

curiosities, the absence of a method for clonal reproduction is of little significance. However, some species in this group, especially *Garcinia mangostana*, would be much more widely used if the disadvantages of seedling reproduction could be avoided. The mangosteen produces viable, apomictic seeds in abundance but seedlings are barren for about 2 decades. This characteristic and the fragility of the plants when young prevent establishment of this excellent fruit by any but the most determined enthusiasts. The mangosteen is extraordinarily difficult to graft and these results show

that our methods do not satisfactorily propagate the species. With this and many other tropical plants, further research is needed to improve methods of vegetative reproduction.

#### Literature Cited

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## STATUS OF ANNONA CULTURE IN SOUTH FLORIDA

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Among the first tropical fruits introduced into Florida are several species of *Annona*. The custard apple, *Annona reticulata* and the sugar apple, *Annona squamosa*, were early found to be well adapted to South Florida conditions and their culture in home gardens became rather widespread.

Over the years, a number of other species of *Annona* were introduced and those that had any merit were accepted and grown by home gardeners who were interested in these fruits or they remained in collections for possible use as rootstocks.

A review of annonas grown by members of the Rare Fruit Council International, Inc. in Florida gives a good indication of relative popularity of the species. *Annona squamosa* was reported to be growing in yards of more than 65 members; *Annona muricata*, the soursop, was being grown by about 60 members, while some 42 members are growing *Annona reticulata*. *Annona cherimola*, the cherimoya, which seldom produces any fruit here is reportedly grown by 27 members, while the popular hybrids between *Annona squamosa* and *Annona cherimola* are grown by about the same number of people as *Annona reticulata*. It should be pointed out that members of the Rare Fruit Council represent a very small fraction of the people growing these trees, but perhaps give some indication of relative popularity.

The sugar apple, *Annona squamosa*, is the most popular of the annonas here because of its high quality fruit and adaptation to our area. Almost all of the trees grown here are seedlings. Selections have been made to get better bearing and fruits, but little has been accomplished because there seems to be very little variability among the seedlings. An enriched soil and frequent irrigation during a dry summer appear to be more important than grafting from a selected tree. Two variations of this species have been introduced, one seedless form from Brazil (and a seemingly identical one from Cuba) as well as a purple fruited form from Cuba. The seedless form is a curiosity, but is not likely to be widely grown because the fruit splits badly as it matures on the tree, and the quality may be slightly inferior. The purple form has purple skin color and a purplish or pinkish flesh. Although this is attractive, the quality is perhaps a little inferior to the average seedling.

Sugar apples are fairly productive. Seedlings begin producing in 3 or 4 years from seed. Fruits ripen over a fairly long period, from mid-August to mid-winter if there is no frost. They are grown in only the warmer areas of South Florida because of their sensitivity to frost. Production of 20 to 50 fruits per year on a small tree is average. An exceptional tree might produce over a hundred. Fruits can be picked a few days before they soften on the tree and held inside the house to ripen. After they get soft, they can be held for several more days in the refrigerator. The softness of the fruit has made it difficult to handle commercially,

so they have hardly ever been sold except at a few roadside fruit stands.

Besides the frost hazard, sugar apples suffer from other problems. The chalcid fly and ambrosia beetles are the two most serious pests. Chalcid flies oviposit in the seeds in the very young fruits. This often is followed by a secondary infection of fungus which causes the fruit to "mummify". Ambrosia beetles oviposit in the young stems and the larvae that develop cause much dieback during the winter season when growth is slow. Both of these insects can be controlled by spraying with benzene hexachloride, but the backyard gardener seldom bothers with this and just accepts whatever losses occur.

The custard apple, *Annona reticulata*, sometimes called bullock's heart, is a more vigorous and larger tree than the sugar apple. (In some parts of Florida, the pond apple, *A. glabra*, is called custard apple, but its fruit is not ordinarily eaten.) It is a little hardier to cold and thus is more commonly seen a little farther north in areas like Bradenton on the west coast and Merritt Island on the east coast; as well as warmer spots in the "Ridge". Stone cells in the flesh of the fruit give this species a lower rating in quality than the sugar apple. Seedlings free of stone cells have been reported to, but not seen, by the author. Seeds of a purple fruited form of this species were received from southern Mexico and trees grown from them have fruited at the Montgomery Foundation in Coral Gables, producing the purple fruits with purplish flesh. There is little difference in quality between purple and other custard apples. To my knowledge, no cultivars of the custard apple have been grafted. Most seedlings produce fruits with a red brown or yellowish skin.

The custard apple fruit ripens in late winter and spring when there are few other annonas. Unfortunately, it is very susceptible to the chalcid fly, so a large percentage and sometimes all of the fruit, will be mummified.

The cherimoya (*A. cherimola*) is generally considered to produce the finest quality fruit of all of the annonas. Seeds, budwood and even grafted plants have been brought into Florida for more than 50 years and still no success has been attained with any variety or seedling. The trees will grow well enough, but only a few misshapen nubbins are produced instead of the delicious fruits one sees in tropical highlands. This species cannot be recommended for culture in South Florida.

The soursop, *Annona muricata*, is a popular species to grow in the warmest areas of South

Florida. It is well adapted to our soils and climate except for the cold weather. Temperatures in the 40° to 45° F range will cause all of the leaves and most small fruit to drop. Temperatures at the freezing point, or just below, will cause damage to the wood.

Various selections of soursop have been made but none has shown any overall advantage to seedling propagation. A variety was introduced from Cuba by Mr. W. F. Whitman of Bal Harbour, which has no fibre in the fruit. Although this is a valuable characteristic, the variety is very unproductive and most years produces no fruit at all. A worthwhile character seen in some seedlings is cauliflory. In these seedlings, flowers are born on the trunk or larger limbs; sometimes on spurs with several flowers. This character may result in greater productivity.

Soursops bear two main crops a year in South Florida. Spring blooming results in ripe fruit in July, August and September. Summer blooming results in ripe fruit in December, January and February. Cold damage to the trees may prevent spring flowering and cold weather in the fall may cause all the fruit from the summer flowering to drop. Thus, it is very difficult to evaluate soursop clones for productivity.

The ilama, *Annona diversifolia*, is grown to a very limited extent in South Florida. The "Imery" variety, introduced from El Salvador by the University of Florida at Homestead, provided some impetus to culture of this fruit because it grew well and bore good crops. Ilamas may have white flesh or various shades of pink flesh. They ripen during a short period in August and September and they split open on the tree when they are mature. We have been unsuccessful in ripening fruit picked before it splits. One more objection to this fruit is the large number and size of the seeds. The ilama does grow and bear fairly well in our area, however, and seems to suffer much less from mummification of the fruits by chalcid fly, than do the atemoyas and custard apples.

The ilama fruits are much larger than sugar apples and may weigh up to 2 pounds. Pound for pound, the ilama will probably bear as much or more fruit than the sugar apple. Unfortunately, good comparative experiments have not been made in productivity of any of the annonas in our area. The "Imery" variety, originally introduced from El Salvador, is a large, pink fleshed variety. Although it has beautiful fruit, it is not judged by tasters at the Fairchild Tropical Garden to be as high quality as some of the white fleshed seedlings

at the Montgomery Foundation, and has not born as heavily as some of the seedlings.

Great emphasis has been placed in finding or creating a hybrid between the cherimoya and the sugar apple so that a higher quality fruit can be successfully grown in the tropical lowlands. Hybrids of these species were made some 50 years ago and called atemoyas. They also occur naturally in Venezuela and perhaps elsewhere. They are called chirimorinones in Venezuela from chirimoya and rinon, which is the local name for sugar apple. In Israel, hybrids originated from seeds planted when sugar apple and cherimoya were planted side by side. This has happened in other countries such as Florida in the U. S. Graftwood from Australia, Hawaii, Israel and Venezuela has been imported to Florida for comparison with hybrid varieties of local origin.

The following atemoyas have been grown at the Montgomery Foundation: Bradley, Caves, Chirimorinon A, B and C, Island Gem, Kaller, Lindstrom, Page, Priestly and Stermer; as well as a number of seedlings. Although these have all fruited, none could be said to be very satisfactory. The greatest problem is shy bearing. Some will bear a small crop for one or two years and then skip several years. Other difficulties also occur such as heavy damage from chalcid flies and splitting of the ripening fruit, as occurs with ilama. Some varieties ripen unevenly with hard spots in the soft flesh and Kaller often develops a hard black membrane around each carpel enclosing a seed. Eating quality varies from year to year.

Recent atemoya introductions from Israel include Geffner, Malamud, Bernitski, Kabri and Malai 1. The first two are growing at the University of Florida AREC in Homestead, while the last three are growing at the USDA's Sub-tropical Horticultural Research Station in Miami. These have not been grown long enough to properly evaluate.

Although the fruit is small and tends to split badly, the Page variety has been the most satisfactory variety at the Montgomery Foundation. Hopefully, some of the newer varieties will turn out far superior to it, or at least we will learn some new cultural methods to improve production of varieties with superior fruits.

A variety of annona was introduced from Ha-

waii which was thought to be a hybrid between a pink ilama and cherimoya. It has done very poorly here but did produce one or two nubbins to show that it did have pink colored flesh. I could see no evidence of hybridity and consider it to be a pink fleshed cherimoya.

Hybrids between soursop and mountain soursop (*Annona montana*) are said to have been made in Cuba. Apparently, nothing of great value came from this cross and none of the hybrids is known to have been introduced into Florida. The mountain soursop is more resistant to cold than soursop and can be used as a rootstock. It grows and fruits well here, but the fruit is not of good quality for eating because of a strong terebinthine flavor. I can see little reason to use it as a rootstock since the soursop grows well enough on its own roots and there has been no indication that the stock will increase hardiness of the scion.

Numerous other species of annona have been introduced for trial in Florida. None has been found to be of particular value so far. *Annona jahnnii*, the manirito from Venezuela, has fruited but the fruit was small and seedy and not of high quality. A number of trees of *A. purpurea*, the soncoya, or manirite, have grown here for many years but I have never seen a good fruit produced. A few nubbins have set and then dropped off, perhaps because of chalcid fly infections. *A. dioica* from Paraguay is growing slowly here but has not fruited. *A. globiflora* from Mexico, fruits well but has small fruits of poor quality. *A. nutans* has fruited but the fruit is of poor quality. *Annona senegalensis* fruits well, but is of poor quality. *A. senegalensis* and our native *A. glabra* may have some value as rootstocks, but so far *Annona reticulata* has been the most useful rootstock because it can be used for ilama, sugar apple and atemoya. No definitive studies have been done with rootstocks, but there are often incompatibilities when using species other than the same one as the scion. For example, although ilama has been found compatible with the pond apple rootstock, atemoya is often incompatible with pond apple.

Much work needs to be done with annonas to obtain varieties that will grow well here. The experienced horticulturist may grow many different kinds but the beginner with limited space will do well to grow a seedling sugar apple.