PB84-112515

CULTIVATION OF NEGLECTED TROPICAL FRUITS WITH PROMISE

Part 4. The Lanson

ARS-S-171

DECEMBER 1977

AGRICULTURAL RESEARCH SERVICE • U.S. DEPARTMENT OF AGRICULTURE

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CULTIVATION OF NEGLECTED TROPICAL FRUITS WITH PROMISE

Part 4. The Lanson

By Narciso Almeyda and Franklin W. Martin[1]

ABSTRACT

The lanson, *Lansium domesticum* Corr., is a delicious fruit of Southeast Asia still practically unknown in the Western Hemisphere. The lanson is usually eaten fresh, for it is easy to peel, not messy, and attractive. The flavor is sweet to subacid. The lanson is propagated primarily from seeds, but some success has also been obtained with cuttings, grafts, and air layers (marcots). The lanson is best planted in fertile loams where problems of drought and flooding are avoided. The seeds need prompt planting, for they rapidly lose germinability. They can be started in seedbeds, transplanted to plastic bags, and planted in the field at about 1 year. Once planted, the lanson needs careful watering, fertilization, and weeding. Cover crops may be used advantageously among the trees, and little pruning is normally required. Diseases and insects have scarcely been observed, but anthracnose is troublesome. Rats may damage ripening fruits. If fruits are harvested when they begin to yellow, they are strong, flexible, and easy to handle. A good tree can produce about 1,000 fruits each year.
KEYWORDS: fruit, fruit cultivation, *Lansium domesticum*, *Lansium domesticum* cultivation, tropical fruit, tropical fruit cultivation.

INTRODUCTION

The lanson, *Lansium domesticum* Corr., is a fruit little known in the Western Hemisphere but extensively cultivated for many years in Malaysia, Indonesia, the Philippine Islands, and in other countries of Southeast Asia. In these countries, the lanson is one of the best known fruits and one of the most widely used (*3, 7*).[2] So common is it in other parts of the Tropics that its relative absence in the Western Hemisphere is difficult to explain.

Although the lanson does not rival the best of the Southeast Asian fruits, the mangosteen (*Garcinia mangostana* L.), it is among the best fruits of the Tropics. Many tropical fruits have had the reputation of being excessively sweet, a condition not appreciated by many people. The lanson, on the contrary, has a sweet flavor combined with a subacid taste and a pleasant aroma.

Because of certain desirable characteristics of the lanson, some people consider it better than the mangosteen. Among these traits are: (1) it is a fruit of convenient size, neither too small nor too large; (2) it is a fruit easy to peel and can be opened with the fingers; (3) the segments of the fruit are easily separated for eating; (4) the fruit, while moist fleshed, is not juicy and messy; (5) the pulp is flavorful, agreeable, somewhat pasty, and filling; (6) the pulp is a translucent white color, free of fiber, and attractive; (7) the seed, when there is one, is easily separated from the pulp.

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[2] Italic numbers in parentheses refer to items in "Literature Cited" at the end of this publication.

The lanson is well worthwhile not only for commercial orchards but also for the home garden. At the home level, the lanson should serve to vary the fruit diet, supplement the more traditional fruits, and add new products, including jellies, conserves, refreshments, and wines.

The purpose of this bulletin is to call attention to this unusual Southeast Asian fruit. With a little effort, it could be cultivated extensively in the American Tropics for both home and market use.

THE LANSON

Origin

The literature establishes that the lanson originated in Malaysia, but the exact place of origin has not been located because the species is well distributed throughout the entire country. It is generally believed that the origin is in the extreme south of the Malay Peninsula, not only because the species is more abundant there but also because it occurs there in the wild (*2, 3, 8*). The lanson has been cultivated throughout Malaysia (including Sarawak), the islands of Indonesia, and as far as the Philippines, in the Sulu Islands, and in Cebu (*10*). In the Philippines, this introduced species has been so well adapted that it has become a major species.

In the 15th century, Chinese travelers tried to introduce the tree to the mainland from the islands of Java, but the effort failed. The lanson does not tolerate even slightly cold temperatures nor long periods of cold winds (*10*). Cultivation has not been possible on the main Asian continent except in the extreme south of Thailand and in Vietnam. The lanson has often been confused with the rambai, *Baccauria motleyana* Hook. f. The rambai, another fruit of Malaysia, produces fruits 3–4 cm in diameter in hanging racemes similar to those of the lanson. Some of the differences between these two fruits are (*8*):

Rambai	*Lanson*
LEAVES	
Simple leaves, 15–33 cm in length.	Compound leaves with 5–7 leaflets including a terminal leaflet.
FLOWERS	
Male and female flowers occur in different trees, petalless.	Flowers are hermaphroditic and petalled.
FRUITS	
Fruits are borne on terminal branches but almost never on the trunk.	Fruits are borne only on the trunk and principal branches.
Raceme of fruit up to 1 m in length and open.	Raceme of fruit no more than 25 cm in length and compact.
Peduncle of about 0.5 cm present.	Peduncle absent or less than 0.3 cm.
The ripe fruits are soft to the touch and wrinkle easily.	The ripe fruits are firm and cannot be wrinkled.
The seed is brown, flat, and about 1.25 cm in length.	The seed is green, about 0.6 cm in length, and often missing from the fruit segment.

As with many fruits of Southeast Asia, the lanson has not been extensively cultivated outside of that region. It has been successfully introduced to the Western Hemisphere, but it is found chiefly in a few botanical gardens and in private collections of rare fruits. The tree is now found in a few countries of the Caribbean, some places in Central America, and in the northern part of South America. In Puerto Rico, the species is represented only by a few trees at the Mayagüez Institute of Tropical Agriculture (MITA), on the University of Puerto Rico at Mayagüez Campus, and in a few home gardens. The trees at MITA, introduced from Java between 1915 and 1923, have developed well and have produced fruits abundantly, demonstrating complete adaptation to the environment of western Puerto Rico (*4, 5*). Trials in Florida and California, however, have demonstrated that it is impossible to grow the lanson even in the subtropical regions of the United States.

Probably, the chief factor limiting more extensive use of the lanson has been the relative lack of knowledge about this fruit. Since it is such an agreeable fruit, it is one that surely should be introduced to the public. As with the mangosteen, MITA can supply limited quantities of seed during the usual months of production, September to November.

Botanical Description

The lanson belongs to the family Meliaceae, a well-known tropical family that includes the yellow and red santols [*Sandoricum koetjape*

FIGURE 1.—Foliage and fruit of the lanson.

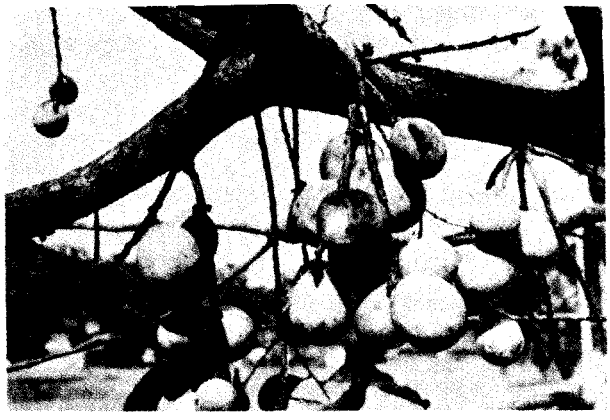

FIGURE 2.—Thick, hanging raceme of lanson fruit.

(Burm.) Merrill] and the sekeria (*Aglaia* sp.). However, it is the best known fruit of the family. The lanson includes two forms, the typical form, or langsat, and that known as duku.

The mature lanson tree is symmetrical, straight trunked, and medium sized. Mature trees reach 10–15 m. The young branches are grayish in color, often with some pubescence (*1, 6, 8*).

The leaves are large, from 30–48 cm in length, and compound with six to eight lateral and one terminal leaflet (fig. 1). Leaflets are elliptic or obovate, from 15–30 cm long, and 7–12 cm wide. The terminal leaflet looks like the lateral leaflets. In the langsat, the leaves are somewhat pubescent on the underside, but in the duku they are smooth. The leaves of the langsat are brilliant green above and clear green below. In the duku, the upper surface is pale green. The margin of the leaflet is entire but undulates through its entire length. The central vein is prominent on both sides of the leaf. The central stem of the leaf as well as the petioles of the leaf are strong and chocolate brown. The petioles of the leaf measure 5 cm in length and are thickened at the base.

The inflorescence arises directly from the trunk or the thickest branches. In the langsat, the racemes reach 30 cm in length, but in the duku only 23 cm.

The flowers are hermaphroditic and small (4 mm in length); many arise from each raceme; and they have a sweet, agreeable odor. The short green calyx consists of five almost round sepals. There are five concave petals.

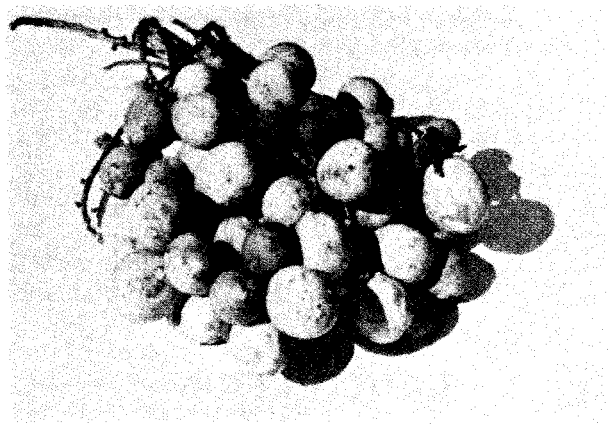

FIGURE 3.—A group of more than 20 lanson fruits.

The stamens form a fleshy tube with 10 small anthers. The small ovary is topped by a short, thick style and terminates with a five-lobed ovary.

The fruits of the lanson are formed in compact, hanging racemes not unlike bunches of grapes (fig. 2). In the langsat, the number of fruits is about 20 (fig. 3), and in the duku only 8 to 10. The fruit is a spherical or ellipsoid berry. Shape varies according to the variety. Langsat fruits measure about 4 cm in diameter, duku fruits about 5 cm. The cortex of the fruit is thin in most varieties but is up to 0.6 cm thick in the duku. The langsat exudes a milky liquid, somewhat sticky and bitter, but the duku lacks this characteristic. The pulp of both forms is white, translucent, juicy, and varies in flavor from sweet to slightly sour. The pulp of the duku is sweet and delicate in flavor. Each fruit consists of five segments varying in size, and only one or two of these contain seeds. The

seeds are about 1.25 cm in length and 0.6 cm in width, green, soft, and bitter. Frequently, entire fruits are seedless.

Varieties

The fruit of the langsat is considered inferior to that of the duku. The two forms can be distinguished as follows:

Langsat	*Duku*
TREE	
Normally somewhat thin with a narrow crown and open foliage.	A wide tree symmetrical with a wide crown and dense foliage.
FRUIT	
Milky juice present in the cortex of the fruit, 3 cm in width.	Without milky juice in the cortex of the fruit, 5 cm in width.

In Indonesia, the duku consists of a number of varieties with descriptive names. Varieties of duku are not recognized in Malaysia, although an intermediate form is called duku-lanson (*2*). In the Philippine Islands, an intermediate type is found with a thick cortex and more latex than the duku but less than the langsat.

CULTIVATION

Propagation

Seeds

Almost all lanson trees, no matter where they occur, have originated from seeds (*4, 5, 10*). Trees propagated from seed vary in vigor, production, and fruit quality. The practice of propagating from seed is so simple that it will probably continue, but it is not the way to produce superior fruits. Planted from seed, the trees need about 15 years to mature and produce (*4*). By means of other forms of propagation, this time can be cut considerably. For this and for other reasons, vegetative techniques are recommended for propagation.

Lanson seeds lose their ability to germinate within 8 days after extraction from the fruit. Even in 5 days, germination percentage drops to 75. If seedlings are needed either for use as stock for grafting or for other purposes, the seeds ought to be planted at the time of extraction from the fruit or within 1 or 2 days. If the seed is left in the fruit, the germination time can be extended several days. The dried seed can be stored several days in a refrigerator at a temperature of 4°–6° C. Seeds are best stored in polyethylene bags. Maximum storage time under such conditions has been 14 days.

The seed can be planted in polyethylene bags, pots, seedbeds, or directly at the orchard site. The container is filled with a damp soil mixture almost to the top, leveled, and slightly tamped. Small furrows are made 5 cm apart, and the seeds are placed lengthwise in the furrows. A fine soil mixture covers the seeds, and the container is watered. The containers should not be left in full shade. Good planting mediums include sterilized sand, sawdust, coconut fiber, peat moss, sphagnum moss, or any other similar material free of pests or disease organisms. Some planters use a mixture of two parts river loam, one part well-cured sugarcane-filter press cake, and one part well-washed sand. Moss has been used extensively as one of the best mediums to preserve humidity. Besides its great water-holding capacity, moss aids in the easy removal of the seedlings at transplanting. When the plant is about 8 cm in height, it should be transplanted to polyethylene bags, pots, or cans.

It is probably more economical to plant seeds directly in polyethylene bags or other containers than in seedbeds, thus eliminating the transplanting operation. The plants suffer less strain with this method. The technique has the disadvantage that some of the seeds do not germinate, leaving the containers without plants. Seeding directly to the container might be advisable when the seeds available are not limited. Several seeds can be planted in each container, and the weaker seedlings can be eliminated.

The technique of planting directly to the orchard site avoids transplanting problems. However, the problem of care of the young tree, especially in the days following germination, is intensified, possibly eliminating the cost benefits of the direct planting.

As with the mangosteen, the largest lanson seeds ought to be selected for planting. The seeds vary considerably in size. This difference is associated with differences in rate of germination of growth. Large seeds assure rapid germination and vigorous growth. Lanson seeds weigh from 0.08 to 2.0 g. Seeds weighing less than 1 g should be discarded.

Asexual methods

Little information is available on propagation of the lanson by asexual techniques. Vegetative propagation normally produces trees that are earlier bearing, smaller, better shaped, and more prolific. The lanson can be propagated by bud grafting, but the percentage of success is low. In some countries, the terminal- and lateral-wedge techniques have been used, but also with a low percentage of success. Air layering (marcotting) has been used with some success in the Philippine Islands. Various propagation methods have been tried at MITA.

Cuttings.—Propagation by cuttings is the oldest, simplest method of asexual propagation. It is inexpensive and rapid and does not require special abilities. The incompatibility associated with grafting is avoided.

At MITA, trials have been made with cuttings 15–20 cm in length. Four to six leaves were left on each cutting. Beds of sand or equal parts peat moss and perlite were washed and sterilized with formaldehyde to control insects and diseases. Cuttings were divided into two groups corresponding to the two mediums and further divided into a group treated for 5 seconds with a solution of 50 percent ethanol with 0.05 ml/l indolebutyric acid (IBA), and another untreated group as control. The rooting beds were localized in a greenhouse under heavy shade. Mist spray was applied 5 seconds each minute to maintain constant wetness on the cuttings. Limited success was obtained with the sand and no hormone control. About 60 percent of the hormone-treated cuttings in sand, and untreated or treated cuttings in moss and perlite germinated. Since the many other variables associated with cuttings, including age and position of cutting and time of year, were not studied, there is reason to believe that a successful technique for propagation from cuttings can be developed.

Grafts.—Although the technique of budding or bud grafting has been used in the propagation of the lanson, it has not been successful. This method is most useful when both the scion and the stock are small and vigorous. Success depends on maintenance of the stocks in perfect condition and on the careful selection of the buds for grafting. Bud grafting is an art.

The most common method is the T-graft (shield budding). The blades for grafting should be well sharpened before beginning. The materials on hand should include a razor-sharp grafting knife, a sharpening stone, pruning shears, pruning saw, alcohol or another disinfectant, and strips of paraffin or polyethylene plastic. The part of the bud to be removed should be cut first so that a small part of the cortex remains with the bud. The bud piece must be the right shape and thickness, so that the piece can be introduced into the stock with only a little pressure. The buds should be removed from the branch with a cut parallel to the branch itself so that the bud piece is sufficiently flat.

To insert the buds, an incision is made through the cortex of the stock in the form of a T or an inverted T. Usually the upright T is preferred, although some experts cannot see a particular advantage one way or the other. If the stock is vigorous and has a tender stem, the bud can be introduced from the end of the arm of the T with a light pressure and without the need to loosen the cortex with the knife. If the knife is used, it tends to bruise the tissue of the cortex, reducing the chances for success.

The bud is tied into place with a grafting rubber that is applied lightly and in a spiral so that the two tissues are well united. To make the graft waterproof, it is covered with a strip of paraffin winding from below upwards (*9*). Paraffin tape is extremely useful. When not obtainable, strips of polyethylene plastic can be used.

The terminal-wedge graft is most widely used for asexual propagation, for it is one of the easiest grafts to manage. This method does not require as much skill as does bud grafting. With fruits such as the mango and the avocado, wedge grafting is a particularly worthwhile technique (*9*). The method can be used not only with small plants, but it is also useful in converting the upper parts of a mature tree by grafting (topworking). As with the T-graft, considerable ability is required, not only in the grafting technique itself but also in the selection of the scion and the stock. Normally, wedge grafting can be done throughout the year, but it is usually much better to graft during the spring when the buds begin to swell, but before serious growth begins.

Both the stock and the scion should be free of insects and diseases. Remove the upper part

FIGURE 4.—Side-grafted lanson plant.

of the stock by a horizontal cut 20–25 cm above the soil. A vertical cut is made into the stem of the stock from the center of the freshly cut stem. This cut should be about 4–5 cm long. The scion should be obtained from the young extreme of a branch of the desired species and should be of the same diameter as the stock.

The lower part of the scion is then trimmed obliquely in the form of a wedge about 3 cm in length and is placed in the cleft formed in the stock. At this stage, it is important to match the cambial layers of both scion and stock. Once in place, the scion is held with a grafting rubber and covered completely with wax strips applied in a spiral from below to above to protect the graft from humidity.

The side graft (*9*) is also a much used method for propagating many fruits (fig. 4). As with the terminal-wedge graft, side grafting is an easy technique. This graft is used when the diameter of the stock is greater than the diameter of the scion. There are numerous variations of the method. The method described here is the one that has been most useful in propagating the lanson.

The side graft consists of making a cut in the form of a T generally in the cortex of the stock 20–25 cm above the soil. The scion, usually 7–10 cm in length, is obtained from the tip of a branch. The lower part of the scion is cut in a sloping form on one side and is introduced into the T, fitting close together the cortexes on one side. If the scion is introduced so that it opens its own path, then the bark remains fixed to the wood of the stock. The graft is covered with a grafting rubber and with paraffin stripping (*9*).

Air layers.—In making an air layer (marcot), roots are induced to form on a portion of a stem ringed and covered with a rooting medium. This is a propagating method that has been used for more than 1,000 years by the Chinese, and thus it is often called "Chinese layering." In addition to ease of accomplishment, the main advantage of marcotting is that it is almost always successful. Large trees are produced in a fairly short time, especially with species that produce roots easily. In some species, trees up to 8 cm in diameter and 2.5 m in height have been produced in as little as 3 months.

The biggest problem with air layering is that it is difficult to maintain the humidity of the medium for a sufficient period of time. To cover the rooting medium, wood, sheet metal, paper cover, and rubber have been tried, with only partial success. The introduction of polyethylene has resolved this problem, for it is highly permeable to the transmission of gases but retains water vapor well. It resists decomposure and keeps the rooting medium wet for long periods.

Tests at MITA have been made using air layers with the lanson and other species. The branches were ringed by cutting out a 2-cm strip around the stem. Steam-sterilized sphagnum moss, moistened to the extent of runoff, was applied around the stem, covering the portion above and below the ring. The moss was tied in place and protected with several layers of polyethylene plastic. Air layers prepared in August and October (the rainy season in Mayagüez) were most successful, with less success in December and none in other months of the year. Apparently, external conditions greatly influence the ability of the lanson stems to develop roots. Although not all the facts neces-

sary for the establishment of air layers have been investigated with the lanson, these preliminary results suggest that air layering should be useful.

Soils

The lanson is versatile and little demanding with respect to soils, but it is limited in areas of prolonged drought (*10*). Furthermore, it will not tolerate extremely alkaline soils. A soil that is relatively humid, yet well drained, slightly acid to neutral, and with a high content of organic material is preferred. In Malaysia, the lanson is grown especially in shaded, humid soil, but it is widespread in other soils also.

The lanson is sensitive to poor drainage and cannot support more than a few days of water saturation. It does not grow in areas with a high water table. The roots rot rapidly when constantly wet and deprived of oxygen, and the tree soon dies. As a rule, therefore, the lanson should not be planted where the water table is within 1 m of the soil surface. The best planting site should have both declive and good internal drainage.

In Puerto Rico, lansons are planted in soils of the series Humatas and Daguey. These soils are acid clay soils with medium fertility and some organic material. They present serious problems during dry periods. The roots do not penetrate deeply because of a lack of air and the compactness of the soil. During excessively dry periods, the soil tends to crack, damaging the tender roots. If the soil is irrigated during this time, the soil is not uniformly wetted, and the resulting strains of wetting and drying continue to damage roots.

Among the better soils for the lanson in Puerto Rico, in other words soils that are better than those now used for the lanson, are those in the northern part of the island, including the series Catalina, Consumo, Corozal, Ingenio, and Naranjito. These are deep soils where rock is first encountered 1 m or more below the surface. They are acid soils of moderate fertility and are appropriate for the propagation of fruits in general.

Generally, however, the soils of the northern coast are utilized for other crops. In other parts of the island, soils that are ideal for the lanson are the series Aceitunas, Bayamon, Coto, Espinosa, Maleza, and Vega Alta. These are also deep and fertile soils.

With the help of a good, year-round system of irrigation it should be possible to cultivate the lanson in the dry parts of the island (south and southwest). Soils such as Constancia, Cortada, Jacaguas, and Machete should be well adapted to the lanson.

Planting

The field for planting should be prepared in advance. If multiple cropping is to be practiced, the existing vegetation, such as weeds, vines, and shrubs, should be completely removed. Trees, if not too many or too large, can be left for temporary shade. The lanson produces better in the shade, but the cover should not be dense.

Once cleared, the land should be plowed and harrowed to provide a good bed for planting. Heavy clay soils will need two or three passes with the plow. If the field is extremely wet, it is desirable to dig drainage ditches to prevent standing water.

If mixed crops are not to be planted, land preparation can consist of only a thorough cleanup of circular areas around each planting site. These areas should be about 3 m in diameter.

The planting system depends in part on the land slope and the facilities available to till and harvest. In flat land that vehicles may enter easily, the system favored is one of rows in which plants are spaced at the same distance as that between rows. On lands with some slope, trees are better planted on the contours, following level lines established by surveying. Such a system reduces erosion. Other systems of planting, such as staggered rows, have been developed to increase the number of trees per unit area, but such systems may impede rapid tillage.

For the lanson, the recommended distance between trees is 9–12 m, depending on the variety, the topography, the fertility, and on other factors affecting the development of the trees. The duku ought to be planted at a greater distance, usually 1 m extra, because of its broader form. On fields planted on the contour, there is not necessarily a uniform distance between rows. In deep and fertile soils, the distance between trees ought to be greater than that on poor soils, in order to leave room for more vigorous growth. The maximum distance should be 12 m between trees. Inadequate dis-

tances permit the mature trees to touch each other, restricting the penetration of sunlight between the trees. This shade may increase damage from leaf diseases.

After deciding on the distance between trees, the field should be marked for holes. The holes should be large enough to accommodate the entire root system comfortably. A good size is 0.4 m in diameter and 0.4 m deep. The soil is placed to one side and mixed with rotted manure or other organic material, and one-fourth kilogram of mineral fertilizer (10–10–8). Part of this mixture is placed in the bottom of the hole and the rest at the sides of the earthen ball when the tree is transplanted.

Transplanting should be done as soon as the plants reach a suitable height, about 0.6 m. At this size, the plant is tough enough to be located permanently and to resist the strain of transplanting and changes in ambiance. The best trees should be selected for transplanting. Plants of 0.3 m or less are normally too young and tender to survive.

The lanson should be planted during the rainy season so that the tree can receive sufficient moisture. In Puerto Rico, this is from June to October. If possible, an overcast day should be selected, or even a slightly rainy day. Under these conditions, transpiration is reduced to a minimum, and the possible survival of the tree is enhanced.

If trees are planted in cans or polyethylene bags, these must be removed at planting. At times, trees are planted without removing the plastic bag. Although a few roots will escape from the bag, the practice cannot be recommended. The bags last well in the soil, impeding the normal development of the root system. The tree should be placed in the hole at a depth similar to that in its own container. Once the tree is planted, the soil mixture should be tamped firmly around the ball to avoid air pockets, and a slight depression should be formed, permitting some water to catch in the area and to enter the soil near the majority of the roots.

Fertilization

Few systematic experiments have been done to determine the mineral nutrient needs of the lanson during growth and production. Nevertheless, fertilization from the beginning of fruit production is necessary if good growth and production are to be achieved. Fertilization should begin when newly germinated seedlings are transplanted for the first time to their individual polyethylene bags. Four milliliters of liquid fertilizer (20–20–20) is mixed with 1 l of water and is used to water the plant itself, as well as the soil. Such treatment should be repeated each 2 weeks. If liquid fertilizer suitable for foliar application is not available, commercial mineral fertilizer can be used, but only the soil is watered. A fertilizer abundant in nitrogen is needed, for it stimulates rapid growth of foliage.

When the lanson is planted, one-fourth kilogram of mineral fertilizer of a balanced formula such as 10–10–8 should be applied in addition to manure or organic material. Some growers use a large quantity of organic material and little or no mineral fertilizer. Such material, such as sugarcane-filter press cake, is a great source of mineral elements and releases its nutrients slowly over a long period. Organic material improves the structure of the soil, particularly the aeration, an important factor in development of roots. A well-developed root system stimulates growth of the entire plant and results in higher yields.

Once the trees are established in the field, the fertilizer applied can be adjusted according to the age, size, and general appearance of the tree. For each year of growth in the field, one-half kilogram of additional mineral fertilizer can be applied, but the total amount per tree should not exceed 5 kg. The yearly total can be best divided into two applications, the first half at the beginning of the rainy season and the second about 6 months later. This second application should coincide with the beginning of flowering that occurs in Puerto Rico in August or September. Normally, the fertilizer is then available during the critical period of fruit growth, which ends with harvest in October or November.

Before fertilizer applications, a good cleanup should be made around the tree to remove weeds, vines, and branches. This cleanup is important so that the weeds do not compete with the tree for nutrients. Fertilizer is scattered in a ring around the tree but not close to the trunk. This fertilizer should be incorporated into the soil using any tool available. Another method is to dig several holes around the trunk, divide the fertilizer among the holes, and cover with soil.

Irrigation

Lanson trees require water in the soil throughout the year, but water is likely to be lacking, especially during the first 3 years of growth. Timely irrigation, important for maximum growth, can supply the deficiencies. The needs of the lanson for water are comparable to those of any other young tree crop.

The water needed varies, depending on the size and age of the tree, the type of soil, and the weather. During the first 2 years, watering each week or 10 days is desirable during the dry season. However, once the trees have established themselves well, the irrigation can be reduced. Loose and sandy soils require larger quantities of water than heavy soils that can store water better. The root system of the lanson is fibrous, and the small roots are localized chiefly in the upper part of the soil. In many countries, the loss of the crop has been associated with dry weather during the normal season of fruit maturation. A short dry spell is probably injurious during the flowering season also and seems to increase loss of flowers before fruits set.

If a long dry season occurs, trees that are in production should be watered before the new buds begin to develop. Irrigation should then be done about twice a month, especially under the crown of the tree. Until rains occur or fruits mature, such irrigation should be continued.

Various techniques are used for the irrigation of orchards. Superficial irrigation with irrigation ditches is probably the system most used and certainly gives complete coverage. It is not convenient if the terrain is too sloped, or if the soil is too porous to permit the flow of water through the ditches. In such cases, nutrients are also leached from the soil. If economy of water is not a serious consideration, revolving spraying heads based on an aluminum pipe system are useful. This method of irrigation should be avoided during flowering.

The best way to conserve water in the soil is the use of mulches. Water penetrates the mulch rapidly during the irrigation process but is lost slowly because of the protection from winds and the sun.

Pruning

The lanson requires little pruning. Pruning ought to be done only when it is necessary to accomplish a specific task, such as the improvement of the shape of the tree. During the first few years, pruning should be done to develop the form of the tree. The trunk should be encouraged to grow straight, without major branches and with the lateral branches well distributed. Branches that grow too close to the soil ought to be pruned away.

When the tree acquires a mature size, it will require maintenance pruning. This pruning consists of eliminating dry and sick branches, shoots from the base of the plant, and branches that interfere with cultivation. The crown should not become so dense that light cannot reach all parts and air cannot circulate freely. When the branches grow together, they should be pruned apart. The fruits appear on the trunk and larger parts of the side branches, and so severe pruning can drastically reduce fruit production.

The wild lanson often tends to grow tall. With the cultivated forms, it may be necessary to prune the central leader once in a while to maintain the trees at a convenient height and to stimulate growth of side branches. Smaller trees make treatments easier and greatly simplify harvest. The duku, with its dense crown, is suitable as an orchard tree but needs thinning during its mature phase.

Some farmers prune throughout the year, but this custom may adversely affect fruit production. The best time for pruning is when the harvest is finished and before new vegetative growth begins. January to April, the dry season, are the best months for pruning in most of Puerto Rico.

To remove large branches, first cut the lower part of the branch with a pruning saw, about half way through. This first cut should be about 30 cm from the main trunk. Make a second cut 30 cm more from the trunk, but from above. The limb will fall smoothly without carrying with it a long strip of the bark and cortex. Finally, a third cut should be made as close as possible to the main trunk, more or less vertically so that water will run off it. The cut surface should be covered with disinfectants or paint used especially for this purpose.

Care

Even in Malaysia, the home of the lanson, little tillage is done around the lanson trees

(*10*). Better attention would improve the condition of the trees. Tillage has several purposes and phases: killing weeds, planting leguminous and cover crops intercalated with the trees, and using mulches. The main purpose of cultivation, however, is the control of weeds.

A weed-free orchard is especially important during the first few years of growth until the trees are large enough to cast a significant amount of shade. During this time, a weed-free circle of about 3 m should be maintained. This weed control is usually done with a machete. If the weeds are not seedy, they may be left on the soil as a protective mulch. However, the base of the trunk of the tree should not be so treated. A mulch discourages the growth of new weeds. It rots slowly and reduces evaporation during the dry season. A mulch also reduces runoff and erosion, especially on slopes. Finally, a good mulch protects fruits that fall, so that they can be collected easier and with less damage.

The remainder of the plantation should be cleaned frequently, principally to avoid production of seeds, but also to reduce the loss of water and fertility because of competition of the weeds. This operation can best be done with a disk plow passed only superficially over the surface. The layer of loose soil so formed serves, as does a mulch, to prevent evaporation. Herbicides have scarcely been used up to now with the lanson.

In the first few years when the trees are small, crops such as bananas, plantains, yams, sweetpotatoes, pigeonpeas, and others can be planted between the young lanson trees. These crops may give an income that will offset the costs of maintenance of the finca. When the trees begin to grow vigorously, however, this practice should be suspended lest the interplanted crops compete with the trees for nutrients and water.

Once crop plants are removed, the ground below the maturing trees can be planted with legumes that enrich the soil. The leguminous plants fix nitrogen from the soil, and when they are cut and buried in the soil, furnish a good portion of the nitrogen fertilizer as well as organic material needed by the trees. The planting of legumes should be managed during the spring or at the beginning of the summer. During this time, they will grow rapidly and will soon be ready for disking into the soil. On rough terrain where machine planting is difficult, seeding can be done by hand.

These legumes are recommended as cover crops:

1. The pigeonpea, *Cajanus cajan* L. (Druce), is already widely cultivated in Puerto Rico, and in fact supplies one of the most important foods in the traditional Puerto Rican diet. Its roots deeply penetrate the soil and are supplied with a great number of nodules that increase the content of nitrogen in the soil. Its stems are woody, but the foliage makes good green manure.

2. The common cowpea, *Vigna unguiculata* (L.) Walp, is another important crop used as human food. Cowpeas grow well during hot, dry weather. Most can also survive and grow well during torrential rains, and only a little rain is sufficient to cause them to grow luxuriously. Once well developed, they can be disked into the soil as a green manure or cut and left on the surface as a mulch.

3. *Canavalia* species, the jackbean, including the well known *Canavalia ensiformis* (L.) DC., the common jackbean, is another useful cover crop. Jackbean grows rapidly, covers well, and has been well tested as a cover crop for growing fruit trees. Because of its dense foliage, jackbean provides a good amount of organic material in the soil.

4. The velvetbean, *Stizolobium deeringianum* (Bort.), and tropical kudzu, *Pueraria phaseoloides* (Roxb.) Benth., are vines that cover the ground in a relatively few weeks. Their roots do not penetrate deeply but do contain numerous nodules where nitrogen is fixed. When the vines mature, an excellent cover is provided, but kudzu, with its climbing tendency, must be watched so that the vines do not cover the young trees, smothering them.

Shade

Little is known concerning the need for shade during the development of the lanson. In the Philippine Islands, the lanson is cultivated with partial shade from coconut palms. There, shade is believed necessary for the best fruit quality. Although this technique should be useful in the Western Hemisphere, the coconut is more often grown in this region in sandy coastal soils of low fertility, hardly adequate for the lanson. If the lanson is grown in such soils, the fertilizer would have to be increased. Despite this dis-

FIGURE 5.—Lanson trees planted without shade in heavy, compact clay soil.

advantage, the lanson could yield to the coconut grower an additional valuable crop.

In Malaysia, lanson trees are found in the shade of many forest species. Many duku trees are grown in the shade. It is believed that shaded soils are cooler during the hottest times of the year. Furthermore, the leaves of the shade trees furnish organic material to the ground, which may serve as a substitute for applied fertilizers and as a protective mulch. Nevertheless, this is not overwhelming evidence of need for shade. Many trees growing in full sun produce well.

In trials at MITA, small lanson trees (0.6 m) were planted in various plots in the soil Humatas, some with and others without shade (figs. 5, 6). The tree *Erythrina berteroana* Urb. was used for shade. Plants were fertilized twice a year with one-fourth kilogram of a 10–10–8 mineral fertilizer each application. The trees were sprayed[3] once a month with a mixture of malathion,[4] zineb,[5] and a spreader-sticker. After 3 years, the trees planted in full sun showed reasonable growth. However, trees in the shade had grown considerably more and were judged to be healthier and more vigorous. Although statistical comparisons were not made, the easily seen differences were convincing.

Adult trees in full production that were growing beneath shade at MITA died when the shade was partially reduced, indicating the complex and delicate situation with respect to appropriate shade. More tests are needed to analyze the need for shade, especially to see if shade can be used for the establishment of trees and gradually eliminated thereafter. Since light is associated with nutrient uptake, removing shade possibly results in rapid nutrient uptake, temporarily exhausting the soil. If lanson trees are well fertilized and watered while shade is gradually removed, it should be possible to condition trees to grow in full sunlight.

DISEASES, INSECTS, AND OTHER PESTS

Few diseases and insects have been observed on the lanson in the Western Hemisphere. Because of the few trees in this part of the world, such conditions have perhaps not yet had the opportunity to develop. As soon as large-scale commercial operations begin, pests and diseases can be expected to multiply. This is a com-

[3] Regarding the use of pesticides on the lanson, see "Notice to Readers" on page ii.

[4] Diethyl mercaptosuccinate *S*-ester with *O,O*-dimethyl phosphorodithioate.

[5] Zinc ethylenebis[dithiocarbamate].

FIGURE 6.—Lanson trees planted beneath the shade of *Erythrina berteroana* Urb. trees.

mon occurrence in other kinds of crops, both introduced and native.

The most serious problem seen in Puerto Rico has been attacks on the young trees by the sugarcane root borer, *Diaprepes abbreviatus* L., locally called "vaquita." This insect is thoroughly disseminated wherever fruit trees are found. The attacks are most serious during May, June, and July, and may be transitory. In other cases, small trees have been defoliated, and the vitality of the trees has been seriously reduced.

The egg of the borer is deposited on the surface of the leaf. After hatching, the larva falls to the soil where it buries itself, living on the roots of almost any plant. The adults feed on leaves, especially young buds and new leaves. The damage is easy to recognize, for the margins of the leaves are eaten away.

The adult borers measure about 2 cm in length. The head and the thorax are black, mottled with white, green, or copperish scales. Because of the reflection from these scales, the insect sometimes appears white or yellow. The legs are entirely yellow.

The larvae as well as the adults can be controlled with diazinon,[6] using 400 ml with 380 l of water (1 pt with 100 gal), or on a small scale, 2 tsp in 1 gal water. To the 380 l of mixture, 25 ml of a spreader-sticker such as Triton B–1956 can be added, or 4–5 drops per gallon. Spraying should be done carefully to wet all leaves and should be repeated each 2 weeks in cases of serious infestation.

Various types of scale insects have been observed on the lanson. In general appearance, scales differ from other insects. They are roundish and flat, seldom more than 3 mm in diameter. The species seen remain attached to the stem where they suck the juices of the plant through the surface of the leaf or through the cortex of the stem. Often, the attack is light and insignificant, but sometimes the leaves turn yellow and drop. Trees infested with scales suffer heavy losses of sap and foliage; as a consequence, fruit production is reduced considerably. In extreme cases the tree can be killed.

The most common and most damaging scale is *Pseudaonidia articulatus* Morgan. It is a transparent yellow color. When present in great numbers on both branches and leaves, it can completely defoliate a tree. On the underside of leaves, and to a lesser extent on the young branches, is found *Pseudaulacaspis pentagona* Targioni, which is roundish and white, with a yellow center. Attacks of this second species have been light so far.

[6] *O,O*-Diethyl *O*-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate.

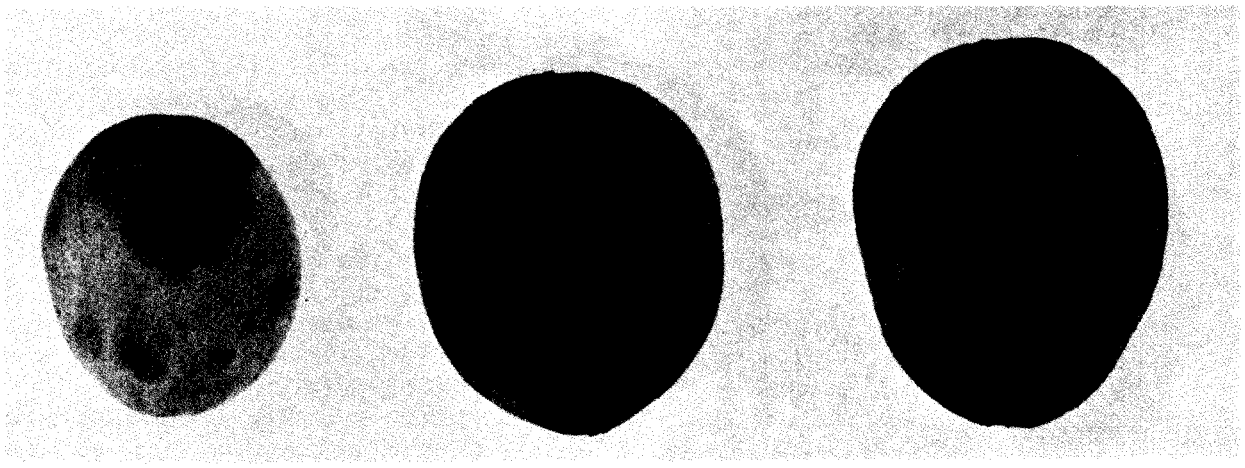

FIGURE 7.—Lanson fruits attacked by the fungus *Colletotrichum gloeosporioides* Penz.

Scales are usually fought with oil sprays. An emulsion can be prepared using 1 part of oil mixed with 50 parts of water. If an insecticide is also desired, malathion can be added at the rate of 1 part malathion (by volume) per 250 parts of water. High-pressure equipment should be used, and the spray should be directed at the underside of the leaves. Oil sprays should not be used during hot times when the tree is suffering from drought or during the period of flowering.

A less frequent pest that sometimes needs attention is the red spider mite, *Tetranychus bimaculatus* Harvey. These pests are found on the underside of the leaves. Measuring only 0.3 mm in diameter, the mite is copperish in color and has eight hairy legs. The mites are present almost everywhere, but sometimes occur in tremendous numbers. Leaves that are attacked turn yellow and eventually fall. Trees that are attacked lose vigor and production. The surface of the fruit is roughened, with areas of dark color. Oil spray as recommended for scales is also effective with red spider mites.

Throughout the Tropics can be found the disease called anthracnose, produced by the fungus *Colletotrichum gloeosporioides* Penz. (fig. 7). Symptoms are seen in the fruit as discoloration of small areas to large chocolate-colored spots. When the infection is strong, the petiole of the fruit is also infected, and this usually causes premature fruit drop. The symptom called "teardrop," frequently seen on lanson fruits, is caused by this fungus.

Anthracnose can be combated with any fungicide containing copper. To this fungicide should be added a spreader-sticker, especially during the rainy season, in order to prolong the beneficial effect.

At times, lanson trees are attacked by a sooty fungus. This condition is not a disease, for the fungus does not live off the plant as does a parasite. The condition shows itself as a thin black film produced by masses of the mycellium of the fungus *Meliola*, which lives on the secretions of certain insects. The disease is especially abundant in shaded areas with excessive humidity. When the coverage is light, damage cannot be measured, but when it occurs as a dense film over most leaves, it obstructs the light necessary for photosynthesis. This growth can be arrested, and deformations of the leaf can be produced.

The control of this condition requires the use of various practices that improve the condition of the tree. Sufficient aeration must be provided by pruning, excessive shade must be eliminated, and then the tree should be sprayed with any oily spray with fungicidal and insecticidal properties. This can be prepared by mixing 1 part of oil and 1 part of malathion (by volume) with 250 parts of water. Within a few days after spraying, the black film begins to slough off in the form of dry scales. A second application after 2 weeks completely eliminates the symptom. The effects of all oil sprays on flowers and fruits should be carefully observed so that damaging mixtures are avoided.

Rats cause considerable damage to the lanson (fig. 8). Rodents chew the young, tender branches and often kill them. Damage to large branches and to the main trunk reduce flower production and yield. As the fruits ripen, they

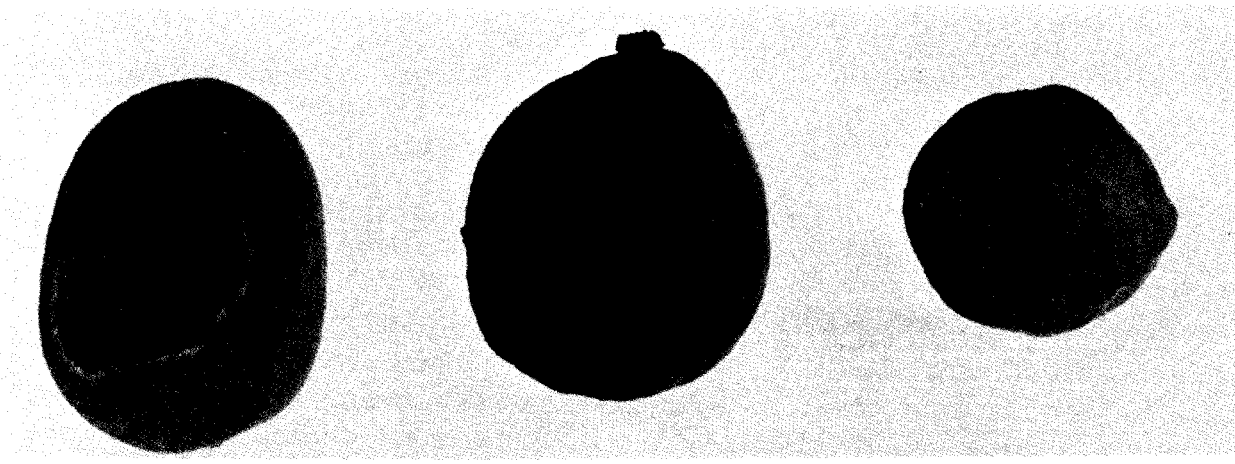

FIGURE 8.—Rat damage on lanson fruit.

are subject to attack by rats; even fruits that are not opened are often gnawed and scarred.

Rats can be eliminated with a variety of compounds. Among these is warfarin,[7] the most trustworthy. One part of warfarin is mixed with 19 parts of any meal or flour such as oatmeal or cornmeal. Warfarin includes an anticoagulant that acts slowly and generally kills the animal in 4–5 days. The chemical ought to be available each day so the rats can eat daily until they die.

HARVEST

The age at which the lanson begins to produce varies with the mode of propagation and treatment received. Trees from seeds need 10–12 years before coming into production. Trees that are grafted begin to fruit much earlier. Whereas neglected trees require many years before fruit production, well-cared-for, fertilized, irrigated trees free of insects and diseases begin to fruit before their eighth year. Production is delayed in cool areas or areas with long seasons of cool winds.

In the commercial orchard, the fruit should be harvested a little before it is completely ripe to insure less damage at harvest and a longer shelf life. It is necessary to know something about the appearance of the fruit as it approaches maturity. In the lanson, it is easy to recognize this state. As it ripens, the lanson fruit changes from a light green to a pale yellow. Intermediate stages can be recognized. Since not all fruits arrive at the same stage simultaneously, various pickings are required. In the family garden, the fruits can be left until they are a straw yellow. Mature fruits are firm and compact.

Since fruits are produced on large branches and the central trunk, they are relatively easy to harvest. It is usually fairly easy to climb the tree. The entire racemes are carefully removed and lowered to the ground by ropes. Sometimes bags or baskets are used for this purpose. On cutting the racemes, special care should be taken to avoid damage of the buds at the base, for new flowering racemes will arise from these buds. With respect to fruits too far to reach, various arrangements are used, such as baskets equipped with shears, bamboos with collecting baskets and cutoff blades, and so forth.

Once harvested, the fruit should be handled carefully to avoid blows, since the principal loses arise in this manner. It is not uncommon to find scratched, cut, or bruised fruits in the market, resulting from carelessness in the harvest.

Fruits should be sorted by size, and in some cases by maturity. During the sorting, the damaged fruits can be removed and discarded. For marketing, a variety of kinds of boxes and other containers are available.

Normally, a lanson produces about 1,000 fruits each year. The quantity and quality are affected by many factors: the variety, the soil, the cultivation of the orchard, the fertilizer used, the irrigation, and pest control. If all factors have been handled well, the harvest should be a good one.

[7] 3-(α-Acetonylbenzyl)-4-hydroxycoumarin.

USES

The lanson is used principally as a fresh table fruit, easy to serve and convenient to eat. The peeled fruit can be conserved in sugar sirup after boiling. It is a good fruit to candy because of its size, transparency, and flavor. Good wine has been made from the lanson.

The wood of the tree is a clear brown and not of fine grain. It has been used chiefly for small objects such as handles of tools and small objects in the home, since the wood is elastic and long lasting. The cortex of the tree is considered to be of medicinal value and is used in Malaysia and Indonesia in the treatment of dysentery and malaria. The bitter seed is milled and used in treatment of fever and has been commercialized for this purpose in Java (*2*).

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