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THE LYCHEE

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"Beneath these green mountains where Spring rules the year

"The arbutus and loquat in season appear

"And feasting on lychee—three hundred a day

"I should not mind staying eternally here."

Thus sang a Chinese poet 900 years ago about a luscious fruit native in southern China.

Early travelers to China extolled its virtues, and encouraged its introduction into Europe and America. One said, "It is one of the very finest fruits in the world, not excepting the apple and the pear." Another said, "It is the most tasty and beautiful fruit that God created in the Universe"; and another, "One of the daintiest packages that has ever been wrapped by Nature's hand is the little spherical litchi fruit. No one, whether he is a student of nature or not, can examine the litchi without admiring its beauty and the sanitary method by which the fruit is preserved."

The lychee is known to have been cultivated in southern China as early as 1766 B.C. It spread around the tropical and subtropical world in the 16th and 17th centuries, following Magellan's circumnavigation of the world in 1519-1521.

Eventually, the lychee did come to America, where it is to be seen in many countries of Latin America, and ultimately to the United States. It is thought to have been introduced into the United States around 1870 by General H. S. Sanford, world traveler and collector of exotic plants, who purchased 23 square miles of Florida land at Belair, near the present city of Sanford, where he established several hundreds of varieties of fruit bearing and ornamental plants. In 1883, Charles Armory of Sanford sent fresh lychee fruit to the Massachusetts Horticultural Society for exhibition. In 1885, Reasoner Brothers Royal Palm Nursery at Onceco, Florida began importing trees from Saharanpur, India.

In so far as known, the first tree in California was one purchased from the Reasoner Brothers Nursery by E. D. Hadley which he planted at his residence on East Sola Street in Santa Barbara in 1897. It fruited for the first time in 1913, and continued to bear off and on for the next half dozen years. Mr. Hadley sold the property in 1919, and there seems to be no further record of it. Both it and the old home near which it stood were destroyed many years ago,

The lychee was first introduced into Hawaii by Cheng Check, a Chinese merchant, in 1873.

In former times, many persons in the United States came to know "Chinese lychee nuts" which were imported from south China in large amounts, principally for the Chinese immigrants in California. The "lychee nut" is the dried form of the fruit, and is to the fresh fruit what a raisin is to a grape (Fig. 1) Customarily, Chinese people gave boxes of dried lychees to friends as gifts during the Chinese New Year season.

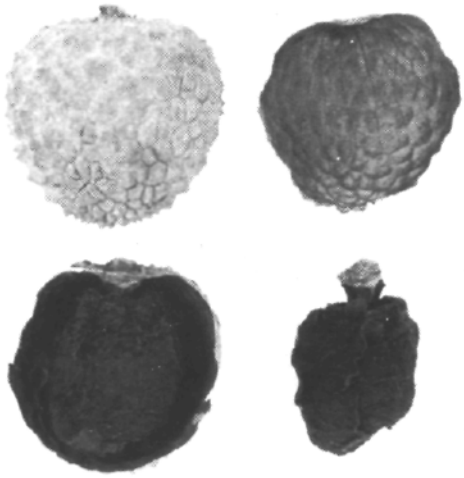

Figure 1. "Lychee nuts," i.e. dried lychee fruits.

Some persons have become acquainted with the lychee from the canned fruit which is imported from Hong Kong and Taiwan, and frequently is seen on the shelves of supermarkets and gourmet food stores. Fresh frozen lychee sometimes are to be seen, also, shipped in from Florida and Hawaii. The fresh fruit is known and generally esteemed by those persons who have been in Florida, Hawaii, southern California, various Asiatic countries, or South Africa when the fruit is in season.

The late Professor G. Weidman Groff, world authority on the lychee, with over 40 years at Lingnan University in Canton, China, stated in his book *The Lychee and Lungan* that the word *lychee,* with the *ly* pronounced as in *lying* and the *chee* as *cheese,* would best convey the correct Cantonese sound of the word. Most horticulturists in the United States have adopted this spelling of the common name.

The Mandarin sound of the word is lee-chee. This pronunciation is commonly used in North China, India, South Africa, and a number of other countries where the lychee now grows. The preferred spelling in the horticultural literature of these countries, however, is *litchi,* which is identical to the generic name of the species.

Groff's preference for the Cantonese pronunciation and the spelling which most closely approximates it lay in the fact that the lychee is indigenous to south China and had its origin as a cultivated fruit tree in the Canton delta of the Pearl River.

Variations in spelling may be encountered in the horticultural literature on the lychee, as

well as on the labels of boxes of dried fruit and of cans of preserved fruit which occasionally appear in local grocery stores. Among the more common variations are lichee, leechee, litchee, lychi, laichi, laichee, laitchi, laitchee, and lici.

Figure 2. Lychee tree.

BOTANY

The botanical name of the lychcee is *Litchi chinensis* Sonn. The species is a member of Sapindaceae, the soapberry family, which comprises about 2000 species of tropical and subtropical trees, shrubs, herbs, and vines that have been classified into 140 genera. Some of the species which are cultivated in California as ornamentals are: *Dodonaea erio-carpa,* a colorful shrub often used for hedging; *Filicum decipiens,* the fern tree; *Harpullia péndula,* the tulipwood tree; *Kolreuteria formosana,* the golden-rain tree; and C*upania anacardiodes,* the tuckeroo. Species grown elsewhere in the world for their edible fruits are: *Euphoria longana,* the lungan or dragon's-eye, a few trees of which are to be seen in California; *Melicocca bijuga,* the Spanish lime of Florida and the Caribbean region; *Blighica sápida,* the akee, which is the national tree of Jamaica; and. *Nephelium mutabile,* the pulassan and *Nephelium,* the rambutan, both of the Malayasian-Indonesian region. A related species native in California is the California buckeye, *Aesculus californica.*

The lychee tree is a medium to large, handsome evergreen, with a short, stocky trunk and a low, large head. (Fig. 2) In Florida, Hawaii, and elsewhere, trees reach a height of 40 feet, with an approximately equal spread when grown under favorable conditions. In some varieties, the branches are crooked or twisting, and low-hanging and spreading, forming a head broader than high. In other varieties, the branches are fairly straight and more or less upright, forming a compact, rounded head.

The leaves of the lychee are arranged alternately on the stems. They are pinnately-compound, consisting of a leafstalk (petiole) and its extension (rachis) with 2-5 pairs of

leaflets. The combined length of petiole and rachis is 3-9 inches. The leaflets arc arranged in opposite or slightly oblique order along the rachis on short stalks (petiolules) of their own which measure ⅛ - 1 inch in length. The blades of the leaflets are a lustrous deep green on the upper surface, and a waxy lighter green (glaucous) on the under surface. They are soft-leathery to the touch. Mature leaflets measure 3-8 inches in length and 1-2½ inches in width. They are elliptical to lance-shaped in outline. The bases of the blades are wedge-shaped, and the apical ends may be tapered to long point, wedge-shaped, or even more or less rounded. Length of petiole and of rachis, arrangement of leaflets on the rachis, number of leaflet pairs, and leaflet shape and dimensions are useful characters for identifying varieties.

The inflorescence is a many-branched panicle which, depending on variety, may vary in length from 3 inches to over one foot (Fig. 3). It bears hundreds of small white or yellowish flowers which give off a mild, unpleasant odor when the tree is in full bloom. The numbers of fruit maturing on a panicle may vary from one to 40, or more.

Lychee flowers measure about ⅛ – ¼ inch across when fully expanded, resting on flower stalks (pedicels) about 1/16 inch long. They have 4 or 5 short dentate sepals, but arc without petals. They have 6-10 stamens.

Figure 3. Paniculate lychee inflorescence.

Five different types of flowers have been described in the literature on the lychee.

Classification of the types is based primarily upon length and function-ability of the stamens, and on development and function-ability of the pistil. The flowers are unisexual in function, so they may be classified broadly as male and female. Both classes of flowers are borne in the same panicle, but tend to alternate in their periods of opening.

The typical male flower has a vestigal or abortive pistil at its center. Surrounding this are the 6-10 stamens with filaments up to ¼ inch in length. A single flower remains functional for several days during which the pollen sacs ripen and shed pollen successively rather than simultaneously (Fig. 4).

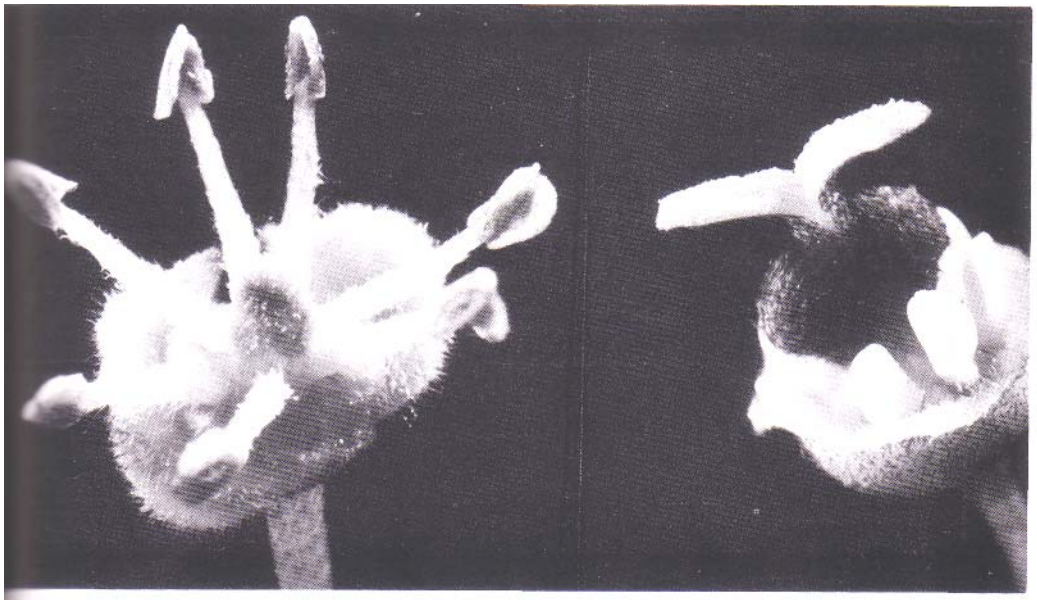

Figure 4. Lychee flowers: left, male; right, female.

The typical female flower has a small, but fully developed, pistil which rests on a short stalk or gynophore. The ovary is two-lobed with each lobe containing an ovule. It is surmounted by short style, which is cleft at the apex into two rays that expose white, sticky, stigmatic surfaces when expanded. The pistil is surrounded by the stamens which, however, have very short filaments, usually no more than 1/16 inch long. The pollen sacs do not open, so the flower sheds no pollen. (Fig. 4).

Generally, only one lobe of the ovary develops into a fruit, the other lobe aborting. Occasionally, both lobes develop, and the mature fruit superficially resembles two fruits adherent to each other at their bases, each containing a seed (Fig. 6).

The typical one-seeded fruit may be round ovoid, or heart-shaped, depending a good deal on the variety. The outer covering is a thin, leathery shell (pericarp), which is bright red in color in most varieties. It is rough in appearance and to the touch, its surface being covered with angular or conical protuberances. The shell becomes brown and brittle upon drying (Fig. 5).

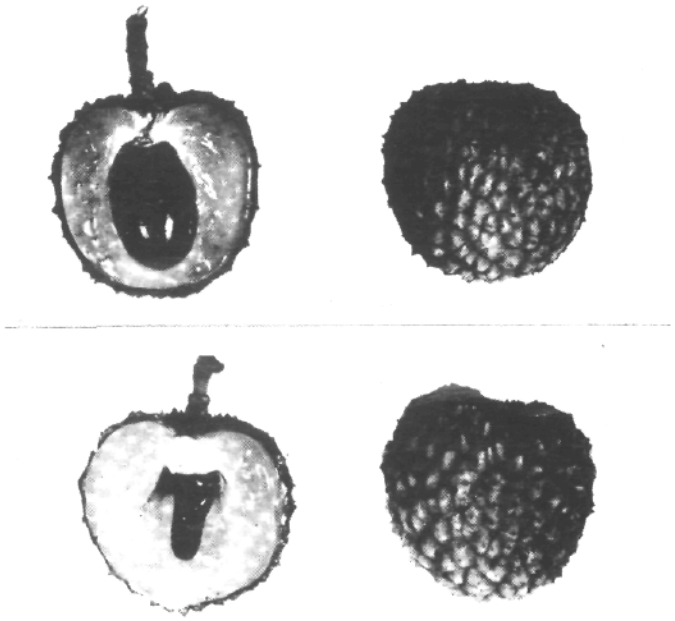

Figure 5. Lychee fruits: top, normal; bottom, abortive seed.

Figure 6. Panicle of small, parthenocarpic fruits compared with normal single and twin fruits.

The fleshy edible portion of the fruit is an interesting structure. It is an outgrowth of the seed stalk, and is called an aril. It grows as the fruit develops until it completely envelops the seed. It is white and translucent, and has a consistency about like that of a grape. The fleshy edible portion of the fruit is an interesting structure. It is an outgrowth of the seed stalk, and is called an aril. It grows as the fruit develops until it completely envelops the seed. It is white and translucent, and has a consistency about like that of a grape. The flavor, which is subacid and quite distinctive in its own right, is likened by

many persons to that of a prime muscat grape.

Upon drying, the aril shrinks away from the shell, and becomes shriveled, brown, and date-like in character. It is in this form only that many persons are acquainted with the fruit as the "Chinese lychee nut" (Fig. 1).

The chestnut-brown seeds are ovoid to oblong in shape, measuring ⅜ - ⅞ inch in length and ¼ - ½ width. In some varieties, a high percentage of the seeds in fully developed fruits may be abortive. The abortive seeds are small and shriveled. The Chinese people call the abortive seeds "chicken tongue" seeds. Fruits with abortive seeds are preferred, for they are no smaller than fruits with normal seeds, and, consequently, contain a larger proportion of flesh (Fig. 5).

In Hawaii, the lychee begins to bloom as early as mid-December in some years, and as late as March in others, with slight differences between varieties in a given season. The fruit crop ripens from about the middle of May to the middle of August. In south China and in Florida, flowering commences in mid-February and tapers off toward the end of March. In China, where numerous varieties are grown, the fruiting season extends from the middle of May to the middle of August. In Florida, where production is limited almost entirely to single variety, the bulk of the crop ripens in June and July. In California, flowering usually occurs no earlier than April, and some localities, does not reach its height until late in May to the middle of June. The fruit crop matures in September and October.

The lychee is a heavy bearer when conditions are favorable for fruiting. In Florida, 155 pounds of fruit were harvested from a 10-year-old tree at Laurel, and 400 pounds from a 24-year-old tree at Auburna-dale. In Hawaii, 7 and 8-year-old trees have produced up to 100 pounds, and 15 to 20-year-old trees up to 300 pounds of fruit.

CULTURAL REQUIREMENTS

The lychee thrives and bears best under subtropical conditions in the absence of injurious frosts. From Florida, it is reported that the mature lychee tree is hardier than the mango and avocado, but somewhat less hardy than the sweet orange. At Homestead, Florida, no injury was observed on mature trees that were not in active growth at a temperature of 28 degrees F. On the other hand, tender growth was damaged when temperatures fell below 32 degrees F, and young trees were severely damaged or killed at temperatures of 29-30 degrees F in unprotected plantings.

For best fruiting, the lychee is said to require cool dry winters and warm humid summers. Winter dormancy seems necessary in order for flower buds to be initiated in the spring. It is because conditions closely approximating these occur in Florida that the history of fruiting has been fairly consistent. In Hawaii, where the winters are normally wet and the summers normally dry, and the winter temperature rarely falls below 56-58 degrees F, bearing is highly erratic.

The lychee requires a large supply of water for optimum growth. The consensus of opinion seems to be: if rainfall is less that 50-60 inches, distributed through the major portion of the year, supplementary water should be supplied through irrigation. The soil around a lychee tree should never be allowed to dry out.

A critical factor in fruit setting is: atmospheric humidity around the tree must be fairly high when it is in bloom. Although the matter has not been studied thoroughly, indications are that a certain amount of moisture in the air around the inflorescences is necessary for pollen germination and fruit setting. In southern China, blossoming and fruit setting occur during the wet season when rainfall ranges from 5 to 15 inches a month and relative humidity is never less than 50 percent on any day. The periods of blossoming in Florida, Hawaii, South Africa, Mauritius, and India occur during the rainy season.

Lychee can be grown on many different kinds of soils, provided they are sufficiently deep. In China, they are commonly planted on lands subject to flooding. Drainage, while not critical, is important, for they cannot withstand submersion of their bases and roots very long if the water becomes stagnant. In Hawaii, they are grown on fairly heavy clay soils. In Florida, they are grown in some areas where the soils are very sandy, Acid soils are thought to be best, but in Florida and India, they are grown satisfactorily on neutral and slightly alkaline soils.

PROPAGATION

The lychee can be grown from seed, but this is seldom done because the fruits of seedling trees usually are inferior to those of the parent variety. Only large well-filled seeds will germinate. These must be removed from fresh fruit. Their period of viability is very short, and, if not planted right away or kept damp, lose their ability to germinate in a few days.

Air-layering, or marcottage, is the usual method used for propagation. Branches ¼ - ½ inch in diameter are the ones most commonly used. First, the branch is girdled by removing a ring of bark, about one inch wide, a foot or two from the end. Then, a ball of damp sphagnum moss is placed around the girdle, and firmly wrapped with a sheet of polyethylene film cut to proper size. The edges of the wrap are lapped or folded, and the ends are tied securely. A sufficient root system, to allow for cutting the layer from the tree, forms in 3-4 months, if layering is done during the warm seasons of the year. Usually, the rooted layers are cut from the tree and planted in containers. They are kept in partial shade and under conditions of fairly high humidity until ready for transplanting to the field.

Grafting and budding are not widely used as means of propagating varieties, because of the time required to grow rootstocks to adequate size and because the percentage of successful takes has generally been rather poor.

The lychee can be propagated by cuttings, but this is not often done because of special conditions and techniques which must be used. The root systems of cuttings are usually inferior to those of air-layers.

VARIETIES

Prof. Groff listed 74 varieties of lychee in his book *The Lychee and Lungon*. It is doubtful, however, that more than a dozen are cultivated widely. The most important

commercially are No Mai Ts'z (Glutinous Rice), Kwai Mi (Cinnamon Flavor), Hak Ip (Black Leaf, Wai Chi (Wai River Lychee), Chen Ka Ts'z (Chen Family Purple, Brewster), Heung Lai (Fragrant Lychee), T'em Ngam (Sweet Cliff), Pat Po Hung (Eight Precious Red), and Fi Tsz Siu (Imperial Concubine's Laugh). Most of the dried and canned lychees imported from Hong Kong and Taiwan are Hak Ip and Kwai Mi.

A book entitled *The Litchi* by L. B. Singh and U. P. Singh published in 1954 reported that 33 varieties were cultivated in India, all of local origin from seeds of Chinese varieties which were introduced into India toward the end of the 18th century.

Both home and commercial plantings in Florida consist of a single variety, known locally as Brewster. The variety was sent by Rev. W. N. Brewster to the United States Department of Agriculture in 1907. It was recorded by the U.S.D.A. as accession S.P.I. 21204. Trees were established at the U.S.D.A. Plant Introduction Station at South Miami, Florida, and at the Hawaii Agricultural Experiment Station in Honolulu. It has since been found to be identical with the variety in Fukien Province, China, known as Chen Ka Tsz, or Chen Family Purple.

In 1955, the U.S.D.A. and the University of Miami jointly introduced a Florida-grown seedling as a new variety, Bengal. It is reported to be a vigorous grower, which does not show chlorosis when grown in the limestone soil of Dade County.

The principal producing varieties in Hawaii, as reported by R. A. Hamilton and W. Yee in the *Proceedings of the Florida State Horticultural Society,* volume 83, 1970, are Kwai Mi, Hak Ip, Chen Ka Tsz, No Mai Tsz, Pat Po Hung, and Groff. The last named variety originated in Hawaii as a seedling of Hak Ip. It was introduced as a horticultural variety and named in honor of Prof. G. Weidman Groff by the Hawaii Agricultural Experiment Station in 1953. Prof. Groff personally took trees of 14 varieties from China to Hawaii in 1917 and again in 1941.

The principal variety cultivated commercially in South Africa is called Mauritius.

The status of Mauritius is problematical. The variety was sent to the Hawaii Agricultural Experiment Station by A. van der Meulen of South Africa in 1951. This turned out to be identical with Kwai Mi, as well as one known locally as Charlie Tong. Latterly, this variety has been coming into California from Hawaii under the name of Annie May Wong. However, a horticulturist at the University of Florida's Subtropical Experiment Station has stated that their accessions of Kwai Mi and Mauritius are not identical.

THE LYCHEE IN CALIFORNIA

As mentioned previously, the first lychee tree in California probably was the one which was planted by E. D. Hadley and grew in Santa Barbara from 1897 to 1919 and possibly a few additional years.

I have seen about 30 lychee trees in California all the way from the vicinity of San Diego in San Diego County to Goleta in Santa Barbara County. They vary in size and vigor from large and healthy to small, stunted, and struggling for survival.

Probably the handsomest is one of the variety Kwai Mi growing on the property owned originally by Admiral Stanley in La Mesa. The Admiral presumably brought it from China

when he was Commandant of the United States Navy's Asiatic Fleet. It stands 20-25 feet high, and spreads 30 feet or more. It is known to have produced good crops annually.

At one time there were a dozen fine trees on the property owned originally by C. O. Nichols in El Cajón. The trees were all of the variety Brewster which Mr. Nichols had obtained in Florida sometime in the 1920's. For many years they were known as the only fruiting trees in California. Time, several changes of owners, and lack of proper care have taken their toll, and only a few remain today. However, the survivors continue to produce fruit in favorable years.

From 1927 to 1965, a seedling of Shan Chi, the wild mountain lychee of China, grew on the campus of the University of California in Riverside. It produced several pounds of fruit almost every year. In 1965, it was about 15 feet in height and 10 feet in spread. It was destroyed by a bulldozer clearing a path for installation of a drain pipe under a roadway.

Flourishing trees are established in a number of localities, among which are: the Tanner and Johnston properties in Rancho Santa Fe; the Bucklew property in Encinitas; the Miller, Darien and Farwell properties in Vista; the Cooper, Beck and Snider properties in Fallbrook; the Thomson property in Bonsall; and the Riley property in Santa Clara. The latter is the northernmost locality in California where the lychee is reported to be growing.

In the past, trees which have been well established in large containers have tended to stand still, or to decline and eventually to die when planted in the open. For every tree that has become established in the ground in California, untold numbers have been lost. The same can be said of Florida, also. It is interesting to note, however, that well established, well cared for trees, out in the open, seem able to withstand the rigors of the southern California climate. In the past winters, frosts which injured avocados and other subtropicals adjacent to lychee trees had no apparent effect on the lychees. In August — September, 1971 there was a protracted hot spell in which air temperatures reached 112-115 degrees F, and relative humidities were often below 10 per cent. No appreciable injury was seen on the lychee trees, whereas avocado trees were severely damaged and citrus trees showed stress. In order to withstand high temperatures and low relative humidities, however, the trees must be adequately supplied with soil moisture.

Just why the lychee should be so difficult to grow in containers in the greenhouse or lath house, and why it should be even more difficult to establish in the open, are questions which have generated much speculation. Various arguments have been advanced as to what the cause, or causes, of the difficulty might be. Among the chief causes cited are the following: the low relative humidities of the atmosphere which prevail a good deal of the time; alkalinity of the soil in most areas, salinity of the water used for irrigation; lack of organic matter in the soil; lack of mycorrhizal fungi in the soil, which are believed to be related to satisfactory growth; soil temperatures too low for optimum root growth during much of the year; poor soil aeration; deficiency in one or more minor elements which may be requisite for growth. It is worth remarking, however, that various attempts to approximate what are believed to be optimum conditions for growth in greenhouse

culture have been rewarded with only a modicum of success.

Sometimes, lychee trees in California may blossom profusely, but fail to set any fruit. This may be due to any one of three causes or combinations of all three. The first cause is the hot desiccating wind known as the Santa-Ana. When one is blowing, its velocity may be up to 50 miles an hour, or more. At the same time, the air temperature may be anywhere from 95°—120°F, and the relative humidity may be as low as 1-3 per cent. One such wind can burn up the inflorescences completely. The second cause is lack of sufficient soil moisture to keep the foliage and inflorescences turgid and to maintain transpiration. The third cause is consistently low relative humidity of the air, which seems to inhibit pollen germination and ovule fertilization. Wetting the tree and the ground all around on hot days or providing the tree with a misting system to keep the foliage and flowers damp may be helpful.

Two phenomena have been observed in California which seem to be unknown in other lychee growing regions.

The first phenomenon is; branches which fruit in one year are unlikely to fruit in the next. This is because the blossoming-to-crop season comes so late (March to September) that fruiting is not followed by a vegetative flush of growth before dormancy is induced by cold weather. When growth resumes in the spring, it is strictly vegetative, and remains so for the year. Elsewhere, the blossoming-to-crop season extends from December to May-July, Fruiting is followed by a flush of vegetative growth, which goes into a rest period in September-November. The next flush in December-January produces inflorescences. Thus, trees in California require two years to complete a cycle which trees in warmer climates complete in one year.

The second phenomenon is the tendency for the trees to set large numbers of small parthenocarpic completely seedless fruits. This seems to be unknown in India, Florida, and Hawaii, and probably elsewhere (Fig. 6).

DISCUSSION

The lychee can be grown and will produce fruit in Southern California in favorable locations and with proper management. One should realize, however, that it is not one of the easiest trees to grow, and that it does not always respond as well as one might wish. And, as seems to he the case everywhere, one can just about expect its fruiting habits to be erratic and unpredictable. One advantage California enjoys is the absence of insects and diseases injurious to the lychee.

Factors to be considered in lychee culture are: 1. start with fairly large trees with well-developed root systems; 2. the two most dependable varieties for producing fruit are Kwai Mi and Brewster; others such as Hak Ip, Groff, T'im Ngam, and Bengal may be tried experimentally, if one wishes; 3. plant in a well-drained, slightly acidic soil; 4. keep the tree well watered at all times; 5. use an organic mulch for several feet around the tree to conserve moisture and keep the ground cool; 6. maintain an adequate supply of moisture around the tree, and wet down the foilage several times a day during a hot spell in the flowering season; 7. do not use weed oil or chemical herbicides around the lychee trees. I have seen several instances of foliage badly burned by both kinds of

materials. The root system of the lychee is fleshy and shallow, and large trees have been killed by using various formulations for controlling grasses and weeds around them; 8. the tree is a heavy feeder, so keep it supplied with a complete fertilizer. Slow-acting organics are preferable to "hot" chemicals for avoiding damage to the roots.

R. A. Hamilton and W. Yee stated in Florida in 1970 that the lychee has been grown in Hawaii for almost 100 years without developing into a truly commercial fruit crop because of erratic bearing habits. They stated further that the lychee is and probably will remain a favorite ornamental fruit tree since there is hardly a tree more ornamental than a well-shaped dark green lychee tree laden with bright red fruit. These statements would seem to apply equally well to California.