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Soar Sop: An emerging fruit of future



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Soap sop (*Annona muricata* L) is a native of South America belonging to the family Annonaceae. It is commonly known as Guanábano, Catuche, Catoche, anona, Graviola, in different countries of the world. It is found both wild and cultivated throughout the West Indies and from southern Mexico to Peru and Argentina up to an altitude of 1100 m msl. It is grown mostly in tropical region of the world from South America to Australia, Asia and Africa. In India, the exact detail of the introduction of this plant is not known. But it is considered that it was introduced along with other fruits of this family in the eighteenth and nineteenth centuries but it gain less popularity than custard apple and sweet sop. This might be due to typical tropical climatic requirement, acidic taste and characteristic smell of fruit. It was used as rootstock for custard apple and sweet sop. Presently it is found growing the tropical humid part of Karnataka, Tamil Nadu and Kerala. The sour sop is an evergreen, slender, low branching and bushy tree which grow up to height of 3 to 6 m. The leaves are obviate to elliptic, 7-20 cm long and 3 to 6 cm wide, with acute tip, entire margin, alternate with smooth, dark green and glossy upper surface and light green lower surface. Leaves emit a strong odour when crushed. Flowers are solitary or in small clusters, 2 to 4 cm long with 6 thick, fleshy petals arranged in two whirls. The outer three petals are more fleshy greenish yellow with tip curved outwardly whereas inner three petals less fleshy and pale yellow colour. The flower has a peculiar smell. The flowers are hermaphrodite. The fruit a syncarp is broadly ovoid or ellipsoid and usually irregularly shaped or curved due to improper carpel development. Fruit are nearly always longer than they are wide. Fruit weight varies from 500g to 1.5 kg which is largely dependent upon the extent of pollination and fertilization. A normal fruit is generally heart shaped to oval, but if there is poor pollination, unfertilized ovules fail to develop and the resulting fruit assumes disturbed irregular shapes and is usually undersized. The skin is dark green with many curved, soft spines 0.5-0.3 cm apart. The fruit stalk is about 3-8 cm long and woody. The ripe pulp which adheres to the skin but is easily separated into segments is juicy creamy white with a cottony texture and contains many black flat round seeds about 2cm size. The pulp has an agreeable sub-acid taste with a distinct flavour. Fruits are harvested when fully mature and turned yellowish green. The ripe fruit are usually consumed fresh as a dessert or snack item. Less acidic and low fibrous lines may be eaten fresh after cutting in sections and with a spoon. The fruit pulp is an excellent source of vitamins B and C, potassium, riboflavin and niacin. This fruit are excellent for processing after removal of seeds and outer skin. The fruit observation studies at CHES Chettalli revealed that the It contains 62 to 85 % pulp, 25 to 30 % Skin and 2 to 3 % seed on weight basis. Fruit pulp is thick and requires dilution before use as juice or squash. The pulp may be sweetened after adding sugar and citric

acid. The pulp may be stored at low temperature without loss of taste and other properties. Enriched pulp, sweetened or unsweetened can be processed and stored frozen for use in various products or reconstituted directly by the consumer. Puree and juice concentrates can be used to prepare iced sour sop drink or mixed with other juices. The juice, with the addition of sugar, makes an excellent ice cream or sherbet. A refreshing drink, Champola, made with strained pulp, milk and sugar is famous fruit drink in Brazil and Cuba. The fruit also makes excellent preserve, jam or jelly. In Malaysia a delicate flavor of sour sop is popular for flavoring ice cream and puddings. In the Philippines and Indonesia, young immature fruits are cooked as vegetables or used in soup. The alkaloids muricine, and muricinine are found in the bark of tree. The bark is high in hydrocyanic acid. Only small amount of hydrocyanic acid is found in the leaves and roots and a trace in the fruit. These compounds are toxic.



Fig 1. Tree



Fig 2: Fruit

The sour sop has some medicinal uses. A decoction of young shoots and leaves is a remedy for gall bladder infection, coughs, diarrhea, dysentery and indigestion. Mashed leaves are used for treatments of eczema and rheumatism. The flowers are antispasmodic. The ripe fruit prevents scurvy while the unripe fruit may be used for dysentery and has astringent properties. Recently there are some reports about the anti-cancerous properties of this plant. These studies were performed in vitro or in vivo in animals, there is no clinical studies in humans. These studies were made of sour sop compared to the effect with adriamycin, a known chemotherapeutic medicine and . It was found that it is 10000 times more potent and kills cancer cells without harming healthy cells. After these report the popularity of this plant has increased tremendously.

Area and Production

Sour sop is a popular crop of grown in South America countries. This small, evergreen and quick growing tree is commonly found on subsistence farms in South-east Asia and the Pacific islands. It is grown extensively in Latin American and South American countries. In other areas in the world, sour sop remains cultivated as backyard tree. There is very little literature about this crop with the exception of information from Mexico, Brazil and Venezuela. In Americas, Mexico is the most important producer of sour sop and in 1997, it was grown on approximately 5,900 ha and produced about 35,000 metric tonnes of fruit. In Venezuela, there were about 3,500 ha and total production was about 10,000 metric tonnes. Brazil grows approximately 2,000 ha with an estimated production of about 8,000 metric tonnes. In India, though sour sop was introduced long back but it is grown very limited scale in the plantations. The average productivity of passion fruit in India is around 25-40 kg per plant. Sour sop yields in Hawaii from trees grown in a marginal field have shown approximately 43 kg/tree on 4 year old trees increasing up to 84 kg/tree on 6 year old trees.



Fig 3: Leaves



Fig 4: Flower

Climate and Soil requirement

Sour sop is the most tropical of the *Annona* species and is considered a plant of low altitudes and a hot and humid climate. It is grown primarily at altitudes lower than 900 m above sea level. However, good productive orchards are found at altitudes of up to 1100 m. Sour sop adapts well to tropical humid regions all over the world. Sour sop grows and produces well at 21 to 30°C. It is very sensitive to severe changes in temperature, especially if it goes below 12°C. In mountainous areas where temperature ranges between 15°-25° C, the tree produces very few fruit. Frost kills, young trees but older trees show some tolerance. Very low temperature, higher temperature and low humidity are detrimental for pollination and fruit formation. Moderate temperature (25-30° C) and high humidity (80 %) greatly improves pollination and fruiting.

Sour sop can be grown on many soil types but sandy to sandy loam soils of medium texture are most suitable. Soil pH should be between 6.0 and 6.5. The soil should be rich in organic matter and low in salts. Best growth can be achieved in deep, rich, well-drained, semi-dry soils. Good drainage is essential to minimize the incidence of collar rot. Water logging is a major cause of floral abscission and root rot. Sour sop cannot tolerate water stagnation but can tolerate dry soil conditions. Thus Water logged and soil without drainage should be avoided for sour sop cultivation

Varieties

There are more than 60 species of the genus *Annona*, among them custard apple is most common. The sour sop has the largest fruit in this Genus. There are wide range of forms and types of seedling in sour sop. These may be divided in different groups as per size, consistency of pulp and taste .These are sweet, sub-acid, and acid; round, heart-shaped, oblong or angular; soft and juicy to firm and dry. Some of the elite lines and varieties have been identified from PuertoRico. In El Salvador, two types of soursop i.e. *guanaba azucarón* (sweet) and *guanaba acida* (very sour) are distinguished. These are good for eaten raw and used for drinks; and only for drinks respectively. In the Dominican Republic, the *guanabana dulce* (sweet sour sop) is most popular variety. In India seedling trees are used for planting, there not much have been done on identification of elite material .only big size and regular bear tree are used as source of planting material. Efforts are going on at CHES,Chettalli to find out, promising line having higher yield, medium fruit size (600-1000g), less acidic and fibers less pulp from the seedling population available in Coorg and adjoining areas.

Propagation

The sour sop is usually propagated by seed. There is a rapid loss of seed viability within six months after harvest. Seeds should be planted as soon as possible after removal from the fruit for better germination. The seeds should be sown in trays or containers and kept moist and shaded. Fresh seeds take 15 to 30 days in germinate with about 85-90% germination. Propagation by cuttings or air layering is not very common. Selected types can be multiplied by cuttings or by shield-budding. Sour sop seedlings are generally the best rootstock for propagation, though grafting on custard apple (*Annona reticulata*), the mountain sour sop (*Annona montana*), or pond apple (*Annona glabra*), is usually successful. The pond apple has found dwarfing rootstock. The use of Custard apple (*Annona squamosa*) and cherimoya (*Annona cherimola*) rootstock was not found satisfactory because of short life of grafted plants.

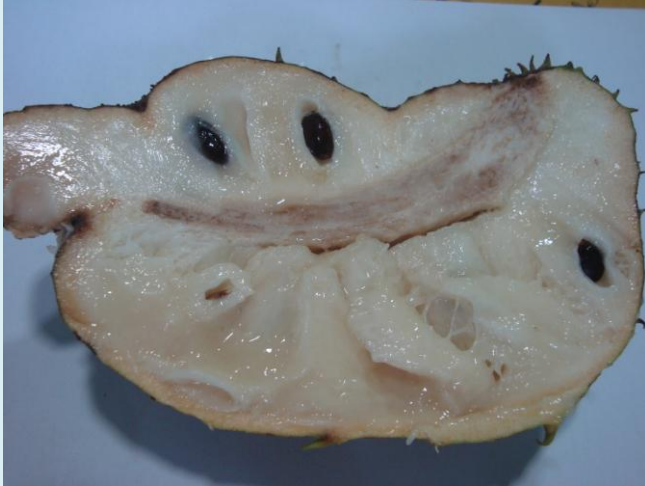


Fig 5. Ripe Fruit (Horizontal Section)



Fig 6: Seed

Spacing and planting

The land should be well prepared by deep ploughing and leveling. Proper spacing should be provided as this greatly influences the growth and production. A spacing of 4 to 6 meters distance is recommended depending on the climate and soil type. Pits of 60 x 60 x 60 cm size are dug and filled with a mixture containing three parts of top soil and one part of compost. Planting is done preferably on cloudy days during June-July after the onset of monsoon so that the plants are well established by the end of the monsoon. Plants should be of 9 to 12 month old and should be of 60 to 100 cm height at the time of transplanting. Plants should be irrigated as soon as possible after transplanting.

Training and pruning

The sour sop usually produces a symmetrically conical tree and is well adapted to the central leader system. The tree can be trained in mushroom shape by topping at 2.0 – 2.5 m height. The fruit in this system is borne on the lateral branches and hangs down for ease of harvesting. Little pruning is required after training of trees. The pruning in later stage is done to thin out diseased, interlocking and weak branches. To regulate the tree size within a certain space, the longest branches extending horizontally and vertically may be pruned annually, preferably immediately after harvest. Very severe pruning reduces subsequent fruiting.

Flowering and pollination

Annona species generally require 27-35 days for flower bud development from initiation to anthesis. Flowering can extend from 3 to 6 months or even longer with heavy peaks. In Coorg condition it flowers

through out the year with two main flowering peaks in April- May and October- November. Two major flowering periods occur after periods of vegetative flushes with the second peak coinciding with the onset of monsoon in India . The flowers exhibit both dichogamy and a protogynous nature. Sour sop floral anthesis takes place mostly between noon and 8 pm and 4 am -8 am with pollen release occurring between 4am and 8am. Flower opening and pollination occurs. Cross pollination may take place early in the morning because at anthesis the flower usually emits a fragrance that attracts insects. In order to increase yield, hand pollination has become an important aspect of cultivation practices in some areas. Beetles are the important pollinators of sour sop flowers with low wind and self pollination. Studies have shown that these beetles breed rapidly in rotted fruit and populations of these beetles are increased by maintaining the rotted on trees.

Nutrition

Adequate fertilization of the planting pit is a basic condition for excellent seedling growth that will result in a productive adult plant producing good quality fruit. As far as fertilizer does in concerned 40g Nitrogen and 60 Potassium should be applied to one year old plant. These doses should be increased at same rate. Four and onwards 180 g Nitrogen, 120 g Phosphorus and 180 g Potassium should be applied to each tree. In addition adequate quality of organic manure should be applied. Fertilizer should be applied around the plant but only lightly incorporated into the soil to avoid damaging the developing root system. In rain fed orchard, the annual fertilization with P should be done in a single application at the beginning of the rainy season. The required quantity of N and K fertilizer should be divided into three doses. First dose should be applied at onset of rainy season, second in the middle and third at the end of the rainy season.

Irrigation

Sour sop can stand periods of drought and prefer rather dry conditions. Water stress should be prevented during flowering fruit set and fruit development as fruit are more sensitive than leaves. Sour sop has a shallow fibrous root system and may benefit from mulching. Prolonged dry spell during January-March may reduce main summer crop and may also affect adversely the development of flowering laterals. If there is no rainfall during the dry months, supplementary irrigation may be given at fortnightly intervals.

Interculture

Sour sop is being shallow rooted as compared to other tropical fruits crops. Deep digging is avoided and weed growth is checked by surface weeding or by scraping and scuffling. Mulching with dried leaves or

grass is done to conserve moisture during summer months. Soar sop is sometime grown with mango and guava as intercrop.

Diseases and Pests

Anthracnose caused by *colletotrichum gloeosporoides* (*Glomerella cingulata*) is the most serious on sour sop particularly in areas of high rainfall and atmospheric humidity and during the wet season in dry areas. This disease causes twig dieback, defoliation, dropping of flowers and fruit. On mature fruit the infection causes black lesion. Black canker (*Phomopsis anonnaccarum*) and diplodia rot (*Botryodiplodia theobramae*) occur mostly on neglected trees and cause symptoms of purplish to black lesions resulting in mummified fruit. Marginal leaf scorch is also caused by *P. anonnaccarum* and *B theobramae* and causes twig dieback. Diplodia rot has darker internal discoloration and deeper more extensive corky rot in fruit. *Cylindrocladium* fruit and leaf spot is caused by a soil-borne fungus *Cylindrocladium colhounin*. It can cause almost total loss of fruit during years of persistent heavy rains. Symptoms begin with small dark spots on the shoulders of the fruit that spread along the sides enlarge become dry and crack. Infection is skin deep but fruit becomes unmarketable.

Insect-Pests

No major pests have been found infecting sour sop in Coorg conditions. But mealy bugs and fruit fly incidence is noticed. In south American countries *cerconota* moth (*Cerconota anonella*) and bephrata wasp are major pests. These pests extensive damage the fruits. Mealy bugs and various species of scale insects are found universally and usually become a serious pest on neglected trees. Mature green fruit are rarely infested by the Mediterranean fruit fly and oriental fruit fly, but these are found on occasion in tree ripened fruit. This can be controlled by a spray of malathion (0.05%) or bait trap or frit fly traps. Spraying may be done only in the afternoon to minimize the destruction of insects pollinating the flowers.

Harvesting and Yield

The fruit is picked when full grown and still firm but slightly yellow-green. If allowed to soften on the tree, it will fall and crush. It is easily bruised and punctured and must be handled with care. Firm fruits are held a few days at room temperature. When eating ripe, they are soft enough to yield to the slight pressure of one's thumb. Having reached this stage, the fruit can be held 2 or 3 days longer in a refrigerator. The skin will

blacken and become unsightly while the flesh is still unspoiled and usable. Studies of the ripening process in Hawaii have determined that the optimum stage for eating is 5 to 6 days after harvest, at the peak of ethylene production. Thereafter, the flavor is less pronounced and a faint off odor develops.

The sour sop is a shy-bearer, the usual crop being 12 to 24 fruits per tree. In Puerto Rico, production of 5 to 8 tonnes per ha is considered a good yield from well-managed orchard. A study of the first crop of 5 year-old tree in Hawaii showed an average of 42.5 kg fruits per tree. Yield was slightly lower during next year. The 3rd year, the average yield was 78 kg per tree. At this rate, the annual crop would be 16 t/ha.

Post harvest Handling

High temperature can cause premature fruit ripening and fermentation of the fruit. Fruit is harvested when fully mature and firm. The skin colour changes as the fruit approaches maturity. The immature sour sop is dark green and shiny and becoming slightly yellowish green at maturity. Sour sop respiration begins to increase within a day after harvest and reaches its peak at the sixth to eighth day. Total soluble solids increase from around 10-16% during the first 3 days of ripening. The major titrable acids are malic and citric acids. After day 5 to 6 titrable acidity, produce a bland flavor and even a slightly odour. The optimum edible stage is at days 6-7, which coincide with ethylene production. Fruit is hand harvested and put into boxes or baskets. Harvested fruit should be handled with care to prevent bruising of the skin. Firm fruit are held after harvest for 4-7 days at room temperature before softening begins, optimum quantity processing occurring 5 and 6 days later. The skin of ripening sour sop gradually turns dark brown to black, but the flesh is unspoiled. Storage below 15° C causes chilling injuries and failure to develop full flavor. At lower temperatures skin discoloration rapidly occurs. It can be use as freshor for processing after removal of outer skin and seeds.