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## About This Issue

The past is not allowed to rest in peace at the archives room of Fairchild Tropical Garden's reference library. Here, the Garden's historian and agitator, Bert Zuckerman is always finding something new in the old.

David Fairchild's *Annona* writings are filed away in five folders. Notes and letters are full of his excitement about a world of annonaceous wonders. He was captivated by these strange and sumptuous plants and in his last years planned to write a book on the subject. The article in this issue could have been the first chapter.

Up until quite recently, little has been done to further the annonas since Fairchild's death in 1954. In 1984, an *Annona* project was started at Zill nursery in Boynton Beach and *Annona* hopes are high again. Zill's *Annona* project is a commercial undertaking, but is remarkable for its bold, long term goals that will ultimately benefit everyone.

I would like to thank Har Mahdeem, who coordinates Zill nursery's hybridizing program, for his help on this issue.

We are hoping that this issue of *Tropical Fruit World* will be a stimulus and impetus towards fulfilling David Fairchild's dream that South Florida will become a center for the collection and development of annonaceous fruits.

Nicholas Cockshutt  
Editor

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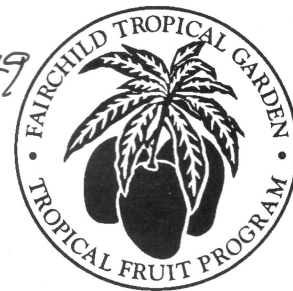
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# Who knows the Annonas?

## Dr. Fairchild Seeks To Popularize Annonas, One Of Tastiest Of Fruits Aug 27 1950 Miami Herald

Dr. David Fairchild, world-renowned author and plant explorer, now 81, has decided how he will spend the remainder of his lifetime.

He will write a major work on the annonas, a large and important family of tropical fruits in which he has been interested for over half a century.

Completely recovered from an illness which kept him from working for several months, Dr. Fairchild appears to be in excellent health. The youthful sparkle has returned to his eyes, and his terrific mental energy seems as good as ever.

He takes daily swims in his pool at the Kampong, his home at 4013 Douglas rd. And he spends a lot of time among his several acres of plants he helped to introduce to Florida from all over the tropical world.

Dr. Fairchild relaxed in a comfortable wicker-type chair while talking about his work with the annonas.

"There were two projects that I really wanted to work on," he said. "One was the annona and the other the mango. Well, the mango already is an accepted fruit, on its way to success.

"But who knows about the annonas? How many people know that the cherimoya is one of the best fruits in the world? Very little work has been done with the annonas by the plant scientists. There's even a lot of confusion about names."

HE ADDED that little effort had been made to select and propagate the better varieties of annonas, nor have the annonas ever been subjected to a breeding program like some of our better known fruit plants.

A long list of annonas has been introduced to Florida. Few of them have survived. Dr. Fairchild has about 20 kinds planted about his place, including the few hybrid varieties.



RARE TROPICAL FRUIT about which he is writing a book is examined by Dr. David Fairchild, Coconut Grove author and plant explorer. The fruit is one of the annonas, the illamce, from Mexico and Central America. A tree on the Fairchild estate, the Kampong, produced the fruit.

Only a few of the annonas have been successful fruiters in Florida. Best known is the sugar apple (*Annona squamosa*). The custard apple (*Annona reticulata*), an inferior kind of fruit, is sometimes confused with the sugar apple.

Another annona which is pretty widely known, especially in Key West and in the West Indies, is the soursop (*Annona muricata*). This spiny-looking fruit is used for making drinks and ice cream.

While the cherimoya will grow in Florida, it will not bear

here. Native of higher altitude areas of tropical America, the cherimoya is grown in some parts of California.

DR. FAIRCHILD believes that by crossing these varieties and by selecting the better fruiting trees, that the annona can be developed into one of South Florida's most successful fruits.

A cross between the sugar apple and the cherimoya has produced fruit in South Florida, but not enough of these crosses have been made in order to select a more desirable fruit for the

Dr. Fairchild's notes on the annonas date back to the 1890s. Everywhere he has traveled where annonas grow he has studied them, asked questions about them, tasted them and made notes about them.

Although no annonas grow in Switzerland, it was in the Geneva botanical library that he found more written information on this fruit than in any other place. While visiting there several years ago he spent days going through the library's works on this fruit.

"I found a huge monograph on the annonas by Robert Fries," Dr. Fairchild recalled, "and I later purchased a copy. Although Fries had only dry specimens to study; although he had never tasted an annona nor had he ever seen one growing on a tree, he wrote the most complete botanical monograph on this family that has ever been turned out."

WHILE HE WAS director of the United States Office of Plant Introduction Dr. Fairchild encouraged the importation of a large number of the 120-odd species of annonas. But the office at that time had little money to spend on experimentation, and little was done to improve these fruits.

The annonas have a widely known relative that is native to the United States, extending from New York to Texas.

It is the papaw, a small tree that bears an edible fruit two to three inches long. The papaw is of no relation to the papaya.

Another relative of the annonas is the pond apple of South Florida, which once grew in great thickets about the shores of Lake Okeechobee. The annona-like fruit the pond apple bears is worthless. However, the pond apple may be used as a

five species, one of which was native, and I proposed to my friend that we establish in the new garden a collection of all the annonas we could gather together and that he would come down when they began to flower and spend the rest of his life in hybridizing them and in producing as Swingle and Webber had with the citrus and its relatives, a lot of entirely new subtropical fruits. It was a great scheme, perhaps too great, for no sooner had we growing in the Buena Vista garden a dozen species of the genus than the devastating freeze of 1917 visited us and froze the young plants, which had barely been established, to the ground.

Safford finished his monograph but, alas, never got to Florida again before his untimely death. In the meantime many years have swept by and there have gathered in South Florida an amazing number of people who would be delighted if they could get their spoons into the delicious juicy fruit flesh of the cherimoya or its relative the sugar apple or even the custard apple.

*Continued on next page*

*If I could put the case in such a way that somewhere, somehow, a single amateur would throw his energies for a lifetime into it, I would feel that my efforts were not in vain.*

Newspaper clipping, Miami Herald, August 27, 1950.

### By David Fairchild

Here and there in my travels in subtropical countries I had been given a taste of the cherimoya but it had never meant much to me. When, however, in 1906, while walking down one of those cobble stone streets of Funchal I met a peasant with a great basket full of cherimoyas which I could buy for a few milreis, I began to realize that in this *Annona cherimola* there was a prospective fruit of great importance. I recall that Mrs. Fairchild and I were delighted with them. They were very large and extremely sweet, and although filled

with seeds were really a great table fruit. I have never since seen finer specimens, and whenever I think of the fruits of the *Annona* my mind returns to Madeira on which little island in the Atlantic they grow to perfection.

It so happened that my friend, W. E. Safford, than whom I never knew a more enthusiastic student of tropical plants, had somehow taken a fancy to the genus *Annona* and had undertaken to monograph it just about the time that we were developing a new garden at Buena Vista near Miami, Florida. We had already growing, in that tip end of the state,



It seems appropriate, although not much progress has been made in the cultivation of the annonas in Florida and California to summarize the situation here and point out what appear to be the possibilities as I see them from an association in Florida with certain species over a considerable period of years.

To the long time interest and devotion to the annonas of my colleagues, Wilson Popenoe, Edward Simmonds and P. J. Wester (1) I owe much of the information which is summarized here for had it not been for their interest, the whole subject of the *Annona* culture in Florida might have dropped completely out of sight before this time.

Two striking facts deserve emphasis from the start. First, there is a native species of *Annona* called the pond apple which grows in the swamps of South Florida and forms a thicket of trees about the borders of Lake Okeechobee. Its fruit is not edible, but it is possible to use it as a stock upon which to grow some of the other species of annonas. Two of these were grafted successfully on it as early as 1908 by Simmonds and Wester. Second, there is a hardy relative of the annonas (the only hardy representative of the whole order Annonaceae, in fact) which inhabits the river bottoms as far north as New York and extends west into Nebraska and Texas. It is known as the "pawpaw", *Asimina triloba*. Contrary to the prejudices of those who are too quick in their judgments of any new fruit, there are seedlings of this pawpaw which bear fruits that when ripened on ice are as delicious as a banana. There are numerous species of *Asimina* in the southern states but *Asimina triloba* is the one bearing the largest fruits. These sometimes reach a length of four inches.

Associated with these two important facts is a third; that already hybrids have been made between at least

three of the species of *Annona*: viz *Annona cherimola*, *Annona squamosa* and *Annona reticulata*, the cherimoya, the sugar apple and the custard apple respectively.

With these facts in mind it has never appeared absurd to me to imagine that not only could there be new and superior varieties of these subtropical fruits produced from crosses that might be made in this immense genus of *Annona*, comprising over sixty distinct species, but that some of the hardiness of the one temperate region relative might be incorporated into the mixture and make possible the northern extension of a new fruit



**Cherimoya vendor on a street in Funchal. Madiera, 1907.**

Photo by David Fairchild

culture of considerable commercial importance.

Not only this, but there are in the family Annonaceae, genera like *Monodora* with flowers exquisite enough to be compared to orchids and others like *Artabotrys*, with a perfectly delicious fragrance. Then there is the genus *Rollinia* with twenty species in it which have golden yellow fruits of great size and delicious flavor. These might come into the picture.

In other words, this family of tropical and subtropical trees and shrubs offers quite unparalleled opportunities to the amateur plant breeder.

I have just read over the field notes and remarks of a host of different people who have from time to time since 1905 sent us in seeds and scions of the different species of this great family and I am amazed at the chaotic character of man's knowledge with regard to so remarkable a group of fruits. Since prehistoric times some of them have been planted by the peoples that inhabit the subtropical valleys and the lowlands of the whole tropical world, and yet one can scarcely be posi-



**Dr. F. J. Galloway with large cherimoyas, 6,000 feet altitude. Colombia, 1941.**

Photo by David Fairchild

tive that there are in existence a dozen named and clearly marked horticultural varieties.

Compare this state of affairs with that of the apple or the pear, for example, where there are hundreds of accurately described and quite distinct varieties, and the opportunity that I am trying to point out should be apparent.

If I could put the case in such a way that somewhere, somehow, a single amateur would throw his energies for a lifetime into it, I would feel that my efforts were not in vain. Let me try, beginning with the cherimoya, to lay the case before you.

According to Safford, the cherimoya was the principal fruit cultivated by the aboriginal inhabitants of western South America. It was introduced into India from Peru at the same time as the Peruvian chincona and today it is cultivated in practically every island and continent in the subtropical world. Also, Wilson Popenoe found in the mountains of the Loja province of Ecuador wild thickets of this fruit and gathered fruits which to all appearances were equal in delicacy and size to the best of the cultivated forms (2).

In the estimation of no less an authority than the great botanist and traveler Bertold Seeman: "The pineapple, the mangosteen, and the cherimoya are considered the finest fruits in the world. I have tasted them in those localities in which they are supposed to attain their highest perfection—the pineapple in Guayaquil, the mangosteen in the Indian Archipelago and the cherimoya on the slopes of the Andes — and if I were called upon to act the

part of a Paris, I would without hesitation assign the "apple" to the cherimoya. Its taste, indeed, surpasses that of every other fruit, and Haenke was quite right when he called it the masterpiece of Nature."

The cherimoya tree is a rapid-growing, bushy one with soft pubescent leaves somewhat like those of the mulberry. It can stand a frost and even a freeze, if the temperature does not go below 15°F, for it has a resting period. It bears fruit throughout the summer and well into the winter. These fruits are borne, like those of the grape vine, on the new wood. Contrary to the usual practice with many tropical fruits of "leaving it alone", the tree should be severely

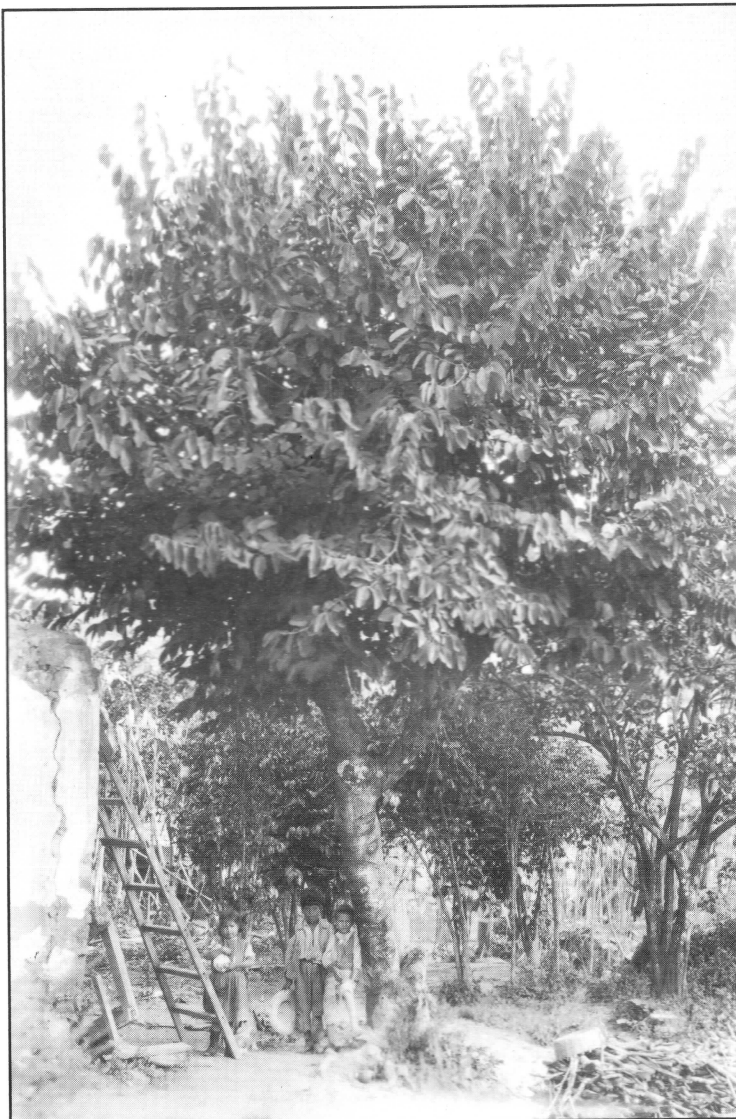
pruned before it starts into growth in the spring in order to induce an abundance of new wood. It is a gross feeder and responds to liberal applications of barnyard manure — even liquid manure.

If treated in this way, the cherimoya tree sometimes produces as much as 300 pounds of fruit. In Madeira the trees are grown on high trellises which protect the fruits from the direct rays of the sun.

The fruits vary in size, often weighing two pounds and sometimes as much as five or six pounds. These are heart shaped with characteristic protuberances and areoles somewhat like the markings on a pine cone. The skin varies in thickness and toughness but is easily broken and the fruit pulp which is creamy white and extremely juicy and sweet has a sprightliness and an aromatic flavor which is reminiscent of some delicate fruit ice, with vanilla and pineapple and perhaps mango in it. With a spoon

one lifts this delicate fiberless pulp which usually has a dark brown seed or two in it and separates the seed from the pulp in the mouth. The number of seeds varies greatly from what seems like a multitude to almost none at all and one of my Madeira acquaintances declared that heavy manuring reduced the number in each fruit, sometimes to three or four. These fruits can be picked while still green and ripened off the tree. They can be placed on ice and held for a week or two and then ripened.

The matter of pollination has worried growers a good deal but since there are records of single trees, iso-



A productive cherimoya tree in the yard of Julio Guerra from which budwood was taken. Antigua, Guatemala, 1916.

Photo by Wilson Popenoe

*Continued on next page*



Pinha, *Annona squamosa*.  
 Juanaria. Brazil, 1914 Photo by P. H. Dorsett

lated from all others, bearing good crops of fruit, the presumption is that the flowers are fertile to their own pollen. These flowers are strange, fleshy, straw-yellow affairs made up of three strap-like petals which are themselves three cornered and, in the bud, fit closely together only to curl open in early evening when the pollen is ripe and the masses of stamens at the bases of the petals loosen and fall (3).

There is a haunting fragrance reminding one of jasmine about a cherimoya tree when in bloom that attracts the great sphinx moths at night and you can see the glint of their eyes if you turn the headlights of your car on them. These moths may do the pollinating but if not, there are many small insects which could do it (4). In California the growers whirl a camel hair brush about in the open flower to ensure perfect pollination (5).

The cherimoya is a truly mountain species and it has gained the reputation of not being fruitful at sea level in the tropics, but whether this applies to the sea level in the subtropics I am not so clear for there are too many exceptions to the rule.

For the most part, the cherimoya has been propagated by seeds and the evidence is pretty strong that it comes about as nearly true to seed

as does the peach. It is one of the easiest trees in the world to graft; one has only to make the simplest whip graft in the spring (January to March) before the growth starts and if the grafted part is covered with melted parawax the scion and branch will unite in a few weeks.

If it had been more variable, more variable than the peach, it seems inconceivable that numerous grafted sorts should not be in existence. As a result of "combing the world" for varieties over a period of a quarter of a century we have been able to locate with certainty little over a half dozen reported varieties: from the valley of Limache near Valparaiso 'Concha', 'Copucha', 'Piña', and 'Sandia'; the 'Pink's Mammoth' (6) from Brisbane, Queensland; the 'Blandy' from Funchal; C. P. Taft's 'Golden Russet' from Orange, California; and an unnamed giant which originated according to James Collins near Redland Bay, Queensland, fifty years ago.

In most of the regions from which we have imported seeds, no varieties at all are recognized. There

is a great variation in the prominence of the tubercles and the shape of the so called areoles, which give fruits strikingly different appearances, but these are not constant on the same tree and are said to vary with the season.

Closely related to the cherimoya and very often mistaken for it is the sugar apple (*Annona squamosa*) or sweet sop of the tropical lowlands. Unlike the cherimoya, this has smooth, hairless leaves which are not deciduous in the winter season. The fruits of the sugar apple, while much smaller and easily falling into pieces (its individual carpels) when ripe, is yet a valuable fruit for coastal regions too tropical to grow the cherimoya. A native of the West Indies and tropical America, it has gone wild in British India according to Watt and there forms an important fruit. It is in fact to be found almost everywhere in the dooryards of tropical villages but nowhere, so far as I have ever heard, have varieties of it been recognized. We have received seeds of the sugar apple from sixteen widely separated tropical countries. In fact it seems as though every traveler in the tropics comes upon this fruit as something new and interesting. Its sensitiveness to frost makes it strictly a species for southern Florida but even there it deserves to be much better known. In British India where it is erroneously called the custard



apple, the practice is, according to Sir George Watts, Commercial Products of India, to plant the seeds in pots and transplant the small plants into holes 3 feet deep and 3 feet in diameter which have been filled with cow manure, old mortar and old garden soil. The trees are pruned and re-manured every March and watered well during the dry season. I suspect that whereas in South Florida, where lime is in excess, no "mortar" is needed, we have erred heretofore, however, on the side of too little manure and lack of severe pruning in the spring in our cultivation of the sugar apple.

In flavor and texture, the sugar apple is very like the cherimoya but it has less acidity and therefore is not quite so delicious. It is a better bearer in the lowlands than the cherimoya but owing to its delicate skin and the tendency to fall to pieces as it ripens will probably never be a good shipper to the northern markets.

The idea of crossing these two species of delicious fruits seems to have occurred to both P. J. Wester and Edward Simmonds as early as 1908, during the early days of our little subtropical garden in Miami, but the vicissitudes through which South Florida has gone and the transfer of Wester to the Philippines has prevented the hybrids which they individually made from getting the attention which their quality deserves. The conception of creating, by the crossing of the hardier deciduous species with the more tropical one, to produce a tree which would grow and fruit at sea level seems to have been a correct one. At least the way has been blazed for much more extensive work in the mingling of the annonas into something different and better adapted to the conditions of horticulture of such regions as south-

ern Florida. Wester proposed at one time a special name for these hybrids—atemoya, made up of "ate" one of the original names of the sugar apple and "moya" the last two syllables of cherimoya.

I personally have only had under my eye the Simmonds hybrids but from my limited experience with them I feel confident that contrary to the experience with the cherimoya in South Florida these will prove to be good yielders. As for quality, they are so delicious that one should be ashamed to desire anything more delectable. They will, I believe, respond to heavy applications of organic fertilizers and should be pruned back every spring, though I must admit that much remains yet to be learned about their treatment as respects pruning.

Not only did both of these experimenters produce crosses of the sugar apple and the cherimoya but they added to this mixture the blood

of the true custard apple (*Annona reticulata*) making thus a tri-specific hybrid *Annona cherimola* x *A. squamosa* x *A. reticulata*, in which the cherimoya was the mother and the squamosa the father and this hybrid again serving as the mother for the custard apple pollen. So far, I have not been able to determine that this triple hybrid has any advantage over some of the seedlings from the straight atemoya hybrid. These seedlings are quite variable as might be expected, some proving rather fruitful and others not so, some dropping their leaves in winter and others not.

The true custard apple (*Annona reticulata*) which is also a tropical species and is known in the East Indies as the bullock's heart is so often mistaken for the cherimoya or the sugar apple that it may be well to point out that it has, unlike the former, long, narrow larger leaves

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Edward Simmonds with one of the hybrid "atemoyas" made from crossing the cherimoya and sugar apple. At the Brickell Avenue garden. Miami, 1914.

Photo from Bureau of Plant Industry, USDA.



# Fruiting of the Ilama

The Kampong, Sunday, August 13th, 1944

David Fairchild's Notes

I have been watching for weeks a very large fruit that has been found forming on the ilama tree, but suspected it was not ripe. Burrows bagged it when he covered the fruits of the atemoya which had been attacked by the little chalcid (*Bephratelloides cubensis*). Becoming curious lest the fruit rot under the bag, I reached up this afternoon and found to my surprise that the fruit had split open and in doing so had split the bag too. I pulled it off and found in my hands a truly wonderful looking fruit. It is squirrel grey in color with immense protuberances lapping one over the other in a fascinating way. Its shell must be at least a half inch thick and as hard as a piece of sole leather. No chalcid fly could possibly puncture it with her ovipositor, I believe. This fruit now before me is a fascinating thing. I can look into it through the large split which extends clear into its center and see the tawny seeds in their places in the light shell-pink fruit flesh.

This fruit flesh seems to be pithy and rather dry. No juice at all has run out. The odor reminds me of a watermelon quite as it did last year. It weighs 990 grams on the scales and measures 5 by 5 1/2 inches, in dimensions, slightly longer than broad. Some of the drooping protuberances are two inches long and 5/8 inch wide.

I see by reference to my notes of July 14th, 1942 that the fruit from this same tree which fell and was picked up on July 14th weighed only 517 grams and it too

had cracked open. In 1943, the same tree fruited but I don't seem to have any notes on it. I recall however that the fruit cracked open and looked dry and uninteresting as it lay on my desk and I felt disappointment and let it lie there. One afternoon, I poked at it with one of my dental tools and to my surprise found under the dry skin which had formed over the flesh a beautiful shell pink and quite juicy flesh that had a flavor reminiscent of the watermelon. I liked it and got "Annona" Page (Roy Page) to taste it too. We were not excited about it, however.

This morning August 14, I found the fruit which I had picked yesterday had faded somewhat and the opened up edges of the crack had turned brown. It was altogether less

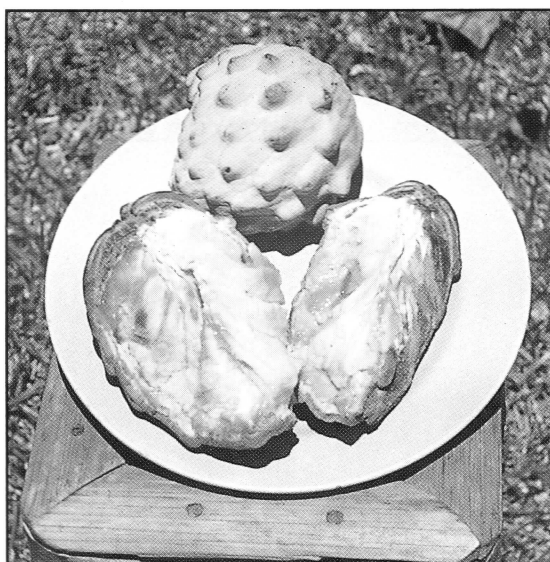


Photo by D. Fairchild. Kampong, 1944.

attractive than yesterday but still most striking. I took two photographs of it this morning and just at the very moment when I stood with the fruit in my hands and thought "I must show this to Harold Loomis", he appeared on the pathway coming towards me.

We broke the fruit clear open and found below the grey fruit skin that had formed on drying flesh, of the most beautiful shell pink color, a very juicy, delightfully sweet flesh with a refreshing flavor unlike any Annonaceae I ever tasted. We both decided that this fruit deserves to be

developed; that its' quality puts it in the dollar-apiece-class air transport fruits for the wealthy fruit fanciers. I wish I could describe its flavor, but who can describe a new flavor of any kind. *Delicious* is the only term that applies.

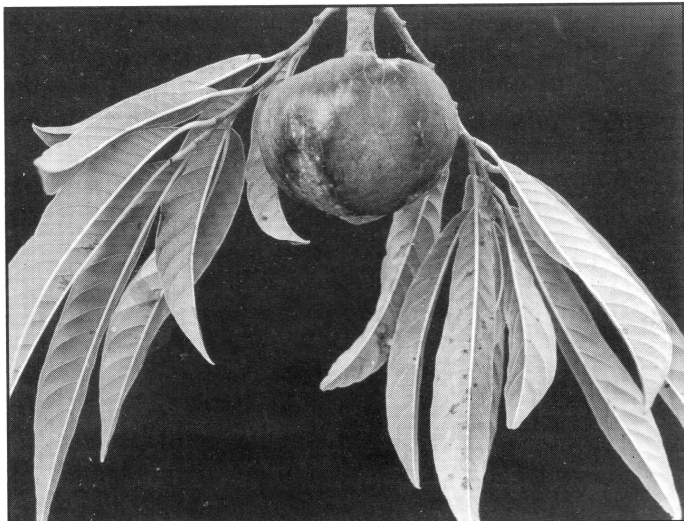
I have here before me three large seeds from the flesh Loomis and I ate. They are very large 23mm by 13mm in dimensions, glossy with a delicate pellicle which comes off on rubbing and of a light coffee brown color.

Would that I were twenty instead of seventy five, for here is the beginning of a fruit industry which I would feel some confidence in being able to develop before the shades got me.

There are two or three less well developed fruits on the tree which I shall try to ripen off the tree. This is from the same tree from which Sands sent me specimens when it first fruited. They arrived July 22nd, were most attractive but failed entirely to ripen. The seeds never matured either.

The ripening on August 13th, 1944 of this large fruit indicates that this will be a midsummer fruit. My trees have not been injured by any of the low temperatures which have visited the Kampong (possibly 28°F or 29°F was the lowest). The trees go semi-dormant in the winters here.

I think it is worthy of further study and quite agree with Wilson Popenoe who said in his *Manual of Tropical and Subtropical Fruits*. "The ilama is probably the finest annonaceous fruit which can be grown in the tropical lowlands; yet it has not, until recently, been planted outside the region in which it is indigenous. Now that it has been called to the attention of horticulturists, its range should be extended rapidly to all parts of the tropics".



*Annona reticulata*

Continued from page 103

that are almost hairless. Unlike the latter it has a solid, compact fruit that does not fall to pieces when ripe. The fruits of the custard apple are heart shaped and sometimes are, unlike either the cherimoya or the sugar apple, netted with crimson veins or even with a crimson blush, which has I presume earned it the name in Guatemala of "Anona morada" or "Raxpac." In Colombia it is known as the "Mamón." Owing to the too aromatic flavor of the custard apple it is not very generally liked although modified slightly its firmer consistency would make it a better shipper than either of its rivals. It often fruits where the sugar apple fails but is quite as tender.

In the same group of species with those mentioned is the pond or alligator apple (*Annona glabra*) which is so common in the swamps of southern Florida that around Lake Okeechobee it has given its name to the soil formation there — the pond apple soil. This species is sometimes confused with the custard apple from which it can be distinguished by its elongated smooth fruit which has no distinct markings, its smaller seeds and its quite distinct flowers which resemble those of the sour sop and have six petals in two series instead of the three elongated strap-like ones and three rudiments of the custard apple. It is not edible, unfortunately, for were it, there might have been developed marsh orchards of this

aquatic species which is often to be seen standing knee deep in the waters of the Everglades bearing its crop of yellowish green fruit.

As long ago as 1910, Edward Simmonds had growing in the garden at Miami a good sized tree of the sugar apple which he had grafted on a pond apple stock and I recollect seeing on Pine Island, in western Florida, in 1930, a pond apple tree which stood in a shallow ditch, within 25 feet of a pond, upon which Mr. M. V. J. Honc had grafted a scion of the custard apple. It may prove, in other words, a wet land stock for these two species and perhaps others related to them and as such of prospective value. The warmest regions of the East Coast of Florida are along the coast where the land is often flooded and such a stock might prove of inestimable value in the production of orchards there.

The guanábana or sour sop (*Annona muricata*) which differs from the cherimoya and the sugar apple materially in that its flowers are like those of the pond apple, having six thick fleshy petals, is one of the most amazing fruits of the tropics. I shall never forget the first time I saw one of the really large fruits of the guanábana in Panama. It was presented to my son and me and we took it on board the boat coming north. It weighed 25 pounds and was as large as a small watermelon and as I held the dark green thing in my hands I thought it must burst under the weight of juice, for

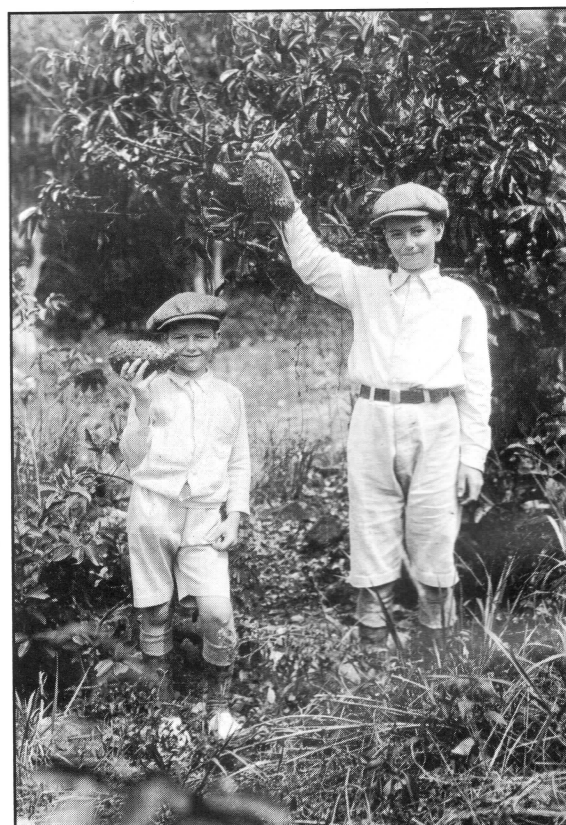
its rind seemed no thicker than the kid skin of a lady's glove.

When we tried to eat its brilliant white juicy pulp we found there were more fibers than those in a mango and we soon learned that it was never eaten, but was drunk. The juice is squeezed out of it and made into the famous "helado de guanábana" of Havana, than which there is no finer flavored sherbet in the world. It is mixed with milk and makes one of the most refreshing drinks called by the Cubans, "champola de guanábana."

I should not give the idea that the guanábana usually produces such large fruits, for as a rule from four to six pounds is considered a good sized one, and in South Florida, where the tree is at the northernmost edge of its range, even two pound fruits are commonest. So far, I have never got track of a named variety of this remarkable fruit that was grafted.

The trees are very sensitive to frost and the cold winds of winter

Continued on next page



Edward and Arlington Sloterdijk, sons of the Harbormaster of Saba, each with a fruit of sour sop. Cuba.

Photo by David Fairchild

even in the warmest parts of Florida often defoliate them. They are so remarkable however and so little has been done to discover the best way to grow them in our gardens there that they are deserving of careful study. The trees are inclined to be prolific if given plenty of organic fertilizer and if the young spiny fruits are carefully sprayed, they can be freed from the mealy bugs which are fond of them and which often deform them badly.

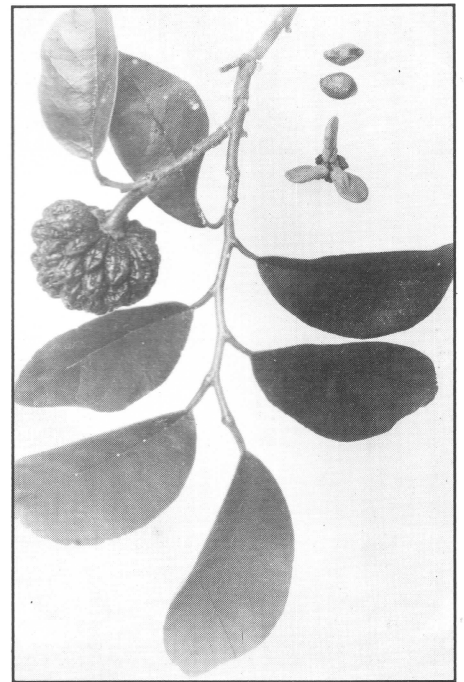
What this species will do if grafted on the pond apple and what spring pruning might do to increase the quantity of fruit are problems tied up with the larger one of breeding it with other annonas. My mouth waters for a taste of guanabana ice, as I write here in Nova Scotia, three thousand miles away from my trees in Coconut Grove.

But these are the well known species of the genus *Annona*. It was only when the quest for other species began and Cook discovered in the region about Cajabón in Guatemala the "Poxté", *Annona scleroderma*, Safford which has a hard shell and a delicious, fragrant fruit flesh which tastes like a sugar apple with a dash of lemon and that separates easily from the seeds; and Popenoe found the beautiful "ilama", *Annona diversifolia* growing and being eaten

by the natives in the borderland of Guatemala and Honduras, a species characterized by having leaf-like bracts at the base of the branchlets; and another thick shelled species of fine flavor growing wild near El Rancho, Guatemala, *Annona testudinea*, Safford; that we realized the gold mine of possibilities which lay in this tropical genus of plants.

Then that indomitable explorer and naturalist C. F. Baker, threw into our lap the seeds of *Rollinia orthopetala* from fruits he had eaten in Pará, Brazil, with a characteristic remark "This is the finest annonaceous fruit of tropical America." It was supposed to have fruits the size of a child's head and of a greenish-yellow color and of delicious flavor. The trees furthermore grew in the flooded woods along the Amazon. It was a swamp species (7). To our delight these seeds grew and one of the small trees fruited and we tasted its delicious, fragrant pulp. The carpels were tinged with orange, making it the showiest of all the annonas we had seen. It was a catastrophe when this *Rollinia* was killed by the 1917 freeze.

This was followed by the arrival of other species of this large genus of trees such as *Rollinia parviflora* from the primeval forests of southern Bra-



*Rollinia* sp. from Bom Fin, Brazil.

Small shrubby plant. Photo by P. H. Dorsett

zil; *Rollinia emarginata* from Horqueta, Paraguay; the Cabeça de Negro from Piracicaba, Brazil, also a *Rollinia*; a shrubby species of this same genus from Bogotá, which Dawe the discoverer reported, had an orange colored fruit; and *Rollinia mucosa* from Calarosa, Colombia.

In the mean time the hunt for other annonas continued to bring in new forms. From tropical Africa we introduced *Annona senegalensis*, which according to some, is a "really delicious fruit with a pronounced flavor." According to the veteran African explorer Schweinfurt "its dark red pulp in a modest degree displays something of that captivating quality which has exalted its kindred plant the cherimoya to its high repute as the Queen of fruits." This has grown exceedingly well in South Florida but has not yet fruited although it has flowered. The striking "soncoya" (*Annona purpurea*) of the lowlands of Central America, whose fruits are as large as a football and covered with strange protuberances and have a fruit flesh of a gorgeous orange color and a flavor of the American pawpaw (*Asimina triloba*), but clinging to the seeds, was another introduction.

*Annona Marcgravii*, (8) a native of Venezuela and Brazil with yellow, intensely fragrant flowers and



*Annona cherimola* grafted onto *A. senegalensis*. From "The Annonas in Egypt", Booklet No. 14. Graft 3 months old. Photo sent to D. Fairchild by the author, M. S. Ahmed.

Photo by M. S. Ahmed



fruit flesh that tastes like "fermented bread dough to which honey has been added, with a sweetish subacid and somewhat bitter taste" according to Safford, was sent by Curran from Colombia and *Annona lutescens* (9) from Sinaloa, Mexico, was sent in, a species which is closely allied to the custard apple but with yellow fruits and tallow-like flesh adhering to the seeds. From the mountains of Puerto Rico came *Annona montana* with fruit having dry, inedible flesh but which might be useful for stock purposes.

Then as if to indicate that the gap between the annonas and the asiminas or pawpaws could be bridged by the plant breeder, Popenoe sent in from the mountains of Pochutla in Oaxaca, Mexico, seeds of a most peculiar tree which he said was rather common there, an unnamed *Sapranthus* which bore its fruit in clusters just like the pawpaw and suggested them in size and shape but had a bright orange flesh which the natives disdained to eat.

While these tropical species of the family were coming in and before the great freeze of 1917 wiped out many of them completely from our collections, the *Journal of Heredity*, Vol. 7 p. 291, through the generosity of Mr. Charles Deering, offered a prize for the discovery of the largest paw-

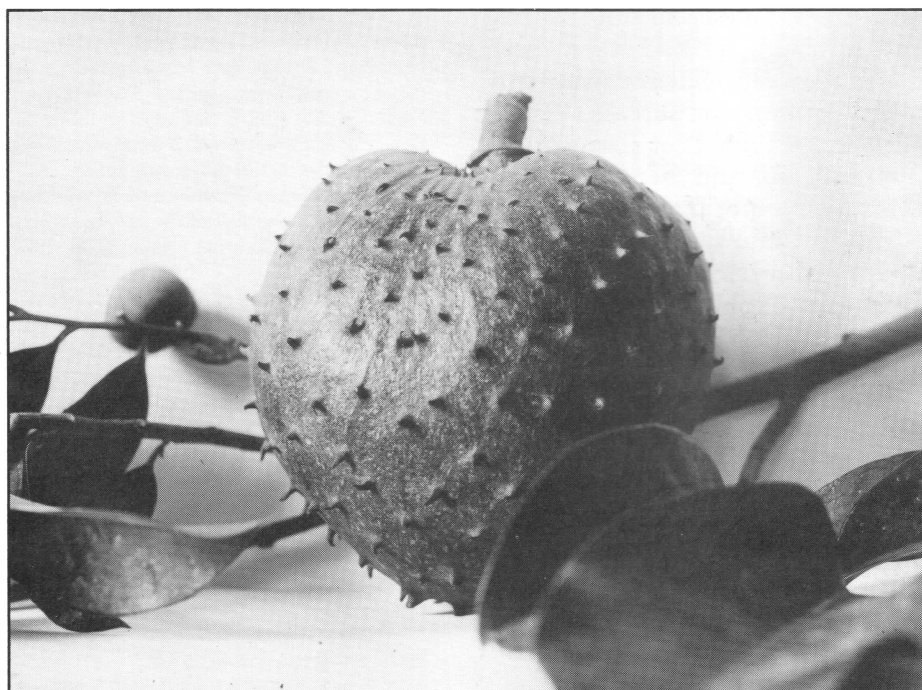
*We have never quite grasped the nature of the problem. It is the maintenance of a collection of living, continually changing organisms of considerable size over a long period of time. This requires a stable organization and the life-time interest of capable men who devote their lives entirely to the problem and do not shift their attention to other fields, attractive though they may appear\*.*

\*Thoughts on creating an *Annona* collection in Florida from David Fairchild's notes on M. S. Ahmed's booklets on *Annona* culture in Egypt.

paw tree in America, and through its publicity located some remarkably large and long lived specimens, and, more than this, some that bore fruits that were of a delicious flavor if ripened on ice, and, not as was the custom, left to rot on the ground below the trees.

I grew from the seeds of one of these prize trees a number of seedlings from which I harvested one year a bushel of fruits of quite unusual excellence. This was before we sold our place in Maryland and went to Florida where I could grow the true annonas, but the experience was enough to make me feel that it was a striking reflection on the imagination of the American plant breeders that aside from Benjamin Buckman of Farmingdale, Ill., who built up an orchard of twelve varieties of the pawpaw and gave them names, the only man who has taken the species seriously is Dr. G. A. Zimmerman of Piketown, Pa., who as a hobby has planted a hillside with pawpaws and is attempting to cross them with some of the southern annonas and by selection to find a superior variety of this strangely neglected fruit—the largest of all the wild edible fruits in the United States. I suppose there are so many people that do not like the pawpaw and see no reason why they should do anything but damn it, that the average plant breeder is discouraged before he even takes the first step towards its improvement (10).

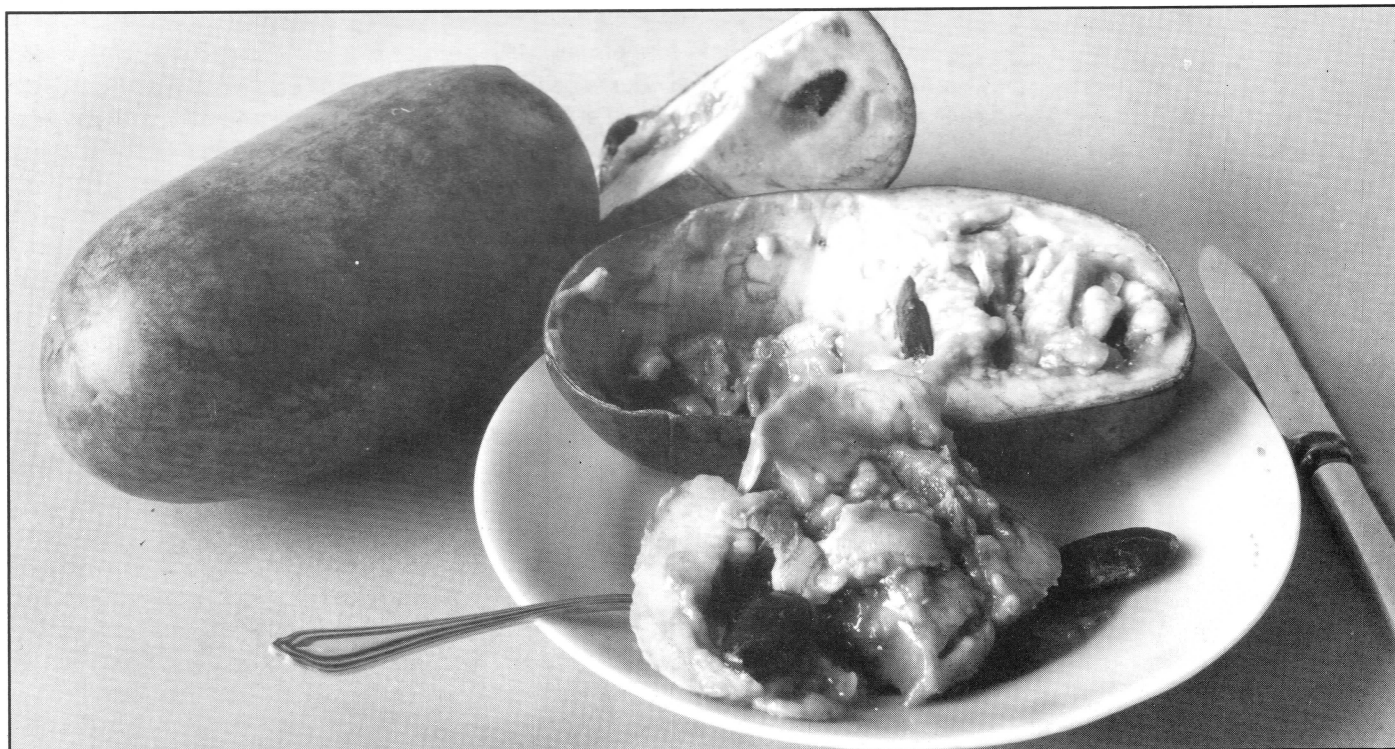
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*Annona montana*. 1937.

Photo from M. S. Ahmed.





Pawpaw from S. L. Martin, Springfield, Ohio. Brought in by Paul Popenoe to be photographed. 1916.

As I remarked at the beginning of this paper, I have indulged myself in what some of my friends will consider a fantastic dream of possibilities instead of "sticking to practical things" but I console myself with the thought that they have not perhaps seen so many of those so called "practical experiments" vanish in thin air as I have. Where are the immense peach orchards of the central valleys of California, or the chestnut forests of the New England states, or the plum orchards of western New York, or the European grape vines which were planted at so many hundreds of places east of the Rockies? The obvious experiments are not by any means assured successes just because they are so obvious.

I am reminded as I write of a sad tragedy which I was a party to and which centered about the cherimoya. In 1911, the office received a request from one of our correspondents in Queensland who had sent to us previously cuttings and seeds of an unusually large cherimoya, asking if we would select a suitable piece of land and buy it for him and have it prepared for the planting on it of an orchard of his particular cherimoya. He went on to say that he was con-

vinced of the commercial possibilities of the fruit and that he did not think the place in which to engage in cherimoya growing was Australia but the United States. He sent cuttings and seeds for stocks and contracted with an American nurseryman to make for him enough plants for a fair sized orchard of cherimoya. He proposed to settle in America as soon as these trees should come into bearing and although he had never seen Florida he was confident that he could make a commercial success of cherimoya there. I could not dissuade him from his plans and therefore did my best to help him but he took other advice, got into the hands of a real estate nursery firm, located the trees on lands too cold for the cherimoya and, in the 1917 freeze they were injured severely and after years of neglect they perished, and he died, and I received a pathetic letter from his widow wishing to sell the land. I have met several such dreamers. The world of invention is full of them and horticulture would not have been where it is today without them.

The Nucleus  
Beinn Bhreagh, Baddeck, Nova Scotia  
March 26, 1937

## Notes

1. Wilson Popenoe studied the fruit in Guatemala, Ecuador and Mexico and introduced the ilama and the tortoise shelled custard apple from Guatemala, Edward Simmonds grew various species and crossed the cherimoya and sugar apple in the Brickell Ave. Garden; and Wester studied the various species in Miami and the Philippines.
2. Popenoe, Wilson, The Native Home of the Cherimoya, Footnote. *Journal of Heredity* Vol. 12 1921 pages 331-336.
3. Flowers open part way when stigma is receptive (female stage); after the stigma has dried and pollen has ripened (male stage), petals finish opening. There is some evidence that under humid conditions the flower's stigma remains receptive long enough to be fertile to its own pollen.
4. Recent studies in Florida and Israel have pinpointed the beetles of the Nitidulid family as prime pollinators (Nagel et al. 1989 and Gazit et al. 1982). There has been little work on pollinators of *Annona* spp. in their native habitats.
5. Hand pollination—using pollen from male stage on female stage flowers.
6. Now thought to be an atemoya.
7. The few *Rollinia* I've seen in standing water were dying. In Amazonia they are grown in the hills. *Rollinia orthopetala* A. DC. = *Rollinia mucosa* (Jacq.) Baill. "good drainage is essential," fruits up to 20 cm in diameter, weighing up to 5 kilograms." FAO Forestry Paper 44/3, Food & Fruit Bearing Forest species; Examples from Latin America, Rome, 1986, p. 273. (Har Mahdeem).
8. Said to synonymous with *A. montana*.
9. Synonymous to *A. reticulata*.
10. See *Journal of Heredity* 1917, Vol. 8 p. 21.

# Zill's *Annona* Project

By Har Mahdeem

In 1984, Zill Nursery started a long-term, self-funded *Annona*-improvement project to develop commercially valuable cultivars for southern Florida.

The project involves searching for cultivars and interbreeding them by manual cross-pollination. The resulting seedlings are grown to maturity; those which show several desirable characteristics are then selected for further observation. Eventually, the best of these will be vegetatively propagated for sale.

In our search for the best cultivars for breeding we have experimented with grafted cultivars from nurseries in Florida and California. We have also explored three areas of Central America for new cultivars: Belize and adjacent northern Guatemala, some parts of the Yucatán peninsula, and southwestern Guatemala. In these places, though we were working in the native habitats of the species, we spent our time not in the forests but in people's yards. We were looking for the best results of a thousand years of adaptation and domestication by the Mayans, and the selections we made, named after the owners or towns, were brought back to Florida as graftwood. Some of these acquisitions are prov-

ing to be of value "as is", besides being good parents for hybridization.

During the first three years of our project, most of our hybridizing experiments were with the 'Priestly' atemoya, 'M-1' (species uncertain) and the 'Fairchild Purple' (*Annona reticulata*). These are all poor producers, so it's not surprising that most of the resulting hybrids which have fruited so far have also proved to be poor producers. They also often suffer from one or more other inherited problems such as: grittiness (from 'Fairchild Purple'), pollen sterility (from 'M-1'), exaggerated susceptibility to mealy bugs (especially 'M-1'), and, in a few cases, total knobby ugliness (from 'Priestly').

In 1985, we began using pollen from three of the new *A. reticulata* cultivars. The hybrids fathered by 'Benque' and 'San Pablo' which have fruited so far have mostly been of good texture and taste, though not very colorful. Hybrids of 'Sartenaya' and the 'Priestly' atemoya have grown huge, but haven't fruited yet.

We also pollinated with *A. diversifolia*, but most of the resulting hybrids lacked the vigor to survive, many dying in the seed flats, others dying after growing to five feet tall. None of the survivors have yet fruited.

Despite these setbacks, a hundred hybrids mothered by 'M-1' or 'Priestly' have produced fruit under conditions that allowed for a fair evaluation. About a dozen of these merited further observation because of their fruits' 'good eating' qualities and acceptable appearance. Most of these have since fallen out of favor however because of pollen sterility, disease susceptibility or poor production. Some of these may still prove worthwhile if grown on good rootstock in a well maintained planting. In the meantime, our moderate success rate does offer us hope for the more than 1,000 hybrids of better parentage which will be ready to fruit

in the next two years.

After the first fruiting those hybrids which have fruit of good quality will also be observed for another year for health, productivity, and pollen viability. Those that show promise will be grafted onto several different sorts of rootstocks and observed for a few more years. Sometimes a cultivar may grow well on a certain type of rootstock for a year or more and only then develop "delayed incompatibility" and die. Once we are sure the hybrid has been fully evaluated, it will be propagated. From then it will be another year and a half before the hybrid reaches a saleable size.

Zill's *Annona* project is an expensive, long range plan which would be spoiled by half-evaluated releases. One day however, we hope to have some worthy *Annona* cultivars that we can recommend for commercial growing in South Florida.



Under a papaya (*A. diversifolia*) tree in southwestern Guatemala. Obispo, a Amerindian of the language Mam, and Har Mahdeem.

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Boynton Beach, Florida.

Zill nursery began in 1930 when L. H. Zill, then 16 years old, made his first approach and "bottle" graft of a 'Haden' mango. He then learned how to "T" bud. In 1933, he grafted 200 plants, thereafter doubled his production every year, until Zill nursery was producing 35,000 trees. In 1986, L. H. Zill retired and his son Gary took over the nursery which has since moved to another site in Boynton beach and renamed Zill's High Performance Plants.

Har Mahdeem came to work for the nursery in 1982. Among his other jobs at the nursery Mahdeem has responsibility for the hybridizing experiments of Zill's *Annona* project.

# Best of the Annonas

By Har Mahdeem

## Cherimoya cultivars

Floridians have been trying on and off for about a hundred years to grow the cherimoya (*Annona cherimola*) without much success. In Florida, leaves and fruits usually sunburn, and are highly susceptible to anthracnose damage. In addition, for some mysterious reason most cherimoya cultivars drop their fruit after the seeds mature. The pulp does not mature and proceeds to dry or spoil, never ripening. It also should be pointed out that a cherimoya is unlikely to produce any fruit at all unless it has been hand pollinated.

In 1987, for breeding purposes, Zill's High Performance Plants acquired from nurseries in California grafted trees of the following eight cultivars: 'Bay Ott', 'Chaffey', 'Dr. White', 'Libby', 'Nata', 'Orton', 'Selma', and 'Spain'. Of the first seven, 'Honeyhart' and 'Orton' have foliage that's well adapted here, but none of them mature their fruits' pulp.

'Spain' is the exception. It has hardy foliage and in dry weather, and with hand pollination, it will set a heavy crop. A few fruits of 'Spain' actually get close to normal California size, while the smaller fruit ripen deliciously. In wet weather 'Spain' fruits are as riddled with anthracnose as the fruits of the other cultivars.

For commercial growers and most homeowners, atemoyas (*Annona cherimola* x *Annona squamosa* hybrids) are a much better choice. But for those home owners who want a pure cherimoya, 'Spain' is the one cultivar I can recommend, and plants from Zill's can be obtained through retail nurseries.

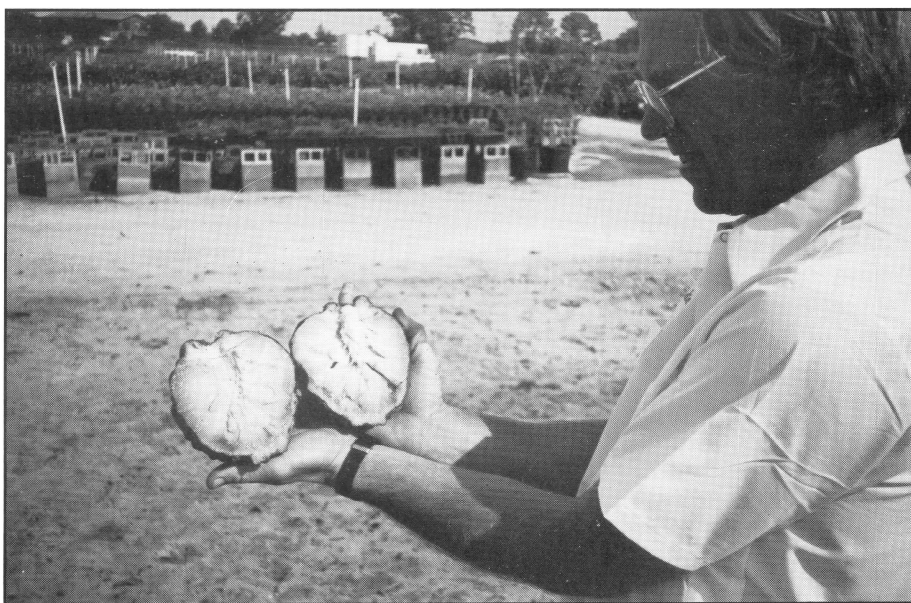
In the future it is probable that some better cherimoya cultivar will be introduced to Florida, or be developed here.

## Ilama cultivars

Because the ilama (*Annona diversifolia*) is so delicious, its seeds have been optimistically carried from its native habit in western Central America to several other parts of the world. Most of these attempted introductions have failed, since freshly planted ilama seeds will not germinate and they eventually rot. In Guatemala, an Amerindian told me he keeps clean seeds in a cool, dry place for a year, then plants them about one inch deep at the start of the rainy season. He says they almost all

soaking ilama seeds in 350 ppm gibberellic acid. I have tried gibberellic acid, storage, and dipping into boiling water and have obtained a few germinations in the first two cases, none in the latter. I have not tried drying in the sun.

Rather than bothering with ilama seeds, we have preferred, in our visits to various communities in southwestern Guatemala, to ask about the best trees to obtain graftwood which we later graft on to *Annona reticulata* seedlings (or *Annona glabra*) here in Florida. These



Gary Zill with hybrid of 'M-1' and 'Fairchild Purple'

Photo by Har Mahdeem

germinate within one week. At the Brilhantes Experiment Station I was advised to dry fresh ilama seeds for six days in full sun, then put them in a basket and pour boiling water over them and quickly baffle them with a blanket to prevent rapid cooling. An hour later the seeds should be planted, resulting in germination in about a week. Another recommendation is to simply throw fresh seeds and peels among weeds under the trees; a few of these seeds will germinate months later, to be transplanted to sunnier spots. Other suggestions are to put seeds under rocks in sun; or dry seeds in full sun for three days, store, and plant after a year, with germination expected in a week.

In Florida much improved germination has been claimed after

introduced ilama cultivars are still very much under evaluation—some of them still in post-entry quarantine.

As a result of four trips to Central America, we have introduced the following cultivars to Florida:

1. 'Pajapita', from the town of the same name. It is a medium sized fruit, with a smooth, pinkish, and lightly cracked skin that unfortunately turns brown when ready to eat. The pulp is dark pink or light reddish. (From 1985 trip.)

2. 'Genova White', from the town of Genova. It has a smooth green skin with a white blush and is lightly cracked. Its pulp is white, lightly perfumed, sweet-tasting, with small seeds. It is a good producer. (From 1985 trip.)



3. 'Guillermo', from El Xab. The fruit is large with whitish-green skin and large rounded bumps, deeply cracked. The pulp is dark pink. (From 1985 trip.)

4. 'Nilito', also from El Xab. The fruit is small with a blue green, slightly bumpy skin. The pulp is red. (From 1988 trip.)

5. 'Román' from El Xab. The fruit is small with blue-green and maroon, rough skin. The inside of the fruit has a purple pulp, a small core and small seeds that "come clean" (ie. pulp doesn't cling to seeds). The taste is sweet, lacking acid and mealy. (From 1988 trip; hasn't fruited here yet.)

6. 'Genova Red', from Genova. The fruit is large pinkish-green, smooth with deeply cracked skin. The pulp is reddish and has a delightful tart flavor. (From 1988 trip; graftwood from 1985 and 1987 trips died; has fruited here but went to waste untried.)

7. 'Efraín', from the community of Betania near Pajapita. The fruit is said to have a light pink pulp and the tree is reported to produce as many as 200 fruits a year. Judging from the number of fruit stems we saw still clinging to the tree, this seems quite possible. All the fruits had been harvested and sold. (From 1988, trip; hasn't fruited here yet.)

8. 'Gramajo', from Betania. The fruit is very large and has a beautiful heart shape. The skin is thick, pinkish-white with a regular pattern of large rounded bumps. The pulp may be purplish-pink, judging from the unripe fruit we cut open. (From 1989 trip, graft wood from 1988 was lost en route, it hasn't fruited here yet)

*No plants of these recently introduced cultivars are available for purchase, nor will they be for at least another year.*

Another named ilama cultivar in Florida is the 'Imery.' It has been propagated occasionally for quite a long time and has large, perfectly round, smooth and pink skinned fruits which turn dark gray brown when soft-ripe. The pulp is dark pink and is sometimes tasty but usually light on flavor. There are often dark, inedible defects in the pulp and the

'Imery' is particularly prone to producing unpleasant tasting fruits after a wet summer.

The 'Fairchild' ilama produces medium-sized fruit. The fruit are elongated and slightly bumpy, with a whitish-pink skin. The pulp is pink, often better flavored than 'Imery', and without the latter's internal defect.

'Rosendo Perez' is another ilama cultivar that can be found in Florida and is said to be of excellent quality.

There is at least one other wonderful cultivar, probably better than all the above, still to be obtained from that same area of southwestern Guatemala. We have been unable to bring it to Florida because we haven't yet found the tree. We bought several fruits of this cultivar at the Coatepeque market, from a vendor who had bought them from another vendor; she thought he may have come from this or that other place. Pepe Escobar, the taxista, Gary Zill,



Basket of ilamas in Guatemalan marketplace

Photo by Har Mahdeem

and I spent the next two days walking to each of the places she suggested, carrying a halved fruit with us, one of the places being a good 5 km beyond a drivable road. We never did find the tree of our "market beauty". It was a medium-to-large fruit, oval, with a leathery, nearly smooth, dark blue-green skin. The skin's design was different from any design I've seen on ilama or any other species; it consisted of lightly raised brownish ridges in irregular intermingling swirls like a Van Gogh painting. The pulp was brilliant red throughout and more vivid than any other ilama cultivar we've seen. The seeds came out "clean"; the flavor was excellent, lively sweet-tart and strawberry-like, with the wonderful aroma that belongs only to ilamas.

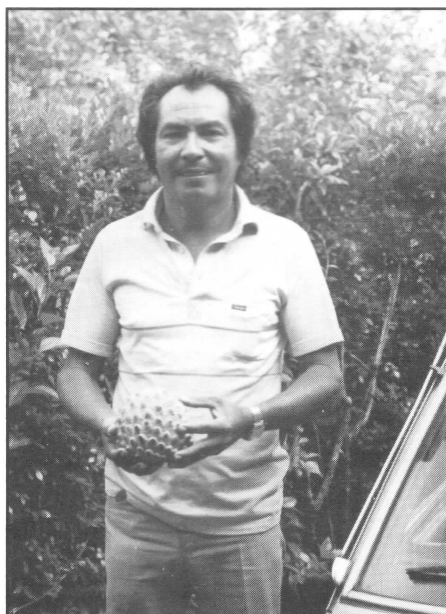
### Soursop or Guanábana

I don't know of any cultivars that are cold hardy or productive enough to recommend for southern Florida. Finding such a cultivar would be a "find" indeed.

### Custard apple (bullock's heart) cultivars

For a long time there's been in Florida a cultivar of bullock's heart (*Annona reticulata*) which we at Zill's

*Continued on next page*



Pepe Escobar with "Gramajo" cultivar of *A. diversifolia*

Photo by Har Mahdeem





Mrs. and Mr. Leodegario Dominguez with L. H. Zill.

Photo by Har Mahdeem

nursery refer to as 'Fairchild Purple'. Indeed it has the most rich, dark red-purple pulp that we've seen in any species of *Annona*, and it has the smallest seeds we've seen in any *A. reticulata* cultivar. It also has probably the most sandy and gritty (stone cells) pulp of any bullock's heart we've tasted—it makes one cough. It produces few fruits and these few are extremely susceptible to anthracnose. In 1984, I found that when 'Fairchild Purple' was used as a pollinator of atemoyas, it produced healthy hybrids.

L. H. Zill, who has a home in Belize, has been traveling through Belize and Guatemala with his employee Leodegario "Gio" Dominguez, selecting creamy, usually colorful, good flavored bullock's hearts. As the result of these travels, the following cultivars have been introduced into Florida:

1. 'Tikal'. This is the result of a recent trip by L. H. Zill, Gary Zill and Gio Dominguez, who went into the Petén Department of Guatemala as far as Tikal, and selected perhaps the best one of all in the town of El Remate, near Lake Petén Itza. They named it 'Tikal'. The pulp is brilliant red throughout except for some white around the seeds and core. It is of excellent eating quality. It hasn't fruited in Florida yet. It grows well

on *Annona glabra* rootstock, or at least has done so for two and a half years.

2. 'Canul'. The fruit is medium sized, with a waxy shiny skin that is night-red in color. The pulp is a pretty purple, deliciously sweet and very aromatic. It is without grittiness but is often lumpy in texture near the seeds. It does not grow well on *Annona glabra* rootstock.

3. 'Sartenaya'. It has red skin and dark pink pulp, but is not quite

as pretty as 'Canul' or 'Tikal'. The pulp's texture and flavor are perfect. The tree is more vigorous than 'Canul' or 'Tikal'.

4. 'San Pablo'. The fruit is large and elongated with a red skin. The pulp is dark pink, of good texture and good flavor.

5. 'Chonox'. When this tree is in good shape there is an extraordinary amount of flowering and a heavy harvest, to the point of draining the tree and leaving it fruitless the following year. The fruit has a red skin and pale pink-cream pulp which is of good texture but low in flavor. Too many fruits and too few leaves could be contributing to this lack of flavor which might be remedied by better growing conditions and thinning of fruits.

6. 'Benque'. The fruit are very large, fat and cone-shaped with a rough black-red skin. The pulp is dark pink, of good texture and flavor.

Bill Lessard brought seeds from an excellent fruit from the foothills of northern Guatemala near Mexico and grew them in Homestead. The best one he named 'Mona Lisa' after his daughter Lisa.

The fruits of the 'Mona Lisa' are described by Lessard as weighing 2-4 1/2 lbs, with a smooth, dusky red glowing skin when ripe; the gritless,



"Market beauty", *A. diversifolia*

Photo by Har Mahdeem

creamy-smooth pulp is red. (One year, however, it produced a crop of pale pink pulped fruits.)

The 'Emerald', a seedling of 'Mona Lisa', has a smooth glowing green skin when ripe, blood-red smooth pulp, and is as sweet as a sugar apple. I have not seen these two varieties and they are currently unavailable for purchase.

There are probably other good cultivars of *A. reticulata*, but is doubtful that there any cultivars much better than the ones we have already collected here in South Florida.

Trees of 'Tikal', 'Canul', and 'Sartenaya' are available for purchase through retail nurseries.

## Sugar apple

Good tasting, green skinned sugar apples (*Annona squamosa*) have been around southern Florida for quite some time. Of particular renown are the "Lessard Thai" group of seedlings, which apparently differ from each other only in productivity. There have also been some seedless sugar apples which are otherwise of note for the way the bottoms of the fruits split spread wide open while still hard, and in the way the pulp remains dryish and very bland in flavor even when fully tree ripened. There are also "purple" sugar apples that are so small and dark they look mummified. These and other pinkish or reddish-skinned cultivars have so far proved to be uninteresting in flavor, low in vigor and poor in productivity.

The one sugar apple cultivar that I would currently recommend, is unfortunately, of obscure origin. Here at Zill's we've sold a few labeled as "L.P." for "Lessard Pink" because we got our graftwood from Bill Lessard. Lessard sold them as "Elsie Page" from whom he had obtained his graftwood (and she from someone else...). We have all agreed in this case to forget origins and just call it 'Red Sugar'.

The skin of 'Red Sugar' is bright red both inside and out. The pulp is smokey-white, with some of the red



Har Mahdeem next to a *Rollinia* fruit.

Photo by N.R. Cockshutt

from the inside of the peel showing though. The flavor is as good as that of good green-skinned cultivars. The fruit is medium sized, the bumps on the skin are not exaggerated, and productivity is good. We can find no fault with this cultivar as compared to other cultivars of this species.

## Muvulu

The muvulu (*Annona senegalensis* = *A. chrysophylla*) is still in the curiosity category in Florida, and is very rare. I am familiar with only one cultivar, the one from the Montgomery Foundation of Fairchild Tropical Garden. This 'Montgomery' muvulu produces very small fruit, 2-5cm long and about 1cm less in width, although they probably get larger sometimes. The extremely thin peel is smooth with a net design. When immature the skin color is green with a white splotch marking each areole; when ripe the peel is all dark yellow-orange with brown splotches and very soft. The pulp is a bright yellow orange, at once rubbery and buttery, with a sweet, palm-fruity flavor; the pulp does not cling to the several seeds embedded in it. Total weight of harvest is low. The trees are sturdy

and handsome.

If muvulu plants become available for purchase in the future, they may be of interest to collectors who have room for large and diverse plantings, and should be attractive to those having a particular interest in the fruits of Africa.

The muvulu is a highly variable species, differing widely in the size, shape and habitat of the tree; in the appearance of the foliage and fruits; and in flavor—from wonderful to pitifully worthless. Presumably the 'Montgomery' cultivar is a well-above average selection. Nevertheless, further selection of the muvulu should be pursued throughout areas of its vast range (West Africa, East Africa and southern Africa). Graftwood should be obtained of the selections as getting muvulu seeds to germinate is difficult, and grafting will preserve exactly the characteristics of the finds.

## Biribá

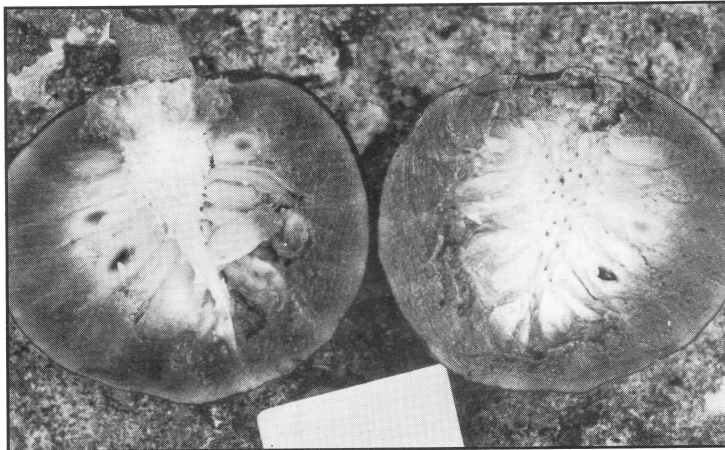
I don't know of any named grafted cultivars of the biribá

*Continued on next page*

(*Rollinia orthopetala* or *R. mucosa*). Other common names include "araticum pitaia", "condessa", "ata" and "pinha". Perhaps originally from western Amazonia but now common from Mexico and the West Indies to southern Brazil. Everyone grows them from seeds. Trees grow up to 10m tall. Most biribá cultivars produce excellent fruits of good appearance, flavor and aroma, and all of them have pulp which is perfectly creamy-smooth in texture. Some have huge fruits, some have brighter yellow peels, some have fewer seeds, or slightly better flavor or aroma. Fruits of most cultivars are covered with large fleshy spines which, though striking in appearance and fine on dooryard fruit, are serious drawbacks in handling for market, as the spines slough off or bruise and blacken. Non-spiny cultivars do exist in Amazonia and Costa Rica and should be vegetatively propagated for commercial plantings.

The biribá should not be allowed to get over ripe. Nor should fruits be eaten that have ripened during the winter when cold weather has damaged the foliage or denuded the tree—such fruits are nasty and bitter. After a freeze, any immature fruits should be removed, so the tree won't waste any more energy on what will be worthless anyway. The trees will set new fruits again in spring and early summer and these will be good.

There is a lot of taxonomical confusion about this fruit which has been variously called *R. pulchrinervis*, *R. deliciosa*, *R. mucosa* and *R. orthopetala*. Though it is agreed that that the fruit of these supposedly different species are indistinguishable or nearly so, the orientation of the petals ("paddles"), whether they point down or up or are horizontal to the ground, is used to indicate a different classification. For this level of differentiation, subspecies names would seem to be sufficient and these distinctions should



*A. reticulata* 'Benque'

Photo by Har Mahdeem

be made with flowers hanging naturally from a branch, not upside-down

the best of the *Rollinia* genus be classified in a similar manner.

herbarium specimens.

According to some the correct name of the biribá should be *Rollinia mucosa*, Jacq. as Mr. Jacquin was the first to describe it. In this case however, to rigidly follow this taxonomic rule of precedence is a great disservice to a wonderful fruit. As the *Annona* genus' most celebrated fruit is classified by its common name (*A. cherimola*, cherimoya), perhaps its not to much to ask that

### Ideals for Individual Cultivars

- ✓ **Eating quality:** delectable flavor and aroma, smooth texture (no grittiness, chalkiness, or bothersome fibers), non-clinging pulp or seeds that "come clean", lots to eat, and not too seedy—a good pulp-to-seed ratio.
- ✓ **Appearance:** symmetrical shape and interesting skin design, bright colors, outside and inside, lack of defects or bruises.
- ✓ **Fruit hardiness:** tough skin, resistant to insect attack, sunburn, handling and post harvest refrigeration.
- ✓ **Tree hardiness:** Vigorously healthy growth, resistant to insect attack, disease, wind, cold, full sun, and drought; compatible with one of the good available rootstocks.
- ✓ **Pollen viability:** pollen should be fertile, effective.
- ✓ **Flowers:** should be numerous, with an aroma attractive to pollinating beetles.
- ✓ **Easy to cultivate:** the limb structure and sturdiness should not require too much pruning or propping, or a branching pattern that makes it hard to get at the fruit. The fruit should change appearance when they are mature but still hard, so they can easily be distinguished from immature fruits when it is time to be picked for shipment and marketing.
- ✓ **Season:** should be at a time of year when there are not too many similar fruits on the market.
- ✓ **Production:** the tree should produce every year.

### Ideals for all *Annona* cultivars

- ✓ **Variety:** there should be annonas of different flavors, aromas, sizes, shapes, colors, textures and skin designs for customers to choose from at any one time.
- ✓ **Seasons:** different annonas of several types should be marketed each season of the year.
- ✓ **Production locales:** There should be available to growers cultivars adapted to many different climates (temperatures, day length, moisture, wind), and compatible with rootstocks adapted to different soil conditions.





*Annona scleroderma*. 1904 in Cajabón, Guatemala.

Photo by O. F. Cook

# ***Annona* *scleroderma*: A New *Annona* for Florida**

**By Har Mahdeem**

The cawésh (*Annona scleroderma*), with which I became acquainted in southwestern Guatemala, is currently my favorite *Annona*. It has not yet fruited in Florida (1); several five to eight foot trees are now growing in different locations in southeastern and southwestern Florida. If they prove to be somewhat cold hardy or if they experience mild winters, the trees should fruit in February of 1992.

## **Fruit**

The sweet-tart flavor is similar to *Monstera deliciosa* or to banana-pineapple purée—refreshing and lively. A halved fruit makes two sturdy bowls from which very smooth, cream-colored flesh is easily spooned

out. The pulp melts off the many large (2-3cm), shiny, dark brown seeds, because the pulp has no grit. In the better cultivars there are no fibers in the pulp or any membranes clinging to the seeds. The fruits are round, slightly flattened at the poles, or indented at the stem, and are 5 to 10cm in diameter. The 3mm thick skin is leathery, but readily gives to touch when ripe; after the fruit has been eaten and the remains have dried, then the skin becomes hard and shell-like. Ripe cawéshes are green in color, sometimes with unattractive black or brownish splotches. The skin design varies from smooth with a network of colored lines, to smooth with a network of sharply raised ridges, to bumpy with ridges around or partly around the bumps, to bumpy without ridges.

## **Flower**

The flowers are greenish-yellow and both the flowers and their clusters resemble the flowers of *Annona reticulata*. Among the cultivars of *Annona reticulata* the clustering of flowers differs: on some cultivars one finds 1-4 flowers per flowering location; on other cultivars ('Chonox', for instance), one finds as many as 16 flowers massed together—

the cawésh resembles the latter sort. However, the cawésh flowers have a ridge lengthwise down the outside of each petal, and the clusters originate directly out of old wood, so the fruit are borne along the bare branches on the inside of the canopy, not among the leaves.

## **Foliage**

The foliage is mostly on the outer two meters of the branches. The thick, stiff leaf blades are 10 to 25cm long and 5 to 8cm wide on mature trees (up to 35cm long and 10cm wide on vigorous juvenile trees). They are shiny and waxy on top and ever so slightly rusty underneath, with the midrib being more noticeably rusty. The small, still-closed new growth is felt-like and rust colored, but quickly turns a shiny, light greenish-yellow when it opens and expands. The general appearance of the foliage is reminiscent of the mountain sop (*A. montana*) or the unrelated caimito (*Chrysophyllum cainito*). The 1 to 3cm petioles are brittle and the leaves are big and stiff, so leaves are easily broken off by wind; strong winds have completely defoliated exposed trees. The leaves have very little odor, much like guava leaves.

*Continued on next page*



## Tree

The tree presumably evolved in tall forests, though nowadays it grows here and there in back yards or as shade for coffee bushes in the hills between the Pacific lowlands and the volcanoes, ranging from altitudes of 300 to 1,000m. The trees are rare; most people in this area of southwestern Guatemala have never seen or eaten the fruits. Seedlings, which start bearing fruit at about four years of age and 4 to 6m in height, usually continue growing to at least 15m in height and often up to 20 or even 25m high. Trunks measure up to 1/2m in diameter. Trees growing in plenty of sun are heavily branched, starting 2 to 4m above the ground. Crops are usually heavy, with harvest times ranging from early January to early April, but mostly in early February. The fruits usually do not fall when ripe; harvesting requires climbing agility, a long-handled picker, a bag with a long rope attached (or a tough-handed catcher on the ground), and, preferably, a ladder to reach the lowest branch.

## Cold hardiness

Cold hardiness of mature trees is not known. Tiny cawésh seedlings, protected from wind inside a shadehouse and covered with a protective coat of ice from overhead irrigation were killed by the two days of 28-30°F freezes in December 1989. Those seedlings among them with trunk diameters of 3mm or thicker dropped their leaves and their tender tips and survived, but didn't regain their vigor until well into the following summer. At the Fruit and Spice Park, in Homestead the temperature fell to 24°F and killed an unprotected, field planted, seven foot tall seedling (2).

## Pests

Woodpeckers, orioles, grackles and jays will peck a hole in the cawésh fruit and eat all the pulp out. None of the trees or fruit I've seen have shown any insect damage. I suspect that the cawésh may be immune or at least resistant to *Annona* seedborer, though some told me otherwise—they

may have been describing the problems of *Annona reticulata*, which grows in the same area and is sometimes called by the same name. Its fruits are usually riddled by *Annona* seedborers. Another person has described what were probably scales or mealy bugs infesting cawésh fruits. Everyone I have spoken to who has a fruiting cawésh tree has told me that they have never seen insect damage on the fruits or on the tree.

## Propagation

Fresh cawésh seeds germinate readily (about 90% in a month) but dried seeds can take about six months to germinate. All the grafts we attempted with cawésh after each of



Cawésh (*A. scleroderma*) fruit from a tree in the backyard of Arcelán Martínez Gomez. Photo by Har Mahdeem

my four trips to Guatemala failed. However, in Australia, Alan Carle has *Annona scleroderma* trees growing on both *Annona muricata* and *Rollinia mucosa* rootstock.

At the Brillantes Agricultural Research Station, in the Guatemalan Department of Retalhuleu, cawésh has been experimented with as a rootstock for *Annona reticulata* although I don't know the details.

Here in Florida, I budded three cawésh seedlings with *Annona cherimola*, which failed; three others with *Annona diversifolia* which failed; three with atemoya, one of which lived and is growing; and three with *Annona reticulata*, two of which are still growing. When the tips of these cawésh seedlings were cut back to force out the grafts, the seedlings over the next couple of weeks slowly

exuded 1/2 inch long piles of sap at the cuts.

Though young seedlings can grow slowly in full sun, they grow several times faster in partial shade.

## Conclusion

The excellent taste of the cawésh indicates it could be a marketing success, and the skin's toughness points to superiority in shipping. Whether or not South Florida weather will allow a winter or spring-harvested *Annona* crop to become a commercially viable endeavor remains to be seen. Perhaps with wind breaks, freeze protection, netting to protect the fruits from birds and pruning for harvesting ease, grafted cawésh trees could become a commercial crop.

In my opinion, it will at least prove to be important as a parent of hybrids and will probably be useful as a rootstock. I have high hopes for the cawésh as a dooryard planting, for inside its plain wrapper there is pure delight.

## Notes

1. In two or more *Annona* collections here in South Florida there have long been some specimens labeled as *A. scleroderma*; though I've not seen the fruits or flowers of these I can say that the trees bear no resemblance to *A. scleroderma*. I suspect that these are specimens of *A. reticulata* var. *primigenia* ("natural" or botanical variety, not cultivar) the primordial, wild unimproved *A. reticulata* (which I've seen in S. W. Guatemala), which by the marked contrast between its small (up to 4 cm), almost worthless fruits and those of the cultivated sorts of *A. reticulata*, provides one of the better illustrations of the results of the multi-millennial horticultural endeavors of the Mayans.
2. In Australia, an article about growing *A. scleroderma* in Australia appeared in the Rare Fruit Council of Australia Inc.'s March, 1990 *Newsletter*. The *A. scleroderma* tree is 6m tall, grafted onto a "Mexican soncoya", and has produced two bountiful crops. The lowest temperature it has experienced is 4°C (39°F), which resulted in no defoliation or other signs of stress. It would seem that *A. scleroderma* is less cold sensitive than soursop (*A. muricata*). This article will be reprinted in an upcoming issue of the Rare Fruit Council International's publication *Tropical Fruit News*. (P.O. Box 561914, Miami, Florida 33256, \$25 per year.)

# Heat Production in the Flowers of an Annona

By William Tang

The Annonaceae is an archaic family of flowering plants. Like other primitive angiosperms many annonas have pollination systems involving beetles, including those of the genus *Cyclocephala* (2,4). Studies of some wild annonas indicate that beetles are attracted to their flowers by the sweet or fruity odors that they released during the evening (2). If you have an *Annona* in your yard you may have noticed such odors in the spring when they come into bloom.

I recently began studying heat production in the flowers of annonas. Like many plants with succulent pollination organs, the fleshy flowers of annonas may produce heat to help volatilize the odors they produce. Heat production is known to occur in the flowers of aroids and waterlilies and in cycads and many palms (1, 3, 5). Heat production has recently been reported in several wild annonas in Brazil (2). Of the specimens in the collection of Fairchild Tropical Garden one dwarf species collected from Paraguay, tentatively identified as *Annona cornifolia*, demonstrates heat production clearly (fig. 1). This species is a shrub growing to no more than 1 to 1.5m high. Its flowers, when mature, are cream-colored and shaped like an inverted cup (fig. 2). At sundown these flowers show a dramatic rise in temperature and a strong fruity odor is released. It appears to require a specialized pollinator as no fruit have set on these cultivated plants.

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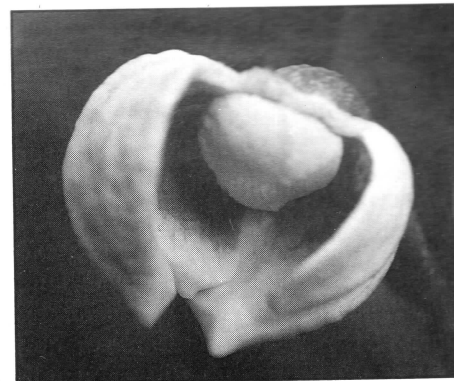


Figure 2. A mature flower of *Annona cornifolia*. Two of the fleshy petals have been removed to reveal the crimson-colored inner chamber.

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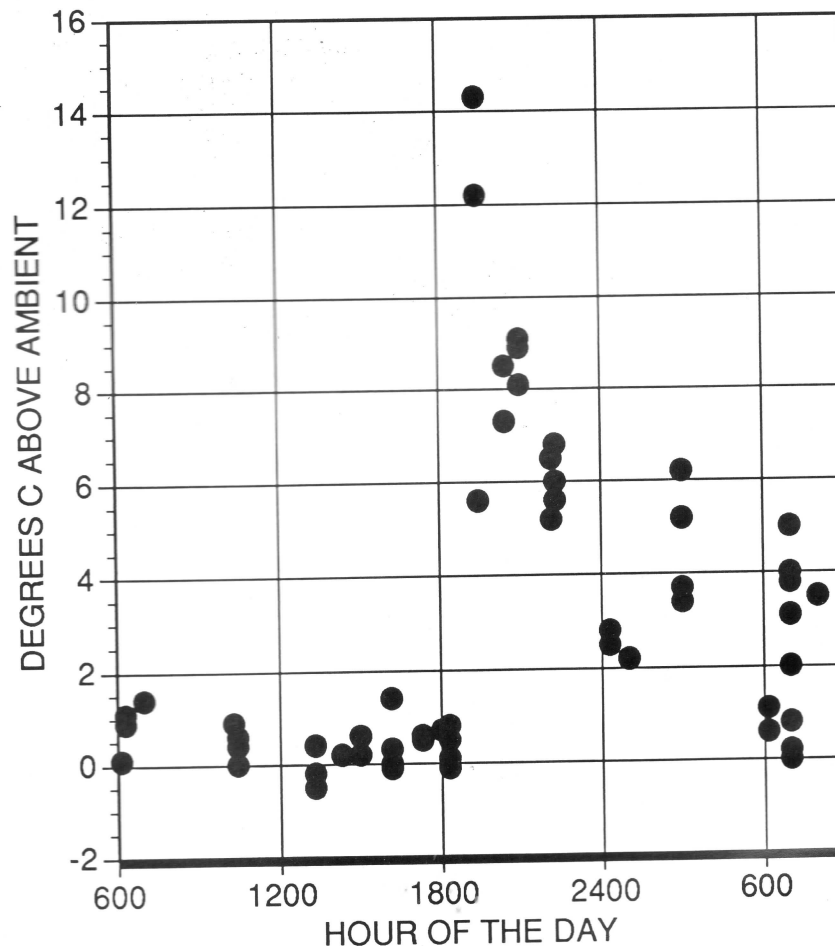


Figure 1. Temperatures of 29 mature flowers of *Annona cornifolia*, measured as °C above ambient air temperature, plotted against hour of day. Flower temperature rises dramatically just after sunset and heat production continues until petals are abscised shortly before or after sunrise the next day.

William Tang is a collaborator on the adjunct staff of FTG's Research Center at the Montgomery Foundation. He has published research papers on cycad pollination and seed dispersal.

# Other Annonaceous Fruits

There are perhaps over 2,000 species in the family Annonaceae. Most of the *Annona* genus and all of the *Rollinia* genus are found in the New World, but the family is predominantly found in the Old World.

Little is known about many of these annonaceous species. The fruits of some species have never been described; sometimes only one fruit was seen and described, or else, the several fruits described only came from just one or two trees.

So far, I have only tasted fruits of a dozen Annonaceous species and some hybrids, but I have read of many more species that I would love to meet up with. This list is a selection of some of the more interesting genera and species.

—Har Mahdeem

## Annona Genus

100 or more species. Leaves are alternate, 2-ranked, entire, and without stipules. The typical flower has a 3-parted calyx, and 6 petals in 2 series, the inner petals alternating with the outer; in all cases the outer petals are edge to edge. In some species (*A. muricata*, *A. montana*, etc.) the overlapping inner petals are broadly rounded and somewhat smaller than the outer. In other species the inner petals are scarcely larger than the stamens (*A. squamosa*), or nonexistent (*A. acuminata*). In several species abnormal individual flowers may develop with 4 or 8 petals. The flowers are hermaphrodite and protogynous with the stigmas maturing before the pollen sacs dehisce. In most species, the seed coat is thin and membranous revealing the wrinkles of endosperm underneath.

### *A. bullata* Rich.

"Laurel de cuabal" (...of rocky places). Cuba, West Indies. Small hardy tree on dry soils. Fruits yellow, hard, small, seedy, sour or tasteless, dry, unfit for the table, but pigs like it. Leaves eaten by horses and cattle. The leaves have a close network of prominent veins. The wood is aromatic like laurel. (4, 9)

### *A. coriacea* Mart.

"Araticum-do-campo", "araticum-de-tabuleiro" (...tablelands), "araticum Liso" (...smooth). Eastern and central Brazil and northeastern Paraguay. Narrow shrub to 5m, twisted trunk, on sand bars and sandy, sparsely vegetated plateaus. Fruits to 22 x 15cm, usually mis-



"Araticum-guazú-del-campo (*Annona dioica*) from Paraguay. The two trees growing at Fairchild Tropical Garden are a result of seeds sent by Clarence Johnson in 1968.

Photo by Clarence Johnson

shapen, areoles not very apparent—marked only by depressed lines, sparsely covered by rusty hairs; pulp white or light yellow, of pleasant flavor. Ripening in October, or later. The leaves are wide and leathery. (1, 4, 5, 6)

### *A. cornifolia* St. Hil.

"Cuyaba", "araticum-das-Caatingas", "araticum-do-campo", "araticum mirim". Eastern and central Brazil and Paraguay. Small shrub 30cm to 4.5m tall. Fruits the size of hen's egg, bright red or reddish orange, irregularly scaly; hairy when immature, later bald, tuberculate—pointed. Pulp edible, sweet. (1, 2, 3, 4)

### *A. crassiflora* Mart.

"Marolho", "araticum-dos-grandes" (...of the larger sorts), "araticum cortica" (...cork), "araticum de boia" (...buoy or float), "araticum do campo". Eastern and

central Brazil and eastern Paraguay. Narrow shrub to 6m, trunk extremely thick, twisted and crooked, branches tortuous, with reddish hairs on new growth. Thick bark used for fishing net floats. Fruits to 18cm long and 12cm wide, yellowish-green, with rhomboid-conical areoles, rusty, hairy; pulp white or yellow, edible, sweet and agreeable, or insipid, pleasantly aromatic. There is a variety with red pulp that's sweeter and tastier. Eaten fresh or juiced. Seeds reddish-gray brown. (1, 2, 3, 5)

### *A. dioica* St. Hil.

"Araticum-do-campo", "araticum grande", "marolino", "ata", "pinha", "Corazon de India", "aratikú ñu" (...fields, in Guaraní language), "aratikú pe" (...creeping). Central and southern Brazil, eastern Paraguay and northeastern Bolivia. Shrub to 2m. Fruits in Brazil said to be 15-25cm long and 8-10cm wide;





in Paraguay said to average 7.5 x 7cm, but reference is made to a Mr. Balansa who said the fruits got very large when ripe, the excessive weight causing the branches to rest on the ground. Fruit skin covered with short matted fuzz and numerous rounded bumps with points. The pulp is of precious flavor and aroma, and from it a very agreeable drink is made. Fruits ripen December to January, also June. The species name means "diœcious" but Correa says that it is a monœcious plant. Hoehne says the flowers are male, rarely hermaphrodite. The plant consists of grouped stems, usually unbranched, rising from underground rhizomes. Leaves are elliptical or widely round, leathery with yellowish hairs on underside of leaves and on petioles and on flowers. The corolla is pale yellow or greenish-yellow with red spot at inside base of petals. Plants are abundant and gregarious on prairies and scrublands, usually on dry, sandy soils. (1, 2, 3, 5).

#### ***A. glabra* L.**

"Pond apple", "araticurana", and many other names (-rana means "pseudo-" or "inferior" in Tupí language). Coastal regions of Florida (also around Lake Okeechobee) all the way to Rio Grande do Sul, Brazil (and sometimes inland in Brazil), and along the eastern coast of Africa. Tree to 8m, in wet places or deep acid sandy soils. Fruits to 13cm, smooth, yellow or red-yellow turning brown when soft-ripe; abundant cream-yellow, fibrous pulp smells very good but usually tastes very bad - acrid, soapy and bitter - but sometimes merely insipid. Though most trees produce inedible fruits, a few rare trees produce quite edible fruits. The thick red bark and roots are often used as cork or fishing net floats. Root bark could be an ingredient of perfume. With some difficulty, can be used as a rootstock for *A. cherimola*, *A. diversifolia*, some varieties of *A. reticulata*, and, with rare success, *A. muricata*. It does not work as a root-stock for atemoyas. (1, 2, 4, 9)

#### ***A. jahnii* Saff.**

"Manirito" (small soncoya). Northern Venezuela to Rio Meta area of Colombia. Tree to 6m, flat-crowned. Usually grows in patches of trees on the dry savannas, and is very drought hardy, but it also grows in bottoms; it is sometimes cultivated. Flowers pyramid shaped 2cm, wide; petals 3, very thick. Fruits ovoid, to 9cm long with pyramidal upturned spines, spirally arranged, covered with reddish hairs; calyx persistent; pulp yellow, slightly juicy, sweet, pleasantly flavored or not very appetizing; few seeds, 1cm, brown. (4, 10)

#### ***A. montana* Macfad.**

"Mountain sop", "araticum-de-paca", etc. From Cuba to Paraguay. Tree to 15m, vigorous, ornamental, dark green and shiny, dense foliage, spreading habit. Fruits prickly, usually 15cm, round, sometimes elongated to 26cm (in Brazil), in West Indies often dry and inedible, in South America pulp whitish or yellowish, soft fibery, mucilaginous, strong-smelling, flavor or fermented bread dough with honey and sometimes soap. Most are inedible "as is" unless one is very hungry, but can be made palatable with lots of sugar and other additives. A few trees produce fruits entirely edible and juicy, with nice strong aroma and good flavor, but still very fibrous. Tree is adaptable to different soil types but has been unsuccessful in most rootstock trials, though *A. dioica* grows very well on it. (1, 4, 7)

#### ***A. nutans* R. E. Fries**

"Aratiku-i" (small), "aratiku-nu", "araticu-guazu" (tall). Central Brazil, southern Bolivia, Paraguay and northern Argentina. Short shrub, or tree to 6m, with slender erect stems and short, straight, ascending branches, which are sometimes thorny; new growth red-hairy, later bald. Corolla pale green with maroon-red spots inside. Fruits to 7 x 5cm, irregular, oval, or roundish, orange, with very prominent, sharp, conical areoles, pulp edible. Ripening November to August, flowers August to January, flowers have also been seen in March. (1, 3, 4, 5)

#### ***A. purpurea* Moc. & Sessé**

"Soncoya", "chincua", "manirote", "torete", "cabeza de muerto" (Cadaver's head). Mexico to Venezuela. Often 10m or more, broad spreading crown, large wide thin wavy leaves; very ornamental tree, especially with the eye-catching fruits, but the tree is too cold sensitive to look good in Florida. Trees rarely fruit in Florida because the flower buds, wrapped in bracts, remain dormant for about a year before opening, and fall off anytime cold weather mistreats the tree. Fruits to 20cm, roundish, green, brown when soft ripe, covered with very numerous, tall pyramidal, hard-pointed, sharp projections and short rusty hairs. Pulp is bright orange, fragrant, juicy, very fibrous, the fibers clinging to the 3cm seeds which are very numerous. The fruit quality is said to vary considerably. The two I tasted in southwestern Guatemala were nauseating and the locals told me that eating the fruit can make one come down with the chills. In other areas of Central America they are said to be mango-flavored even, and superior to other Central American annonas! (1, 2, 4, 8)

#### ***A. salzmanii* De Candolle**

"Araticum-de-Bahia", "araticum bravo" (...wild), "araticum-do-compo", "araticum liso". From Bahia to Sao Paulo (Brazil). On sandy arid plains. Small tree, thick trunked, very branchy. Leaves with veins impressed on both sides. Fruits to 20cm long, pulp soft, very tasty. (1, 3, 4)

### **Anonidium Genus**

Five species. Flowers more or less unisexual. (4)

#### ***A. mannii* Engler & Diels**

"Junglesop", "mongongwe". Tree to 20m or more, perhaps juvenile for 10 years. Fruit is very large, 30-70cm long, 20-40cm wide, consists mostly of seeds and the seeds are large (3 or 4cm long), but there is still a lot of pulp to eat. Pulp is mealy-creamy and the fibers cling to the seeds. Nice aroma. Eaten fresh. Some trees produce fruit with gritty pulp, others have sweet-tart fruits, some have very sour fruit. Diœcious (?). Trees are full of massive hanging multi-branched flower panicles. (U.S.D.A. Inventory, personal communication with Paul Noren, Imeloko, Zaire.)

### **Asimina Genus**

Unlike *Annona*, *Asimina* spp. fruits are not syncarps. One flower produces a cluster of fruits. Mostly found in southeast United States.

#### ***A. triloba* Dunal**

"Pawpaw", "Nebraska banana", "Hoosier banana". Central and eastern United States. Medium sized tree, up to 12m; attractive pyramid shape. It is hardy to -20°F (some say -25°F) and it prefers to grow in shade, especially when young or growing in warmer regions. Grows best in rich alluvial soils. Slow growing, seedlings fruit in 3-8 years. A number of nursery catalogs, including Burpee, now offers improved varieties.

Deer, rabbits and goats don't eat the leaves or branches, and pawpaw trees and fruits are singularly free of pests and diseases.

Fruits are oblong, smooth and commonly 5-8cm long, clustered six to eight. The better kinds of pawpaw are 15 x 8cm, weighing 12 ounces each and found in clusters of two. The pawpaw is the biggest tree fruit native to the United States—a record pawpaw weighed 17 ounces. The better pawpaws have very fleshy, yellow pulp of a firm creamy texture with an alluring aroma, rich and

*Continued on next page*

pleasing flavor which is often said to taste a bit like a banana. Poor pawpaws can be extremely seedy, white fleshed and mushy textured, without aroma or with a repulsive odor, nearly flavorless or else tasting of turpentine or bitter tea. The seeds can be large or small, in two rows or in one row. The skin can be waxy or fuzzy, bluish or greenish yellow, yellow or coppery brown. The natural pollinator is the carrion fly (blue bottle fly). Hand pollination is useful to increase fruit set. (2, USDA leaflet 179, 1939).

### Dugetia Genus

Some 65 species in New World. New growth is covered with groupings of tiny hairs and thin, dry scales. The fruits are composed of distinctly woody carpels set in cavities on the hardened central core. These carpels tend to disunite at maturity. The carpels are massed globularly without stipes and usually coalesce by their pulp, like many seeded berries. Many species possess excellent edible properties, although the pulp is rather scanty. The petals in the flower buds overlap. (4, 5, Rusby)

### D. stenantha R. E. Fries

"Jaboti", "pe-de-jaboti", "mão-de-cabra". Cultivated along Solimões River, Amazonas. It has a straight trunk and many short branches. Flowers 3cm long; only three petals which open slightly. Fruit are 7cm irregular-round and skin is covered with protuberances very similar to *Annona squamosa*. The pulp is yellow, and slightly fibrous with a few, 2cm long, seeds. Sweet and pleasing taste. Ripe fruits in October and November are avidly competed for by humans and animals. Botanists have not found trees in the wild. (7)

### Fusaea Genus

Three species. New growth covered with simple hairs. The flowers are perfect, petals large and silky haired, inner petals larger than outer. Several rows of overlapping petaloid, sterile stamens surrounding normal fertile stamens which are swollen above the pollen sacs. Fruit is a round syncarpium; smooth, areolate and small seeds.

### F. longifolia (Aublet) Saff.

"Fusáia", "pinaíoua", "karatu'a'a". Amazonia and Guianas. Shrub to 12m, in the shade of trees of the non-flooding parts of the rainforests. Corolla widely spreading, purplish and silky haired. Fruit 7cm, round smooth and areolate

without protuberances or with protruding little leathery flaps. Skin thin and reddish-pink. In the Guineas the fruit is said to be very good, pleasing flavor with reddish and gelatinous pulp that contains many small seeds. In Amazonia the pulp is said to be whitish or yellowish, turning red when fermented, and exuding a strong, pleasant aroma. (2, 4, 11)

### Porcelia Genus

Five species. Clustered fruits similar to *Asimina* genus. I haven't seen a description of the *Porcelia* genus, nor a discussion of what distinguishes it from the *Asimina* genus. Some botanists in the past have classified *Annona glabra* and *Asimina triloba* as *Porcelia*.

### P. nitidifolia Ruiz. & Pav. (Synonym is P. saffordiana, Rusby)

Rurrenbaque area of the Beni Department, Bolivia. Tree to 30m, perhaps the largest annonaceous tree. Found at an elevation of 300m. Leaves are 15 x 15cm, thick, bald and spear shaped on stout 1cm petioles. Flowers deep purple, thick and leathery, with six petals, nearly equal in size. The fruit is compound, weighs about 15 pounds and is made up of 9 carpels (fruitlets), each of which is 15 x 6cm, nearly cylindrical, bald, and rounded at the ends. These fruitlets are arranged as triplets in three circles, those of adjacent circles alternating. Two rows of blackish seeds are embedded in the pulp of each fruitlet. The fruits closely resemble those of *Asimina* and are highly prized. (H. H. Rusby's article in *Memoirs of the New York Botanical Garden* 7: 242, 1927).

### Rollinia Genus

About 65 species, all in the New World. The fruit resemble those of the *Annona* genus but are very distinctive with three stiff, fat petals arranged like the paddles of a three bladed paddle wheel that's fallen on its side, or like the blades of an agitator. The flowers hang down from the branches, with a small groundward opening below the sexual parts.

### R. sylvatica, Mart.

"Pasmada" do mato" (Yellow surprise of the forest), "araticum do morro". Eastern, central and southern Brazil, Paraguay. Shrub or tree to 8m. Fruit 4cm to apple-sized, round or flat bottomed with prominent pentagonal or conical areoles that are hairy and slightly rusty. Skin yellow and thick. The pulp is white, juicy and very tasty; it is often used to make a fermented beverage. (1, 2, 3)

The following annonaceous genera are said to contain edible fruit or spices: *Alphonsea*, *Artabotrys*, *Cleistopholis*, *Cyathocalx*, *Desmos*, *Ephedranthus*, *Fissistigma*, *Goniiothalamus*, *Habzelia*, *Miliusa*, *Monanthotaxis*, *Monodora*, *Polyalthia*, *Popowia*, *Raimondia*, *Rolliniopsis*, *Sapranthus*, *Sphaerocoryne*, *Stelecocarpus*, *Trigynaea*, *Unonopsis*, *Uvaria* and *Xylopia*. The genus *Guatteria* has numerous medicinal species.

These less common *Annona* species can be found at Fairchild Tropical Garden or the USDA's Research Station in Miami: *A. bullata* (FTG & USDA); *A. dioica* (FTG); *A. glabra* (FTG & USDA); *A. globifera* (FTG); *A. jahnii* (FTG); *A. montana* (FTG & USDA); *A. purpurea* (FTG); *A. senegalensis* (FTG); *A. spraguei* (FTG); *A. cornifolia* (FTG).

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# Pests of *Annona* Species

By J. E. Peña, H. Nadel  
and V. Torres

## Annona Seedborer

The most serious insect pest problems of *Annona* fruit crops are two species which belong to the families Eurytomidae (Order Hymenoptera) and Stenomidae (Order Lepidoptera). The common name for the first group of pests is seed chalcid or annona seedborer, which describes the behavior of the adults who upon emergence bore a hole through a seed and then through the pulp. A complex of species of annona seedborers are found in the orchards and natural habitats of species of *Annona* in the neotropics. Hosts recorded for the seedborers include *Annona muricata*, *A. squamosa*, *A. squamosa* x *A. cherimola*, *A. reticulata*, *A. cherimola*, *A. montana*, and *A. glabra*. The annona seedborer found in Florida, *Bephratelloides cubensis*, has several generations a year. Other species *B. pomorum*, *B. paraguayensis*, *B. petiolatus* and *B. limai* are mostly found in South, Central America and the Caribbean Region. Fruit growers faced with this pest until recently did not know its habits, biology or how to manage it. In 1984, research was initiated at the University of Florida's Tropical Research and Education Center, Homestead, to investigate the seedborer's life history, behavior, host plants, and to evaluate cultural,

Tropical Research and Education Center, University of Florida, IFAS, Homestead, Florida.

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*Bephratelloides cubensis* on atemoya

Photo by Julie Nagel

chemical and biological controls which could be incorporated into management recommendations.

### Description of Life Stages

The adult female is a reddish or reddish-brown colored wasp, 1/3 to 1/4 inch long. The main distinguishing characteristic of this wasp is the almost complete absence of males. The adults can be observed at rest, emerging from fruits or ovipositing during the hottest times of the day (10:00 a.m. to 3:00 p.m.) The female life span ranges between 1 to 11 days; the female oviposits its eggs in developing seeds and the incubation of the eggs last 12 to 14 days, the larval stage lasting 42-55 days. The larva is near white to cream colored, legless and swollen near the center. The pupal stage lasts 12 to 13 days. The emerging female tunnels a distance of 0.6 to 1.1cm through the pulp, leaving a circular exit hole in the fruit epidermis.

### Dynamics

The annona seedborer population develops during winter months in Florida, mainly in bullock's heart (*Annona reticulata*). Because this fruit is not grown extensively, populations of adult wasps, which emerge from February to late May at the end of the fruiting season, are relatively low. Atemoyas (*A. squamosa* x *A. cherimola*), which begin setting fruit in April, become infested early in the season because they are setting fruits when the majority of seed borers are emerging from bullock's hearts. The



*B. cubensis* damage

Photo by Jorge Peña

initial infestation in sugar apple orchards is later and this is reflected in a lower overall infestation compared with atemoya. Emergence and therefore new infestations in atemoyas and sugar apples occur for several weeks, and may not abate until the end of the fruiting season. The wasp prefers fruit sizes in the range of 1/2 to almost 2 inches diameter. Although fruits larger than 2 inches are attacked, usually when annona seedborer populations are high, most of these attacks probably do not result in infestation. The preferred fruit size presumably corresponds to the stage in which the seeds are still very soft and easy to penetrate with the ovipositor. The seeds of the larger, older fruits are probably too hard to penetrate and the distance from the fruit surface to the seed may exceed the

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length of the ovipositor.

### Cultural Control

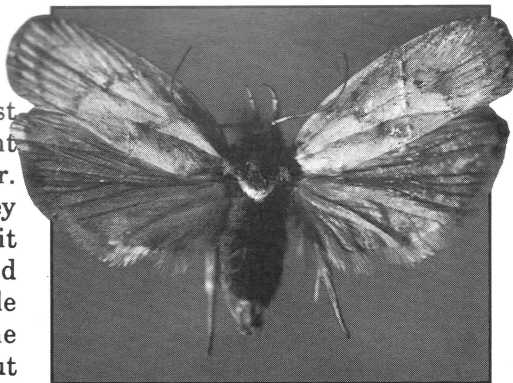
Bagging the fruits is the best cultural control method to prevent infestation by annona seedborer. Polyethylene bags were used and they held up for the duration of fruit growth. Small fruits were bagged before they reached the vulnerable size; but early in the season, the grower can bag the fruits without regard to size, because the infestation is usually very low. Ideally fruits should be bagged just before they reach vulnerable size as very small fruits have a very high probability of being naturally aborted. Labor involved in bagging includes not only the amount of time spent applying the bag (approx. 20-30 sec.) but also the time spent searching for the unbagged fruit. The latter may far exceed the former, and vary according to tree productivity, height, foliage cover, and worker.

### Chemical Control

In Florida, there are no pesticides registered to use on *Annona* crops. Our experiments with several materials have given poor or only fair control: Ambush®, had erratic results; Malathion®, when applied during the summer, gave fair control; the material that provided the best control under laboratory conditions was Lorsban 4E®. (Note: neither Ambush, Malathion nor Lorsban is registered for use on *Annona*, and their use was only for experimental purposes.)

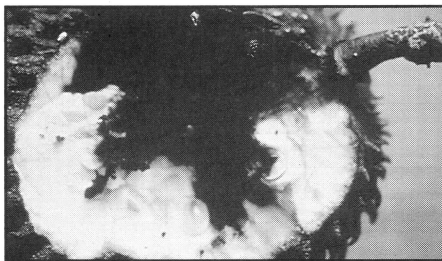
### Biological Control

Because of increasing societal concern over pesticide residues on produce, we surveyed different countries (Ecuador, Colombia, French Guyana, Dominican Republic, Brazil) for beneficial organisms against the *Annona* seed borer. Last year, one biological control agent was found in Florida, the fungus *Beauveria bassiana*, which was collected from a seed borer adult. The fungus was applied to adult borers in the laboratory and provided adult mortality 8 days after treatment. Our research in this area, however, has just begun and more research is needed to determine the full potential of this natural



*Cercanota anonella*, adult.

Photo by F. Garcia



*C. anonella* damage on sour sop

Photo by J. Peña



*Cocytius antaeus*

Photo by H. Nadel



*Philephedra tuberculosa*

Photo by H. Nadel

enemy under orchard conditions.

### Annona Fruit Borer

The annona fruit borer, *Cerconota anonella* (Lepidoptera: Stenomiidae) is the second key pest of *Annona* sp. This species is not endemic to Florida, but occurs in northern South America, Central America and the Caribbean. The larva of this insect damages the fruit epidermis, pulp and seeds. Preliminary obser-

vations showed that moths are attracted to black light traps. The moth is white or cream colored, 1/2 inch long. The main distinguishing characteristic of this moth is the banding pattern on the wing. The larva has a purplish-pink body and a light brown head capsule. Biological control agents for this insect are common in Venezuela, Ecuador and Colombia.

### Other Insect Pests

In the neotropics, *Annona* crops are also hosts for more than 200 insect species. In Florida, at least 32 species have been collected from these trees. The most common ones are:

1. Larvae of Lepidoptera species of the families Sphingidae (*Cocytius* sp.), Geometridae (*Epimicis* sp.) and Noctuidae (*Gonodonta* sp.). These have been found attacking *Annona* leaves; Damage by these species can be recognized by the irregular feeding on the leaf blade.

2. The most damaging scale attacking these crops is the papaya scale, *Philephedra tuberculosa*, which attacks leaves, young stems and fruits. Ninety percent of the scale is found on the underside of the leaves.

3. The mealybugs, *Pseudococcus maritimus* and *P. nipae* which are oval in shape with their body covered by wax-like secretions are found on fruit and leaves. A black sooty mold develops in infested fruit.

Pest research in these crops is at a preliminary phase and a follow up study of the control and dynamics of these pests is necessary. To avoid unilateral pest control methods, researchers at TREC and *Annona* growers are establishing a common plan of action for a pest management program in annona crops.

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# Annona Problems and Prospects in South Florida

By Nicholas Cockshutt

An update of the 1988 survey conducted by the Tropical Fruit Growers of South Florida and Jonathan Crane, Tropical Fruit Crops Specialist at the University of Florida's Tropical Research Center in Homestead, found that there are now 75 acres of atemoya (*Annona cherimola* x *A. squamosa*) and 49 acres of sugar apple (*Annona squamosa*) of commercial *Annona* production in Florida. Crane believes that the sugar apple acreage has been under assessed (1). The *Annona* industry of South Florida is a very recent undertaking and dates from Marc Ellenby's pioneer plantings in 1981.

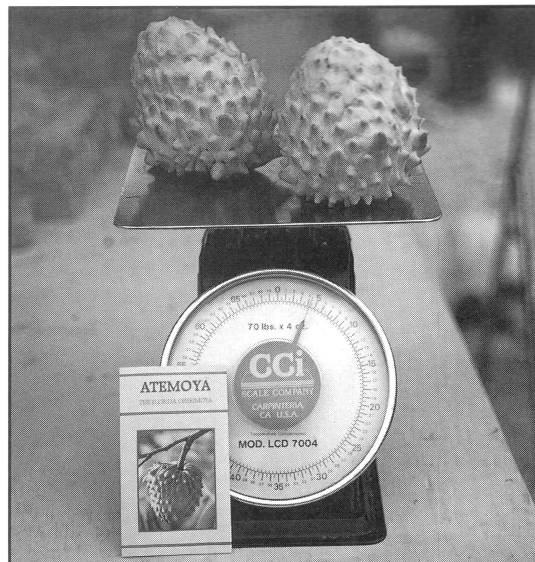
The atemoya is thought to have mainstream possibilities and is grown and marketed by J.R. Brooks & Son, South Florida's largest packing house. Ellenby is the other major grower of atemoya in South Florida and last season the two growers sold 100,000 pounds of fruit. Most of Ellenby's atemoyas are marketed through Brooks.

There is some debate about whether growers have reached a production ceiling for the current atemoya market. The consensus seems to be that growers should continue to step up production until they have enough fruit to "effect" or open up the market.

Brooks is not interested in packing or marketing sugar apples, and this year the company converted a 10-acre orchard of sugar apples by "top working" it with atemoya.

Nonetheless, there is a dependable ethnic market for the sugar apple and Ellenby and a number of other farmers grow and sell their own produce. This year Ellenby had a better season for sugar apples than he did for his atemoyas. He is optimistic about the potential market for sugar apples and hopes to increase sales to Asian populations around the country. The other sugar apple growers concentrate mostly on the local Latin market.

The *Annona* growers' arch enemy is the annona seedborer (*Bephratelloides cubensis*), which in a bad year is capable of taking out as much as 60% of the crop. This year growers were granted an emergency exemption to use malathion to control the seedborer: the insecticide is sprayed on the fruit at an early stage of development while it is still vulnerable to the insect (1/2 - 2 in. diameter). Last year the growers were given a similar exemption but it came too late to be of any help. The growers hope that



Two good-sized atemoyas

Photo by Marc Ellenby

the Environmental Protection Agency (EPA) will eventually approve a section 3 registration (full use) in the near future. Other insects that cause problems are *Ambrosia* beetles (*Xyleborus* spp.), *Philephedra* scale and mealybugs (*Pseudococcus* spp.) (2).

The annonas of South Florida may be bothered by a number of disease problems. Anthracnose (*Colletotrichum gloeosporioides*) is a perpetual problem causing blossom blight and damage to the fruit (3). Studies in the Homestead area have already established the efficacy of Benlate® and growers are hoping that one day they will have this systemic fungicide approved through the federal government's IR4 program. Rust fungus (*Phokospora cherimoliae*) has been causing much premature defoliation this year and is diminishing the late season yield of fruit. As with other minor tropical fruit crops, *Annona* growers are permitted few defenses against plagues of pest and disease. One small victory was the EPA's approval in 1989 of Roundup®, up to 14 days before harvest, as a herbicide in atemoya, carambola and sugar apple groves (in Florida only).

Seedling atemoyas show such variability that commercial growers use grafted plants, the 'Gefner' being



Starting a grove. Marc Ellenby beside an atemoya in 1981.

Photo by Marc Ellenby

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**Atemoya flowers and fruit. One flower is opening up into its "pollen" or male phase.** Photo by Marc Ellenby

the preferred cultivar (4). There are still lots of questions about the effects of the various kinds of rootstocks. There is potentially a wide range of possible rootstocks, but there have been compatibility problems. For instance, four-year old atemoyas on *Annona reticulata* rootstock have been breaking off at the graft union. At Ellenby's grove 25% of his 'Gefner' on *A. reticulata* rootstock plants have suffered from this delayed incompatibility, but the remainder are growing vigorously and he feels that they are now safe. In Australia a recently published book, *Growing Custard Apples*, maintains that the atemoya and *A. reticulata* are in fact incompatible (5). Seedling atemoya and sugar apple are the most common rootstocks in south Florida. A pond apple (*Annona glabra*) with a cherimoya interstock is sometimes found as a rootstock. Ellenby grows two kinds of seedling sugar apples: the "Lessard Thai" and the "Jamaican sugar sop." He prefers the Lessard Thai but notes that the Jamaican sugar sop makes a better and more vigorous rootstock for his atemoyas.

Pollination is also somewhat problematic. Annonas in South Florida are naturally pollinated by nititid beetles, so most growers do not need to bother with hand pollination (6). However, Reed Olszack, Field Production Manager with J.R.

Brooks, has in the last two years been experimenting with hand pollination in a number of selected atemoya groves. These carefully monitored experiments have taken place early in the year when it is often too dry for good natural pollination. It is hoped to both increase the yield of early season fruit and by a more thorough pollination improve the quality and shape of the fruit. Whether or not this procedure will prove cost effective still needs to be ascertained.

Annonas grow well in the calcareous rock of South Dade but need a balanced fertilizer program, micro-nutrient foliar sprays and plenty of

environment is also thought to affect fruit development, resulting in "cracking" which makes the fruits unmarketable. The crops should be consistently irrigated and not undergo any water-stress except perhaps a slight stress just when the trees break dormancy.

Grove owners have planted their annonas with various spacings and plant densities. A common atemoya spacing is 15 x 23 ft. (174 trees per acre). A high density planting would be 217-290 trees per acre, a low density planting 57-87 trees per acre (7). There is much temporary interplanting in the low density groves. Differ-



**Harvesting crew loading truck with buckets of atemoyas at LNB Groves.**

Photo by Marc Ellenby

chelated iron. G.M. Sanewski, the author of *Growing Custard Apples*, recommends organic fertilizer (fowl manure) for the first four years in ground.

Growers are becoming more aware of how critical a carefully considered irrigation program is to good fruit production. The crops' moisture preferences are generally contrary to the climate of South Florida and irrigation needs to be adjusted accordingly. Flowering and fruit set occur at a dry time of year (May-June) and irrigation is needed to compensate. Crops will suffer if there is too much rain and humidity during the harvesting season (August-October), so that's a time to cut down on irrigation. Changing from a dry to a wet

ent kinds of rootstocks also affect the spacing: for instance, atemoya on sugar apple rootstock will need less space than atemoya on *A. reticulata*. About 49% of the sugar apple plantings are at moderate density of 108-174 trees per acre and because of the tree's small size it is often grown as an interplant with other crops.

As the groves have become older problems in tree size and shape have become apparent. Trees have grown too tall for the average harvester and their spreading growth is preventing easy access for orchard management and harvesting. Jonathan Crane and Thomas Marler, Research Horticulturist with Fairchild Tropical Garden, are now involved in a study of various pruning techniques for the

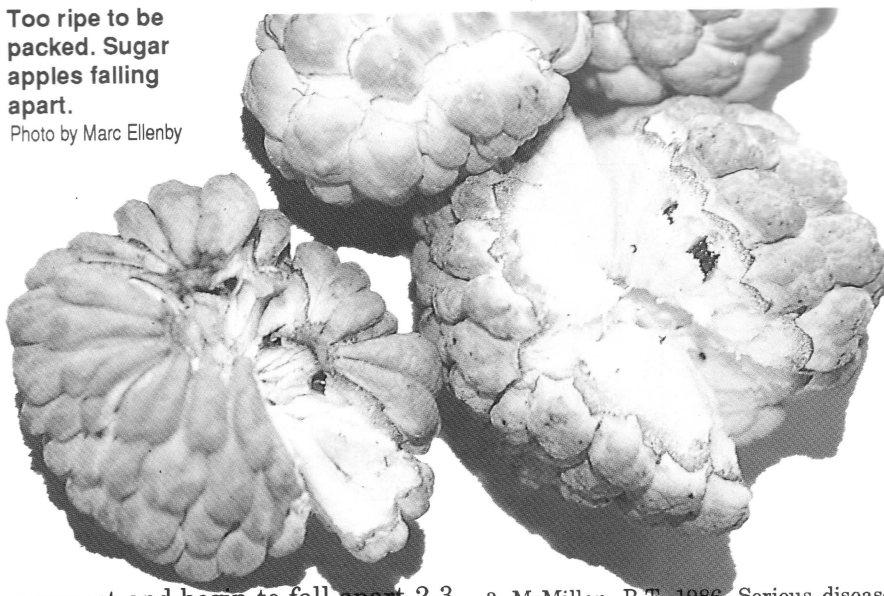


atemoya. Their goals are to learn ways to control size and build a stronger tree. By training the tree to allow more light into the inner part of the canopy, they also hope to improve productivity.

Grafted atemoya and seedling sugar apples begin to bear fruit the second and third year in the ground. This makes them very attractive from the point of view of a grower who needs quick returns; though a poorly planned and undercapitalized venture could prove disastrous. The atemoya takes 110-120 days from flowering to fruit, the sugar apple 90-100 days. Harvesting lasts a long time and for 10 weeks Ellenby says his harvesting team "lives in the trees," combing the orchards for fruits that have reached maturity. Maturity of the sugar apple is easily discerned by the separating of the carpels and a color-break from green to

**Too ripe to be packed. Sugar apples falling apart.**

Photo by Marc Ellenby



prospect and begin to fall apart 2-3 days after harvest.

Anyone who has tried an atemoya or a sugar apple knows that these fruits are not like a peach or an apple, or any other fruit. They are somehow both unique and yet with a taste that seems familiar, like a memory of a transcendent childhood dessert. In California they are doing a great job of marketing the cherimoya. Florida *Annona* growers would do well to copy and cooperate with the Californians. Our greatest hope for expanding our own *Annona* market is to find superior cultivars with improved storage and handling capabilities. Meanwhile, there is still a lot of work to be done in the way of developing better storage and packing procedures.

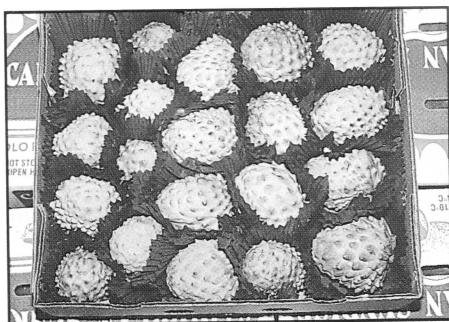
#### Acknowledgments

I would like to thank Jonathan Crane and Marc Ellenby for their help with this article.

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**J. R. Brooks & Son's flat of atemoyas.**

Photo courtesy of J. R. Brooks

cream-color between the carpels. A mature 'Gefner' atemoya looks fuller, smoother and has a slightly more yellow color but it is really isn't that obvious except to the experienced harvester. The fruits are handpicked, hand clipped and hand packed.

A marketing problem for the atemoya is that 40% of the crop may mature in a 2-3 week span—sometimes 30% of the crop in one week. This atemoya "glut" is more than the market can handle and should be a concern for any new grower without an established market.

Limited post-harvest storage is the greatest impediment to the marketing of atemoyas and sugar apples. Atemoyas last 5-7 days after picking before their quality begins to deteriorate. Sugar apples are even worse



**Sugar apples (anon) for sale in a Latin market in Miami. Price is 8 years out-of-date.**

Photo by Marc Ellenby