

## Conclusions

Our observations have led us to conclude that until the genetics of lychee are better understood, until pathogens have been identified and indexing procedures developed, or until other factors involved have been identified, compatibility of rootstocks and scions will continue to be a "hit or miss" proposition. Therefore, to minimize and/or avoid these problems, our program of propagation includes the following:

- Sanitizing grafting areas, tools, and workers, particularly between scion sources.
- Planting seeds of various cultivars growing in close proximity to one another.
- Observing seedlings for uniformity and making selections for new cultivars and/or rootstocks.
- Grafting these seedlings to particular cultivars which they may resemble and/or scions of their parents.
- Planting out and monitoring grafts that "take".
- Decapitating trees that form the best unions and vegetatively propagating the shoots for future rootstocks.

- Distributing grafted trees to various regions to observe performance.

Using these procedures, we have successfully identified rootstocks for several lychee cultivars. Success with one in particular, 'Emperor', has been very good (Fig. 5, 6). A few 'Emperor'/rootstock combinations have exhibited the "rust-like" bark conditions across the graft union, but without any apparent effects on growth or production up to this time (5 years). Until compatible seed source trees are identified, we may have to content ourselves with returning to a singular, identified compatible tree as a source of rootstocks.

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## THE LYCHEE'S HISTORY IN FLORIDA

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**Abstract.** The lychee (*Litchi chinensis* Sonn.) was introduced to Florida before 1880, but attracted little attention until the 1940s when its suitability for fruit production was noted by a small group who thereupon worked effectively to popularize this crop. The discovery of an improved method of propagation, marcottage using polyethylene plastic and sphagnum moss, made mass production of nursery stock practical. In the 10 years from 1948 to 1958, a center of production developed in Sarasota County on the west coast, but prolonged freezing weather in early 1958 killed or severely damaged the plantings there. Production moved southward, and before Hurricane Andrew, 150 acres were concentrated in southern Florida. Lychee trees showed earlier recovery from hurricane damage than many other important fruit crops, and one estimate of the area currently planted to this crop is 350 acres. The two cultivars on which the industry is presently based, 'Brewster' and 'Mauritius', both have production problems, and therefore improved cultivars are needed.

The first introduction of lychee plants to Florida took place before 1880, to a site in the vicinity of Sanford (Manville *et al.*, 1889; Singh & Singh, 1954). Little more was heard of this introduction, but the 'Brewster' or 'Chen Purple', brought from Fujien Province, China, late in 1903 (U.S. Dept. of Agriculture, 1908), had a greater impact on Florida's development of a lychee industry. Although its introduction was re-

corded by USDA without a cultivar name, as P.I. 21204, credit for 'Brewster's' introduction should go to an American missionary of the same name who collected and brought it from China. Many plants grown in Florida were brought from Reasoner's Nursery, in Manatee County. Their stock of lychee probably was propagated from the 1903 introduction, although the name 'Brewster' was not attached to it in their catalog (Royal Palm Nursery, 1937). A tree bought from them in 1919 and planted in south Dade County survived for 73 years, just west of U.S. 1 and north of S.W. 288 Street (Biscayne Drive), until it was destroyed in the aftermath of Hurricane Andrew in 1992 (Collins, 1935). 'Brewster' and a second cultivar, 'Mauritius', introduced by the University of Florida from Natal, South Africa (Ledin, 1957), have been the most important cultivars in Florida's lychee industry to date, although neither is ideally adapted to Florida conditions.

Lychee growing in Florida received substantial support in the 1940s from Col. William R. Grove, U.S. Army (Ret.), who lived at Laurel, in Sarasota County. Judge C. E. Ware, of Clearwater, also was an active enthusiast at that time who promoted lychee culture on the west coast. A ferment of research and development took place, powered by Col. Grove, Judge Ware, and a group of like-minded friends and associates. They founded the Florida Lychee Growers Association in 1951, and this organization made a valuable contribution to the young industry through the publication of their yearbooks from 1954 through 1963. The greatest of these associates was perhaps G. Weidman Groff, a horticulturist and authority on the lychee (Groff, 1921) who before World War II was Dean of the College of Agriculture at Lingnan University, Guangzhou (Canton), China. Returning to the United States after 1947 and settling at Laurel, he contributed substantially to the development of the growing industry until his death in 1954.

Col. Grove's illustrious career included winning the Congressional Medal of Honor as a young officer in the Philippines, heading relief work after World War I in Poland, and in 1922-23 in the Ukraine, and acting as general manager of a meat packing plant in Chicago before he moved to Laurel in 1940. Without formal horticultural training, he nonetheless planted an arboretum on his property and determined, on the basis of the lychee's performance there, that it had great potential for commercial development. By the time of his death in 1952, he had developed a planting of 2,000 trees. Lychee propagation was greatly facilitated by Col. Grove's discovery of the use of plastic and sphagnum air layers ("Air Wrap"), an improvement on the ancient Chinese practice of marcottage. He was awarded a patent for the Air Wrap system in 1951 (Florida State Horticultural Society, 1952). In the last 40 years, this method has been used to propagate many plant species.

Thousands of lychee plants propagated as air layers were used to establish a substantial industry in central and south Florida. This developed and flourished from the late 1940s until the disastrous winter of 1957-58, when many trees in the northern part of the cultural zone (Sarasota, Highlands, Polk and Brevard Counties) were killed or severely damaged. Col. Grove died in 1952 and so did not witness this destruction, which coincided with expanding urban development that permanently removed most of the Sarasota County acreage from production. The further disastrous freeze of December, 1962 served to eliminate remaining lychee acreage from Highlands, Polk and Brevard Counties. As a result, Florida's lychee industry moved southward into Lee, Collier, Palm Beach, Broward and Dade Counties, where it remains. The acreage picture has changed through time. Before the freezes of 1958, 320 acres of lychees grew in Florida. By 1966, 150 acres remained in production (Knight, 1988). The southward migration begun in 1958 was further encouraged by the "Christmas freezes" of the 80s which served to eliminate the few plantings left in south central Florida.

Before Hurricane Andrew, southern Florida's plantings, based on the 'Mauritius' and 'Brewster' cultivars, amounted to 150 acres, the same as the 1966 figure (Crane, 1989). Plantings were severely damaged by the hurricane, but the lychee trees as a whole recovered more rapidly than trees of some other important crops, notably the mango, and this has encouraged replanting. At the present time (October 1994), estimates of lychee plantings in Florida range from 205 (paid assessments to Tropical Fruit Growers of South Florida, Inc.) to 350 acres (J. H. Crane, pers. comm.)

The lychee's popularity with growers is based on sound economic thinking. Market demand for fresh lychee fruit is not likely to be saturated by Florida's production in the near future. If better cultivars can be found, continued expansion of plantings may be expected. The perfect lychee cultivar for Florida has not been found. What is needed to establish a viable industry is a group of at least three and preferably five cultivars that regularly bear full crops of attractive, high-quality, disease-resistant fruit over a long season. For the lychee in Florida we might hope ideally to have marketable fruit coming on from mid-May to mid-August. Preferably the fruit of all cultivars should be similar in appearance, but such similarity is less important than the other needed attributes. Of the two cultivars most planted now, 'Brewster' has an attractive fruit of good quality, but its production dependability is not great; 'Mauritius' usually bears good crops that ripen before 'Brew-

ster', but the fruit is often marred by anthracnose disease, a fact that was observed when 'Mauritius' first fruited in Florida (Ledin, 1957).

The time is overdue for finding and bringing outstanding new lychee cultivars into use. Some work has been directed toward this goal, but more is needed. The USDA germplasm collection at Chapman Field (Subtropical Horticulture Research Station, Miami) contains a number of Chinese cultivars (names unfortunately lost) that were collected and shipped from China by Groff in 1920. Several quite distinct clones were distributed under one inventory number, P.I. 51471. Of this group, 'Sweetcliff', carried on the Miami inventory as M-8516A, was observed to fruit more consistently than other clones. Accordingly, 1200 open-pollinated seedlings of this cultivar were set in the field at Miami in the early 60s for evaluation and selection. The vast majority of these trees did not fruit, although they grew in a normal manner for some 25 years. Those which did bear showed a wide range of variation in fruit quality and appearance, and many appeared to have resulted from cross-pollination. This is not astonishing, given that the lychee's breeding system favors out-crossing and the 'Sweetcliff' tree at Miami is in a mixed planting, near other trees in the collection. A few selections from this background were evaluated in Florida and Israel, and at this point it appears that a couple, 9-34 and 11-57, the latter informally dubbed "Garnet," may have sufficient merit to justify release as new cultivars.

The tropical fruit program recently instituted at Fairchild Tropical Garden, Miami, includes lychee evaluation as a prominent component of the work. An important aspect of the program is the collections and evaluation in south Florida of as many improved cultivars as possible. Among these are clones brought from Australia, China, India, Israel and Thailand. Most are of high horticultural quality. As information is collected on their production and disease resistance, the best performers can be expected to be added to Florida's commercial plantings.

The lychee cultivar evaluation work currently beginning at the University of Florida's Homestead Research Center (IF-AS-TREC), in cooperation with the Tropical Fruit Growers of South Florida, also will collect much-needed performance data for cultivars that are grown commercially elsewhere and for new cultivars believed to have commercial potential. The information gathered in this work can then be applied by growers.

From its beginning, Florida's horticulture has profited from the efforts of individual growers and private nurseries (Knight, 1987). This work is being continued by the Murrays' Tree House Nursery on Pine Island, where an array of lychee cultivars from elsewhere is being evaluated alongside outstanding selections made by the Murrays from their own seedlings.

Thus, the lychee growers and Florida research institutions are working together to build the industry that existed 40 years ago in the dreams of Col. Grove, Judge Ware, Professor Groff, and their friends. The not-too-distant future promises to bring about results worth the wait.

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## DISEASES OF *LITCHI CHINENSIS* IN SOUTH FLORIDA

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**Abstract.** The lychee, *Litchi chinensis* Sonn., is a small to medium-sized tree from China grown throughout the tropical world for its delicious fruit. The lychee, along with many other tropical and subtropical fruits, can be grown successfully in the United States only in peninsular Florida. The lychee in Florida is subject to relatively few serious diseases, but anthracnose caused by *Colletotrichum gloeosporioides*, is an extremely important factor in lowering grade and quality of the fruits and reducing yield. The most serious disease is mushroom root rot caused by *Armillaria tabescens* which can result in tree death. The following fungi also cause diseases of lychee: *Botryosphaeria* sp., *Cephaleuros virescens*, *Colletotrichum gloeosporioides*, *Diplodia* sp., *Fusarium* sp., *Gloeosporium* sp., *Phyllosticta* sp., *Phoma* sp., *Rhizoctonia solani*, *Pythium* sp., and *Spheropsis* sp..

The lychee, *Litchi chinensis* Sonn., is a small to medium-sized tree from China grown throughout the tropical world for its delicious fruit. The lychee, along with many other tropical and subtropical fruits, can be grown successfully in the United States only in peninsular Florida. The tree is well known to many Floridians and has been planted for many years as a dooryard fruit tree and in small commercial groves. Lychee production before 1950 was expanding in north central Florida. However, the freeze in 1962 eliminated the central Florida dream of being the lychee capital. Before Hurricane Andrew in 1992, commercial plantings had increased. At present lychee production is found on Pine Island near Ft. Myers, and Homestead, Florida. The lychee cultivars grown in south Florida are quite hardy to varying degrees.

This paper provides descriptions of the more common fungi found to be associated with the litchi. The reader will find the disease common name, scientific name of the pathogen, symptoms of the disease, and conditions necessary for disease development.

### Mushroom Root Rot

*Armillaria tabescens* (Scop.) Dennis

Mushroom root rot is caused by the fungus *Armillaria tabescens* (Scop.) Dennis (Alfieri et al., 1994; Campbell and Mallo, 1975). The fungus is known as the honey mushroom, honey agaric, oak fungus, and shoestring fungus. Occasionally the fungus produces the honey colored mushrooms around the trunks of dying lychee trees. Although the disease does occur in Dade County, Florida, it is rare to see the mushrooms, but they are produced on affected lychees in the middle and the western part of the state.

The decay is found on the roots and root crown. The fungus produces a sheet of tough, fan-shaped mycelium found between the bark and the wood. As the mycelium ages from a white to a light tan, it becomes soft and watery in texture. Clumps of mushrooms are occasionally found at the base of a dead or dying tree. The mushrooms are a honey-colored or light tan, with a stalk 4 to 6 inches high and a cap 2 to 4 inches across, often dotted with brown scales. Spores formed along the gills of the mushroom are wind-borne. When the fungus penetrates a healthy root it progresses along the cambium layer, growing up to and girdling the root crown. The leaves are dwarfed, turn yellow, or fall prematurely. There are no known fungicides for the control of mushroom root rot.

### Stem Canker

*Botryosphaeria* sp.

Stem canker caused by the fungus *Botryosphaeria* sp. is normally found attacking the terminal branches of the lychee (Alfieri et al., 1994). The disease is noticeable by the sunken, shrinking, oval to irregular, and dying tissues, which later can crack open and expose the wood underneath. The fungus enters through wounds and on dead and dying twigs.

To control *Botryosphaeria* stem canker, prune infected branches and apply a wound paint on the cut surface.

### Algal leaf spot, green scurf, red leaf spot

*Cephaleuros virescens* Kunze

Algal leaf spot, green scurf, red leaf spot caused by the algal *Cephaleuros virescens* is an infrequent leaf spot of lychee (Alfieri et al., 1994). This alga has never been observed on