugleii*. The last two are said to have very fragrant flowers. Some plants of the *reticulata* also have fragrant flowers. Since the death of Small many botanists have either questioned or denied the existence of *tetramerus* as a species. However there is a beautiful plant found in abundance along the east coast of Florida, north and south of West Palm Beach that does not quite fit into any other classification. If I were to cross the *obovata* with the *reticulata* I would expect just such plants to result. I am therefore inclined to think they are hybrids. Be that as it may, nature might have made a worse combination for breeding purposes. Photographs of some of these handsome plants and flowers are shown herewith.

My first experience with hybrids came several years ago when I brought with me from Florida pollen of the large flowered *obovata*, storing it for six weeks with calcium chloride. When the papaws came into bloom I successfully pollinated the flowers of Hope's August with this stored *obovata* pollen. This produced the *trilobovata* (Deming). These plants have been perfectly hardy and have fruited every year when I have taken the time to hand pollinate them. Unless this is done they set only an occasional chance

fruit. This hybrid is rather too highly flavored for my taste, but many people like it. Other crosses made since then with the mild flavored, white fleshed Buckman have tamed down the flavor. The hybrids have been crossed with several other varieties, and fertilized with their own pollen, but the resulting plants are too small for bearing as yet. As a matter of fact all seeds produced are hybrids because I necessarily make crosses when I hand pollinate the flowers to get them to set fruit.

A second cross between the *angustifolia* and *triloba*, producing the *trigustifolia* is making excellent growth. These hybrids are interesting because the male parent, *angustifolia*, has leaves not over a half inch wide and six or seven inches long. The hybrid is much like *angustifolia* in shape of leaf, but it has not yet flowered. It has been hardy so far.

Crosses were made last spring between *incana* and *triloba* and also between the *reticulata* and *triloba*. The seed of these will be planted this spring.

Other hybrids, mostly between the better *trilobas*, are under way and ought to produce some excellent fruit within a year or so. It is interesting to note that by cutting the tops from the hybrid seedlings at the end of the first year and grafting them into large plants it is possible to get a huge growth which often sets flowers the next year. These produce fruit if they are hand pollinated. Cutting off the tops does not hurt the little plants in the least. The grafting is a chore but when a man is getting old it enables him to see the results of his work, perhaps before he passes out. It is expected that these hybrids will form a sort of "half way station" in crossings with the *Annona*.

Hand Pollination Necessary

It is becoming quite clear that if we want fruit in any considerable quantity from our finer varieties of papaws we must resort to hand pollination. Dr. Fairchild informs me that in Egypt *Annonas* are hand pollinated on a commercial scale. This is a tedious job, but there seems to be no way to avoid it at pres-

ent. I have many trees of fine varieties of *triloba* that have never yet set a fruit unless they were hand pollinated, even though they were covered with bloom. This is a poor showing when compared with the limbs shown in Figure 5 from these very same trees covered with fruit so heavily that they are bent to the ground. Some limbs have broken off from weight of fruit and yet not a single fruit set on any other part of the tree. It seems to make little difference what papaw pollen is used provided it is good and the flowers are pollinated early enough. Ordinarily all the early bloom drops off. The later bloom of some trees will set an occasional fruit. Many trees have never set any fruit as long as I have had them under observation, while a few others bear fairly and rather regularly. Once in a while a tree bearing good fruit has this desirable habit. The Fairchild is notable in this respect although it never bears the quantity of fruit it should.

The principal reason for this unfortunate infertility is that the flowers of *triloba* are nearly always dichogamous, with the stigma maturing frequently a long time before the anthers shed their pollen (protogynous). In view of the fact that nearly all of the flowers display this cycle of maturity one can easily see why the early opening flowers set no fruit. The late flowers occasionally get pollinated if an insect or the wind happens to convey the necessary pollen from another flower. This is not at all a frequent occurrence with the *triloba* for its bloom is inconspicuous and almost foul scented.

I doubt whether the wind is an important factor in the pollination of the papaw, and insects in the north are little more valuable. I have never yet seen an insect in the flowers of the *triloba* that appeared to have anything to do with pollinating it. In the south, on the large flowered *obovata* I have often observed a beetle of the *Trichius* group go into the flower and get caught under the petals, which evidently scared him. He would set up quite a whirlwind in the flower and escape covered with pollen, go to another flower, crawl in and do the same

thing. In some years hardly a flower of the *obovata* escapes such treatment. Even though the flowers of the papaw are perfect, they are nearly always dichogamous, so without the aid of the wind or of insects, it seems that to plant different varieties together in the hope of better pollination is not likely to be very helpful.

Our only hope seems to lie in our ability to find special trees which will pollinate their own flowers and bear good fruit. Such plants can perhaps be produced through hybridization and selection. The only other solution seems to be to resort to hand pollination. It may be possible to develop hybrids with the excellent fruit of the *triloba*, and with the attractive and fragrant flowers of the southern species so that they will be attractive to insects or bees. For this purpose I am using on *triloba* the pollen of *obovata*, whose flowers are sometimes six inches in diameter, and the *reticulata* whose fragrance is equal to that of the petunia. This combination, could it be combined with a desirable fruit-type, should be irresistibly interesting to many insects.

The pistils of *Asimina* flowers are so easily injured that large insects may turn out to do more harm than good. During the operation of hand pollination with a fine camel's hair brush it is not an uncommon tragedy to find the stigma on the brush when the job is done. The stigma will not set any fruit on a camel's hair brush or on a bumble bee's legs. However, if carefully done one can in a very brief time pollinate enough flowers to give an abundance of fruit for the family table. A very little more time would be necessary to put fruit production on a commercial basis.

After a little experience pollination does not take so much time as might be expected. When the fruit ripens the time seems very well spent. Otherwise, without hand pollination failure is almost certain under any conditions. For the past two years I had more fruit from my papaw collection than ever before and all from a couple of hours' work. Two years ago there was no fruit of any value anywhere in our district other than that

which developed from that pollinated by hand. I had made a practice of allowing native trees that bore well to stand, whatever the quality of their fruits, in the hope of getting adequate pollination for the good trees. Now I am beginning to doubt whether this is of any real benefit.

Crosses With Annonas

With the *Annonas* it has been very difficult to get pollen at the right time and in sufficient quantities since it must come from Florida or California. However, I now have in the greenhouse many species growing and hope shortly to be able to produce plenty of *Annona* pollen. Last spring I pollinated flowers of the Tiedke and Long John with pollen of the "ate-moya" hybrids and of *A. Squamosa* and had a few fruit set from each. Whether these will prove hybrids must wait the development of the plants from these seed.

It is just possible that we may have to change the chromosome groups in some of these species before the ultimate goal is reached. An interesting discussion on the *Annona* will be found in the *Proceedings* of the Florida State Horticultural Society for 1939 by Dr. David Fairchild.

Since 1916 I have succeeded in going far enough in breeding papaws to realize what an immense job lies ahead. At the same time the vision of what can be accomplished has widened in proportion and I am sure that the end will certainly justify the work and the waiting. The possibilities are thrilling and there are compensations; quite soon the crosses yield handsome ornamentals, novel and interesting new creations. If the experimenter takes a little extra time to hand pollinate until better ways are found, he will be handsomely repaid with an abundance of luscious fruit.





THE LARGEST NORTH AMERICAN FRUIT

Frontpiece

The American papaw (*Asimina triloba*) is the largest native fruit found in North America. It has only been casually utilized, and has remained unimproved by hybridization and selection prior to the experiments reported herewith. This is remarkable because the fruit is liked by many people, and the plant is inviting to the plant breeder, showing great variation in size, flavor, ripening time of the fruit. The papaw is a relative of a tropical genus which has pushed into temperate regions. The fruit has a flavor somewhat resembling its tropical relatives, the custard apple and the sweetsop.