4. Lack of a successful method of vegetative propagation to enable nurserymen to produce large numbers of trees of superior selections.

Growers should consider all of these factors carefully before undertaking the planting of orchards of longan. Small plantings should be profitable under present conditions of demand and price. At this point, however, the longan must be considered a crop of limited potential with important limiting factors to its production. Large plantings probably are not advisable.

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PROCESSING PUERTO RICAN PLANTAINS FOR THE SCHOOL LUNCH PROGRAM

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Abstract. **During 1980, the U.S. Department of Agriculture purchased approximately 200,000 Puerto Rican plantains for a taste-test project in three school lunch programs in the United States. In the pilot project, the first commodity development project of its kind for USDA, the Puerto Rican plantains were shipped to the A. Duda and Sons processing facility in Lake Jem, Fla. There the plantains were ripened, peeled, quartered, infused with domestically produced orange juice, frozen and packed in units of 150 quarter-cup servings. The plantains were then distributed to school lunch programs in New York City, Tampa and Ft. Lauderdale, Fla., and served either as a fruit or dessert. The process of ripening and preparing the plantains for the taste-tests is discussed along with the reaction of the students who ate the new product for the first time.**

The plantain is a member of the genus *Musa* along with other banana cultivars that bear edible fruit (3, 4). The name "plantain" is usually reserved for cultivars which are cooked before eating. Plantains are of economic importance in much of the Caribbean, Central America and part of Africa. In Puerto Rico, they are cooked in pies and other desserts when ripe and prepared much like potatoes when mature green.

Annual production in Puerto Rico can exceed 300 million plantains when growing conditions are good (1). Although some plantains are harvested year around, most of the production is ready to harvest in the late summer and early fall. This usually results in a surplus which, in some years, exceeds 20 million plantains. Much of the crop is marketed in the fresh form, however, some plantains are processed into products for later consumption. Export of the surplus production has been almost nil because of high production costs and competition from other Caribbean countries. The Puerto Rican Government has a program to purchase the surplus production, however, and maintains facilities throughout the Island where farmers bring the portion of their crop they do not sell in the open market. Most of the surplus is used by schools, hospitals or various charitable organizations.

Product Development

During 1980, the U.S. Department of Agriculture decided to introduce a product made from Puerto Rican plantains into the school lunch program in the United States. This would assist in reducing the surplus and possibly expand the market for Puerto Rican plantains. Two requirements were placed on the product: (1) that it meet the nutritional standards established for school lunches, and (2) that it be palatable to students from North American backgrounds.

A. Duda and Sons, Inc., Oviedo, Fla. was contacted to determine if a product could be developed which met these specifications. Plantains in their natural state would not maintain their quality during transportation from Puerto Rico through the commodity distribution system to the school food service locations. Also, green plantains have a starchy bland flavor and ripe plantains have the texture, flavor and cooked appearance of sweet potatoes. Neither flavor is highly acceptable to the average U.S. student.

Since plantains have an appearance similar to bananas, which have a high acceptance rate in school lunch programs, it was decided to approach the product as a fruit rather than a vegetable. With this in mind, the plantains were infused with Florida orange juice to give them a sweet, more fruit-like flavor. Freezing the product produced a sherbet-like texture and also enhanced its flavor.

Analysis of the product determined that size specifications could be established so that each plantain could be quartered during processing and meet the nutritional requirements for a 1/4 cup fruit serving in the school lunch program.

Packing and Shipping

After the successful product development phase, the U.S. Department of Agriculture purchased approximately 200,000 plantains for delivery to the A. Duda and Sons processing facility at Lake Jem, Fla. A single collection point was selected in Puerto Rico at which to pack the raw product so that close control could be maintained on both product quality and size.

At the collection point, individual plantains were cut from the stalks, washed, graded, and packed in corrugated boxes. Each box contained approximately 60 to 65 plantains. The plantains were then placed into storage at 60°F (16 C) as recommended by Lutz and Hardenburg (2) for bananas. After a short period in storage—usually 1 or 2 days—the boxes of plantains were loaded onto a van trailer and transported to San Juan. Here, the van was loaded aboard a van container ship for transport to Jacksonville, Fla. and subsequently to the processing facility of A. Duda and Sons in Lake Jem.

It was originally thought that 4 shipments, each containing approximately 800 boxes of plantains would be sufficient to complete the project. However, because of a severe mold problem with the first shipment additional plantains were required. The extra shipment was divided into two loads of only about 400 boxes each because a shortage of plantains in Puerto Rico toward the end of the season required that harvesting and packing be extended over a longer than normal period. Shipments were spaced so that they arrived at the processing facility at 1 week intervals except for 2 weeks between the first 2 shipments. Transit temperatures were monitored by recording thermometers located in boxes at the front and rear of the loads and in the air-stream on the sidewall of the vans. Temperatures of all shipments were within expected ranges.

Storage and Ripening

Plantains were normally placed in holding rooms soon after their arrival at Lake Jem. Lids were removed from the boxes to facilitate air circulation. As the plantains started to ripen, those most advanced were transferred to ripening flats and moved to another area for final ripening.

Plantains in the first shipment developed an excessive amount of mold during the ripening period. The mold generally consisted of 3 types—a gray substance which appeared at or near the tips of the plantains; a black mold usually located around a cut or break in the skin; or a red or rust colored mold located toward the center of the plantain on the skin surface. Most of the plantains with the gray mold could still be processed by cutting off the ends prior to placing the plantains on the processing line. However, plantains with the other types of mold could not be used, either because the mold penetrated to the edible flesh or because of the probability of contaminating healthy plantains during the peeling process.

The mold types were identified by Dr. John Wells, Plant Pathologist at the USDA Fruit and Tree Nut Research Laboratory, Byron, Ga. as *Fusarium roseum, Alternaria* sp., and *Thielaviopsis basicola.* Benlate and chlorine were recommended as additives to the wash water during packing and mold was not a problem after these treatments were started.

The degree of ripeness is one of the most critical factors in processing plantains when they are to be infused with orange juice. They must be soft to the touch and virtually "black ripe" or covered with large brown or black areas. If they are not ripe enough, the orange juice will not penetrate below the surface of the fruit. If too ripe, penetration will be complete but the finished product loses its integrity and becomes rough, lumpy, and unattractive.

Perhaps the importance of the proper degree of ripeness can best be explained by the following description of the chemical changes which take place in bananas during ripening (5).

> "The pulp of the banana is made up of a great number of very small cells. In the green banana, each of these cells has rigid walls composed mainly of an insoluble substance known as protopectin. Inside the walls are numerous firm starch grains. In ripening, the protopectin is partially broken down by enzymes to form soluble pectin with the result of softening the cell walls. At the same time, the starch is converted by enzymes to soluble sugars which become dispersed in the solid matter within the cell, forming a semi-solid mass."

Processing Operations

As the plantains attained the desired degree of ripeness, they were moved into the processing area where they were peeled, quartered, infused with orange juice, frozen and packed. The total production rate for the plant was approximately 6550 servings/hr. (1/4 plantain). Labor requirements for this rate of production are shown in Table 1.

Table 1. Labor requirements to ripen and process 6550 plantains servings per hour.

Task	No. of workers
Prepare plantains for processing	3
Peel and place on conveyor	6
Vacuum chamber operator and assistant	2
Place servings on freezer trays	3
Place trays in freezer tunnel—supply empty trays	1
Unload freezer tunnel—remove excess CO_2 snow	1
Loosen frozen servings from CO_2 snow	1
Place frozen servings in bags	4
Pack bags in boxes—place boxes in freezer	1
Box make-up	1
Supervisor	1
TOTAL	24

Peeling was accomplished by cutting the ends from the plantains, making a cut just through the skin along the length of the fruit, and removing the peel. The plantain was then placed crosswise on a fluted conveyor and automatically cut in half. The pieces then dropped to a self centering "vee" shaped conveyor where they were slit lengthwise to form the individual servings.

After the fruit was peeled and sliced, the servings were placed in perforated trays and suspended in a vacuum chamber. The chamber was then placed under a vacuum of 29 in. hg. (98 kpa) and the trays were lowered into the orange juice. The vacuum was released while the fruit was still covered with orange juice, forcing the juice into the cellular spaces of the plantains. the fruit was allowed to "soak" in the orange juice for an additional 30 seconds to insure complete penetration.

The plantains were next transferred to another tray containing a bed of CO_2 snow and were conveyed through a cryogenic freezing tunnel. At the exit end of the freezing tunnel, the servings were inspected and placed in plastic bags—150 servings per bag. Three bags were packed in a corrugated fiberboard box and placed in a freezer to await shipment.

Product Testing

Advance sampling of the product by both adults and students suggested that the sherbet-like texture and flavor produced a product that could be served as a frozen dessert. Other studies showed that when the product was baked with brown sugar and butter its texture and flavor was much like a cooked peach. With this in mind, insert sheets were placed in each box suggesting that the product could be served either as a frozen dessert or as a cooked fruit.

Three school systems were chosen to participate in testing the product. They were: New York City, Tampa, Fla., and Ft. Lauderdale, Fla. These systems provided students with varying ethnic backgrounds. Both Tampa and New York City have large Latin enrollments. Ft. Lauderdale has a very limited Latin enrollment. The total number of servings shipped to the three school systems was approximately 620,000; enough for each student to have at least one serving.

The plantain product was served to students in Tampa during November, 1980, in Ft. Lauderdale during December and in New York City during the first week of January, 1981. In Tampa and New York City the product was served as a frozen dessert. However, the servings shipped to the Ft. Lauderdale schools has gone through a thaw and refreeze during transit and there was some darkening of the product making it unacceptable for use as a frozen dessert. Most of the product was baked with brown sugar and butter, as suggested in the insert sheets. However, some managers used the product in baking plantains cakes and cookies.

The plantain product was introduced into the school systems without advance publicity except for 2 schools in Tampa and 1 in New York City. Overall, the student response was good with the acceptance rate ranging from 26% to 73%. According to the food service directors, the overall acceptance rate was higher than normal for a vegetable or fruit. All three school systems indicated that they would like to have the product again.

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HOSTS OF CEPHALEUROS, A PARASITIC ALGA IN FLORIDA[1]

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Abstract. **This extensive list of hosts of the pathogenic alga,** Cephaleuros **sp., in Florida combines a list recently published in the journal** Plant Disease **with hosts that are recorded in the** 1975 Index of Plant Diseases in Florida. **This latest list contains a total of 165 species and cultivars found in 53 plant families, including broadleaf plants, a grass, palms, cycads, and ferns. The alga was found on stems, leaves and fruits, and 34 hosts were obviously damaged by the alga.**

Cephaleuros Kunze is the most damaging of several algae which live on or in vascular plants. Batista and Lima (1) listed 448 hosts of the alga in Pernambuco, Brazil. However, they did not describe any damage caused by the pathogen nor the host parts affected. *Cephaleuros* has been reported on hosts in Africa, Asia, and Australia (3). The alga occurs on cultivated and wild plants in neotropical areas from North Carolina to Argentina (11), and ten of 145 hosts were reported for Louisiana (2).

Cephaleuros is one of the green algae; its vegetative stage is a circular, flat, green thallus. The alga usually occurs on a leaf's upper surface just beneath the cuticle. Microscopic examination reveals a thallus made of flat, short, closely crowded, branched filaments covering irregularly branched rhizoids. The alga is often mistakenly called "red rust" because erect, yellow to red filaments and fruiting bodies arise from the thallus surface. Infected branches bear the erect filaments, but thalli are usually not obvious. Some fruits have surface infections which may occur in shallow depressions, which are formed when infected areas of the fruit surface fail to grow as the fruit enlarges.

The following list of hosts includes the plant parts injured by the alga, when described by the observer, and distinguishes unaffected hosts from damaged ones. The general geographical distribution is indicated by the counties in which a host was found, and the number of times hosts were reported from a county (Fig. 1).

The majority of specimens bearing the alga were sent to the Florida Department of Agriculture and Consumer Services. The alga was identified by plant pathologists, and the hosts' latest nomenclature was provided by K. R. Langdon, Systematic Botanist and Carlos R. Artaud, Biologist, Division of Plant Industry. Their help is gratefully acknowledged. Other sources of information included bulletins, journals, and observations of the authors.

This extensive list of *Cephaleuros* hosts in Florida reveals the great diversity of 165 species and cultivars in 53 families including broadleaf plants, a grass, palms, cycads, and ferns. Algal thalli were found on fruits, stems, and leaves (Fig. 2-5). Very obvious injuries were exhibited on 34

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