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DOMINICA BANANA PROJECT
(No. 538-30090)

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I. INTRODUCTION

A. Background

Bananas are the dominant crop in Dominica. They are grown on about one-fourth of the arable land area and account for more than 50 percent of all merchandise exports. Nearly 6,000 of the Nation's 14,000 farmers are banana growers, the sales of which account for the major part of their regular cash income. Over 40 percent of the national labor force is employed by the banana industry. Locations and names of DBGA and cooperative boxing stations are shown in Figure 1.

At the present time, the Dominica banana industry is in a serious crisis and the Dominica Banana Growers Association (DBGA) is bankrupt. Complete collapse of the DBGA has been averted by grant assistance by foreign aid donors, Government grants, and the forbearance of creditors. Consequently, the banana growers association has been unable to purchase important cash inputs for yield improvements and disease control. The crisis was caused by natural disasters resulting from the leaf spot epidemic of 1978-79 and by hurricanes David and Alan in 1979 and 1980, respectively. In addition, alleged management and organizational deficiencies of the DBGA are given as contributing factors.

The USAID/Dominican Project (No. 538-0083) supports a major restructuring of the Dominica banana industry in three major areas: (a) the establishment of a commercially oriented and independent statutory Marketing Organization; (b) operation of privately managed boxing plants and establishment of firms to handle other functions such as disease control and input distribution; (c) establishment of an independent association to represent the interests of banana growers. This approach to

FIGURE 1

MAP OF DOMINICA

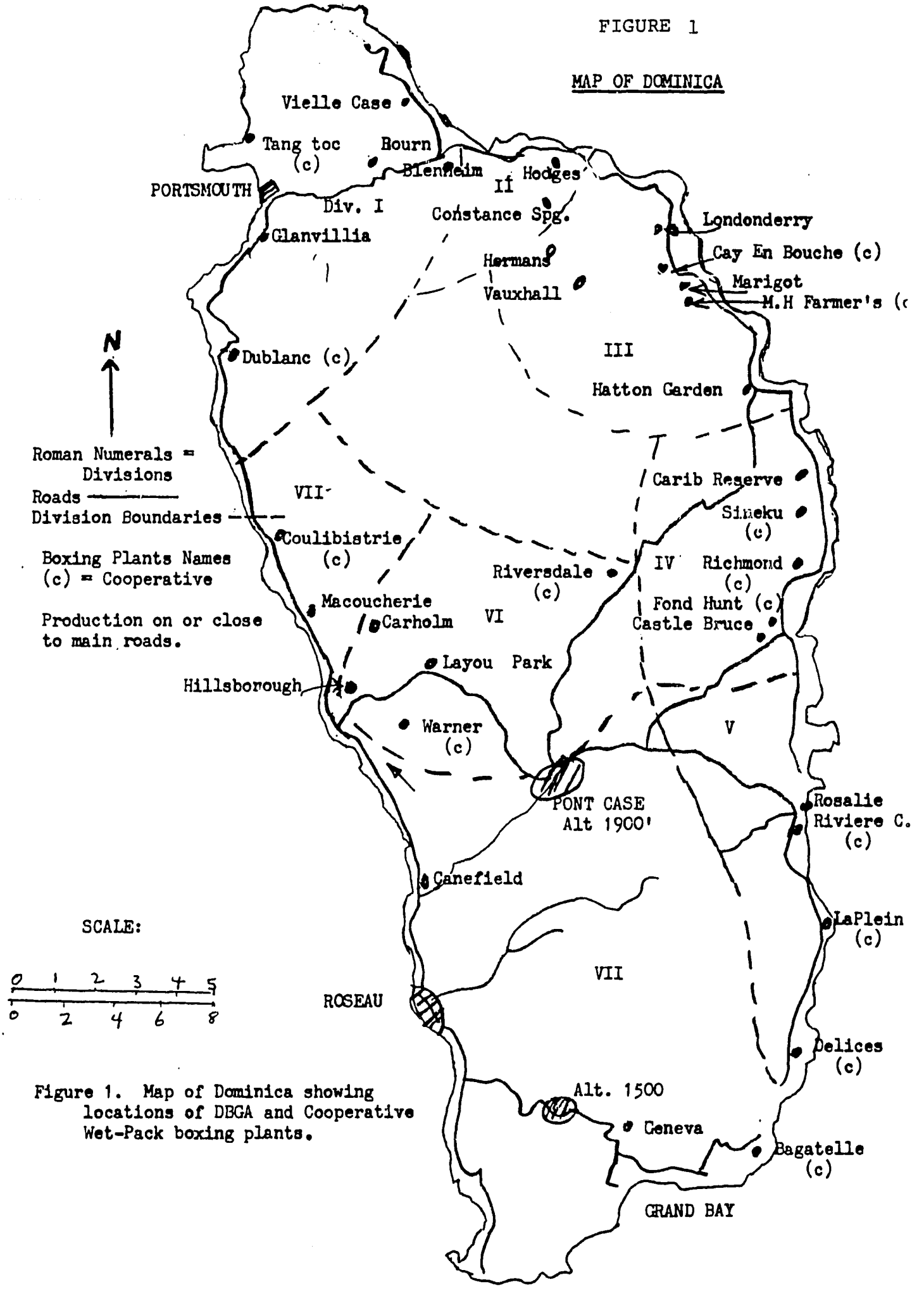

Figure 1. Map of Dominica showing locations of DBGA and Cooperative Wet-Pack boxing plants.

restructuring the industry focuses on resolving the problem of the short-term producers' interests and view points as opposed to the longer and broader term commercial and national interests of the banana industry.

Geest Industries, Ltd. is the buyer and marketer of Windward Island bananas. This Company handles the ocean shipping, ripening, and wholesale marketing functions for most Windward Island bananas, all of which are marketed in the United Kingdom. The United Kingdom, in accord with earlier legislation, takes all the production of the four Windward Islands (Dominica, Grenada, St. Vincent and St. Lucia). A protocol to the Lomé Conference authorizes the United Kingdom to forgive the EEC twenty percent ad valorem duty. This gives to the islands a protected and assured market, relatively free from competition of bananas originating from Central America and other dollar areas. The legality of Britain's legislation and action in this area (contraint of trade) is now being challenged in the courts, the outcome of which is uncertain.

B. Scope of Study

1. General Objectives

The general objectives for this component of the USAID/Dominica project is to assist the Dominican Government, the Dominica Banana Growers Association (DBGA) and the Regional Development Office of the Caribbean (RDO/C), in assessing the potential for expanding the field pack system of handling fresh bananas in Dominica on a cost effective (efficient) basis. The general terms of the project call also for assisting the banana industry in maintaining effective control of leaf spot disease (Sigatoka) in bananas.

2. Specific Objectives

The study will include analyses and recommendations regarding appropriate harvesting, assembly, boxing and transportation systems within project constraints, including:

a. Review existing wet pack operations being managed by the Dominica Banana Growers Association, plants privately owned and operated, and those plants under Cooperative management and determine all associated costs for packing bananas under each form of management.

b. Review the existing method for field packing bananas, and determine all associated costs for packing bananas under this system of packing.

c. Review comparable costs of wet pack bananas to field pack bananas and determine the savings on a per unit basis in relation to each type of packing procedures.[1/]

d. Assess the potential for expanding the field pack system of handlings bananas in Dominica on a cost effective (efficient) basis and recommend targets to which the industry can practically attain, when all relevant constraints are considered.[1/]

1/ The phrase "cost effective and profitable basis" as originally use for this objective is inappropriate because the Dominica banana producers are price takers and have no direct control over selling price. The terms "cost effective", "least cost" and "efficient" are equivalent as they represent minimum cost estimates among the different packing methods. Consequently, the term "profitable" is omitted. The most efficient single method or combination of methods will result in maximum profits or minimum losses for any given wholesale or green market price in any given terminal import market.

e. Considering the general objectives described in Section B.1. and utilizing the analysis in part c. above, the Contractor will inspect the equipment of all wet pack plants (the DBGA, Cooperatives and private) and provide recommendations as to which plants are presently or will be in the future excessive to meeting the banana packing needs of Dominica. For those plants recommended for retention, the Contractor will determine the condition of existing equipment, make recommendations on changes or improvements needed to ensure top quality fruit is being packed on a cost effective basis.

f. Assess the existing system by which bananas are handled, transported, and packed from field cutting to ship loading, and make recommendations on improving the system, identifying suitable vehicles and related equipment.

g. Assess the current leaf spot control program, determine the effectiveness of ground and aerial spraying and make recommendations to improve and make the program more effective. Assess the current chemicals and equipment being utilized in the spray program and make recommendations on its suitability and/or improvement or additional requirements.

h. Utilizing the analysis which evolves from each of the seven tasks described above, the Contractor will identify areas and make recommendations where the private sector should be encouraged to participate or assume responsibilities of the specific aspects of the packing, marketing, and disease control of the banana industry in Dominica.

i. The Contractor, based on the data and information collected, together with the recommendations developed, will identify specific long-term assistance that would be required to assist the Government of Dominica in implementing the recom-

mendations and support the restructuring of the banana industry to create a financially viable industry with maximum participation of the private sector. The Contractor will develop a work plan that includes the types of specialists needed, job descriptions, duties and responsibilities for each specialist, length of time needed and estimated cost.

3. Contract Personnel

Three experienced banana industry specialists were employed for a total of 70 days including travel in January and February, 1984. Robert Reed (40 days) and Robert Dawson (22 days) were employed as banana packing and handling specialists, and Robert Fulton (8 days) for leaf spot or Sigatoka control.

A draft report was submitted to and discussed with USAID representatives in Barbados by Robert Reed on February 8, 1984. A detailed itinerary for the three-person team is given in Appendix C.

The resumes of the three specialists are compiled in Appendix D.

II. EXECUTIVE SUMMARY

A. Scope of Work

The Dominica Banana Growers Association (DBGA) has reached a good level of efficiency in wet and field pack banana boxing operations and has reduced costs to relatively low levels. Additional improvements are recommended, but most of the costs savings have been achieved.[2/]

This report reviews existing wet pack and field pack operations and costs for the Dominican banana industry. Comparative cost studies are then made of existing field and wet packing systems and of improved and redesigned boxing plants. Studies are made also of total boxing costs for handling Dominica's banana crop within the framework of 4 scenarios discussed later.

Other areas studied include transport to port and receiving and loading methods and facilities at the ports of Roseau and Portsmouth. A brief discussion of methods of privatizing the Dominican banana industry is also presented.

A relatively detailed, but independent, study was made of Sigatoka disease management in Dominica. This study is given in Section IX. of the report.

2/ All costs are in EC$. 1 US$ = 2.7 EC$.

B. Boxing Bananas

Dominica has 19 centralized wet pack plants controlled by DBGA, 13 cooperative wet pack plants and 2 private plants. There are 319 field packers at the present time with 81 more scheduled by the end of March.

1. Wet Pack Plants - Standardized Cost Data

Accounting record costs are not very useful in a comparative cost study of different methods because of different ages of plants and therefore in book value depreciation, and in the failure of accounts to effectively standardize costs among plants and methods of operations. To eliminate accounting records variations due to site requirements, construction costs, and boxing plant capacities, new three-line plants were designed to allow standardized comparisons among wet pack alternatives and other boxing methods discussed in this report. Investment cost for each of the standardized plants amounted to EC$ 74,398, excluding interest on any borrowed capital.

Standardized costs thus developed showing all costs from harvest to port amount to $0.0925 per pound. In percentage terms per cost item, the results showed 11.6 percent for cutting and heading; 46.7 percent in-plant labor; 10.8 percent hauling stems to plant; 2.6 percent labor transportation; 4.0 percent plant clean-up; 0.3 percent administration and overhead; 4.0 percent depreciation and interest; and 20.0 percent for transportation to wharf.

2. Revised Design and Costs with Modernized Boxing Plants

A revised design for a 3-line boxing plant was made to improve packed fruit quality, reduce receiving congestion, reduce idle and unproductive time, and increase worker efficiency. These revisions include:

a. changing the plant receiving area by extending the roofed area 50 feet and installing 12 overhead pipelines to supply 204 stems of hanging fruit at all times;

b. installing in-line scales with roller conveyors on each side for feed and takeaway of trayed fruit;

c. installing skimmers to skim off latex at all points in the water tanks;

d. installing a spray bank at the end of tank 2 to provide a final rinse;

e. installing large, circular, padded table at the end of each line that is rotated by the packer selecting the fruit;

f. installing a roller takeaway conveyer leading to the full box storage area;

g. two grades plus a short-fingered pack can be handled in this plant.

Labor performance standards were given, based on those developed in other countries, plus time and ratio-delay studies conducted in Dominica by the consultants. Wage rates for 1984 were obtained from DBGA. Estimated major impacts of the new design were: (1) reduction in idle and wait time resulting in a saving of $10.08 per reception; (2) output per plant rose from 1,608 to 2,700 boxes per reception; (3) latex staining significantly reduced by skimmers and by eliminating field box and dehanded fruit delivery from the farms; and (4) costs per

unit packed were reduced 1.57 cents ($0.0925 - $0.0768) per pound, a 16.9 percent reduction.[3/]

C. Field and Shed Packing

1. Operations

In field pack operations the bunch is cut, dehanded, and the hands set aside and placed above the midrib section of a clean banana leaf for latex draining. Absorbent crown pads, treated for crown rot control, are applied to the crown and set aside on a leaf or canvas packing table for selection and packing. The fibreboard boxes are supplied from the grower's storage and dry pack shed.[4/] Full boxes are removed by 2 headers to the grower's shed for temporary storage prior to loading for transport to dock.

Because fibreboard boxes are susceptible to rain and water damage, a different method called "shed packing" is required. With this method the dehanded bananas are brought to the shed by headers on trays holding up to 32 pounds. The hands are then trimmed, crown pads applied, packed, and the full boxes stored temporarily in the shed to await removal to port.

3/ If harvesting and hauling to plant and dock costs are omitted, actual in-plant boxing costs drop to $0.0375 per pound of accepted fruit.

4/ Empty made-up boxes are delivered from central boxing plants.

Field and shed packing are now paid 8.0 cents per pound for deflowering, dehanding, and packing, including a possible premium of 3 cents per pound for qualified fruit. Subsidies and premiums were not considered in this comparative cost analysis. Field deflowering and sleeving are now required for field or shed packed bananas, and these costs are applied to field and shed packing in the analysis.

2. Cost Estimation - Field and Shed Packing

Field packing costs per pound including all labor, shed depreciation, administration and training, transport to port, sleeving and field deflowering plus material costs of sleeves and crown pads amounted to $0.0868 per pound. Shed packing costs were higher, amounting to $0.0927 per pound. These costs are considered conservative because they were estimated for a full 8-hour per day basis. This means 120 boxes were packed per 8-hour day. Costs for a 5-hour day, for example, would rise to over 11 cents per pound. This demonstrates the large diseconomies resulting from less than full utilization of labor and other fixed inputs, and is the primary reason the consultants recommend that small-scale producers avoid changing to the field pack system. Unless field packers can fully utilize labor over an 8-hour period, the method becomes inefficient and loses cost effectiveness.

D. Comparative Costs

Comparative costs per pound of accepted fruit among the four packing methods analyzed are sumarized as follow:

Field pack	$0.0868 per lb
Shed pack	0.0927 per lb
Wet pack (standardized plants)	0.0925 per lb
Wet pack (modernized plants)	0.0768 per lb

The above comparisons show that field and shed packing can be competitive with wet packing if full utilization is made of labor and other fixed inputs. The field pack is not competitive for small-scale producers who are unable to harvest at least 120 box equivalents per 8-hour day. If field desleeving and deflowering were dispensed with, efficient field and shed packing costs per pound would drop by 1.73 cents per pound.

A chief advantage for centralized packing lies in more cost effective supervision and in the high probability that quality can be maintained at consistently high levels. The consultants, based on exhaustive research in Central America, recommend that individual hands of bananas be allowed to exude latex for 10 to 12 minutes in the field pack operation before applying the treated crown pad. This procedure will be difficult to enforce.

E. The Cost of Alternatives

1. Scenarios

Because the results of the comparative cost analysis showed close correspondence among the methods considered, several scenarios are explored. These scenarios involve cost

estimation for various combinations of wet and field pack outputs. Four scenarios were presented.

a. Sceniario I

That Dominica can maintain a level of 64 million pounds (28,571 long tons) of accepted, boxed bananas. All of this production to be produced by wet pack plants currently operated by DBGA that have been revised and modernized to meet more efficient production standards.

b. Scenario II

That the total Dominican banana production be wet packed at a level of 19.5 million pounds by the cooperatives and the remaining 44.5 million pounds packed in modernized wet pack plants.

c. Scenario III

That 60 percent of the Dominica production be wet packed in modernized plants and 40 percent be field or shed packed.

d. Scenario IV

That varying percentages of the Dominica production be wet packed and field packed utilizing the most cost effective plants for each production level.

2. Discussion

a. Scenario I

To meet the targeted production level of 64 million pounds requires 16.3 modernized 3-line boxing plants. To handle seasonal fluctuation for 50 receptions, an excess capacity of 2,556,500 pounds was built-in resulting in a total of 17 plants. Two boxing plants, Herman's and Vauxhall, would be closed. Expenditures to modify all existing 3-line plants total $419,900, and those to modernize the 2-line plants would be $261,200. These costs are in addition to the outstanding indebtedness of $645,800 as of December 31, 1983.[5/] Total costs per 1,000 boxes from harvest to Geest Industries terminals are $2,062.20. This amounts to $0.071 per pound (See Table 10). The capacity of these plants would be 45,900 boxes per a 20-hour weekly reception.

b. Scenario II

With this plan, 19.5 million pounds would be packed annually by 6 wet pack plants currently owned by cooperatives, and the remaining 44.5 million pounds by 12 modernized wet pack DEGA plants. The average cost per 1,000 boxes packed is $2,138.58 or $0.0737 per pound[6/] (See Table 11).

5/ All costs are in EC$. The $645,800 is the amount remaining on the books as of 12/31/83 and represents the undepreciated balance.

6/ Boxes average 29 pounds of bananas.

c. Scenario III

With this scenario, 10 modernized boxing plants (Glanvillia, Blenheim, Hodges, Londonderry, Castle Bruce, Rosalie, Hillsborough, Layou Park, Macoucherie and Geneva) would be required to handle 60 percent or 38.4 million pounds of Dominica's total production. Field packed bananas would total 25.4 million pounds. Unit costs per pound for the 10 wet pack plants would be $0.069 and costs for the field packed bananas would be $0.087 per pound. The weighted average costs for the 60/40 combination amounts to $0.076 per pound (See Table 14).

d. Scenario IV

This plan involves selecting minimum cost wet pack plants and field packers in varying proportions. The proportions range from a 10/90 wet pack to field pack ratio, increasing in increments of 10 percent to 100 percent wet pack. Unit costs per pound as these proportions cut-in are tabulated in Table 15. Costs per pound range from a weighted average of $0.084 for the 10/90 wet pack to field pack ratio to $0.072 for the 70/30 ratio. A 60/40 wet to field pack combination amounts to $0.073 per pound.

F. Boxed Fruit Transport and Port Operations

1. Field and Shed Packed Fruit

Main roads improvement, truck rates, time costs, and Geest Industries, Ltd. reception facilities at Roseau and Portsmouth were observed for field and shed packed deliveries.

a. Main Roads

Three countries--the U.S., Great Britain, and Canada--are now involved in projects to upgrade and redress all main roads. When completed, in an estimated two years time, transport costs and problems with bruised fruit will be significantly reduced. As far as the consultants could determine, there are no road maintenance provisions in these projects. This is a real shortcoming because high rainfall and heavy traffic results in road maintenance costs that will amount to as much, if not more, than the upgrade and redress projects.

b. Hauling Rates

Trucks of 3 to 5 ton capacity are used to haul fruit to port at a 3 cents per box mile rate. Pick-up trucks now charge on a per trip basis, regardless of the quantity of boxes hauled. In the latter instance, costs per box or pound of fruit hauled varies greatly in relation to the size of load. Truck hauling costs are extremely high, representing 20 to 50 percent of total boxing costs depending on distance to port.

c. The Time Factor - Field Packed Fruit

Because field pack sheds are so widely dispersed, turn-around and transit times are high. This problem becomes greater with small grower lots because several stops are often necessary to fill out a load.

d. Geest Industries, Ltd. Port Facilities and Operations - Field Pack Fruit

Field and shed packed bananas are delivered and weighed in at the Geest Industries receiving dock. After initial weighing the truck is moved to the field pack reception bay and the boxes manually unloaded and palletized. A sample of about 10 percent is taken by a Geest Industries employee and is judged to be premium grade, acceptable but not premium grade, or completely rejected. Rejected lots are returned inland to the farmer who packed it. Some loads contain several lots of bananas, i.e. fruit belonging to several different farmers. In this case, the truck must return to the main weighing station to record the weight of each lot. The truck has precedence in the queue, a fact that upsets wet pack truckers and slows the whole reception process.

2. Wet Pack Transport

Trucks move from the initial weigh-in and are normally off-loaded. The bananas are palletized, and the loaded pallets are transferred via lift truck to temporary storage within the shed to await removal to shipside. A Geest Industries employee inspects samples of the different boxing stations for quality and accepts or rejects the fruit. A DBGA inspection team also samples and inspects the different lots for quality control information and as a check on Geest Industries quality and reject reports.

Rejects at the receiving dock are small, amounting to about 1 percent. Setbacks can amount to substantial amounts in any given reception week. Setbacks are boxes that cannot be accepted because the Geest Industries ship is at capacity and cannot take them aboard. These losses accrue to the account of

DBGA growers. Amounts rejected in the U.K. are small also. An average of 5 percent of the fruit is commercially unacceptable in the U.K and is usually sold at discount prices, thereby lowering the returns to Dominican farmers.[7/] Fibreboard boxes designed to hold 30 pounds of fruit averaged only 29.1 pounds in 1983.

At Portsmouth, the initial procedures are the same as for Roseau, except the boxes are moved by human chain to lighters where they are palletized and towed to ship-side.

3. Trucks

Most trucks are 3-5 ton Bedfords that are around 15 years old. Although these trucks must soon be replaced, the consultants were unable to estimate the number required and consequently the amount of capital outlay involved.

4. Ship Loading

The consultants observed ship loading operations at Roseau and Portsmouth. The operation of the cranes was very careless and completely unacceptable. Much bruising was caused by three stages of the crane's operation. After being secured to the cable, the full pallet is lifted slowly for 3 feet and then accelerated very suddenly to a high speed, the inital shock amounting to several of gravities (g's). This caused much pressure bruising to the fruit. The full pallets were

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7/ According to the Geest Spaulding reports, shrinkage amounts to 2.3 percent. This is low. Central American fruit has a shrinkage factor of about 5 percent for shorter trips.

released and often dropped to the deck and at times boxes were impact damaged during descent. A number of boxes were dropped into the water and lost. Improved supervision of crane operators to correct carelessness would result in much less damage to the fruit.

Also, fresh grapefruit was loaded into the hold containing bananas. All citrus fruits exude large quantities of ethylene gas that causes accelerated ripening of bananas. This practice should be discontinued.

G. Privatization

1. Background

DBGA is to be disbanded and replaced by a statutory corporation by act of Parliament. The new corporation will be commercially oriented and is to be completely independent of growers as they will be represented by their own organization. The role of the new corporation is to purchase and sell all export quality fruit produced in Dominica and to foster other privately owned commercial enterprises with responsibilities for disease control, boxing operations and external transportation and communication.

2. Comment

a. Boxing Plants

The currently operating boxing plants all have plant supervisors and foreladies thus forming a cadre of

trained management for individual plants. If some sort of leasing scheme could be developed, it is likely that at least some of the existing management personnel could be interested in operating the plants.

The advent of field and shed packing already provides a basis for by-passing boxing plants entirely. Because of economic and supervisory problems, Dominica cannot expect these methods to handle more than 40 to 50 percent of total production.

Cooperatives are another commonly accepted method of privatizing agricultural activities. Of the 32 wet pack boxing plants now operating in Dominica, 13 are cooperatives. If the cooperatives are to function properly, they must be tied into the new corporation's structure and disciplined to accept training in operations and quality control.

b. Centralized Supervision and Control for Disease

Leaf spot and other disease should be under the complete control of the proposed statutory corporation because of large capital requirements, scheduling of spray cycles, and monitoring.

c. Other Production and Marketing Inputs

These activities should be centrally controlled to insure proper control over applications and inventories.

d. BDD Management Assistance

The DBGA management has profited greatly from the leadership and advice generated by the current BDD management team. The current individuals should be encouraged to continue on for another tour of duty.

H. Disease Control

Disease monitoring and control were reviewed and recommendations made by R.H. Fulton, plant pathologist for the Experience, Incorporated team. The Sigatoka or leaf spot disease control status in Dominica is very good. Because Dominica has the highest rainfall of the Windward Islands group, more sprayings are required per year. Various recommendations for continued and more cost effective control were made and are included under a later heading of this summary. Dr. Fulton also reviewed some cultural aspects of banana production in Dominica including intercropping, fertilizers, and sleeving of fruit. A comprehensive review of application equipment used and needed for ground and aerial application was made along with numerous recommendations. Chemicals manufactured by several companies were reviewed in some detail.

I. A.I.D. Assistance Projects

1. Marketing Research - Marketing Activities Beyond Dominica

Marketing efficiency, practices and procedures from port reception in Dominica to the retail market in the United

Kingdom is considered priority number one. Functions would include ocean freight, port reception in the U.K., ripening, wholesaling, and retailing.

2. Stem Fruit Grading and Purchasing

Research to ascertain the practicality of purchasing stem fruit by premium and standard grades was proposed. This would eliminate substantial amounts of receiving station delays and permit the rejected fruit to become property of the corporation to be sold to vendors or for use as a part of a hog feeding ration.

3. The Banana Box Syndrome

Disadvantages of the box in current use include difficulty in packing hands that are large; more board-feet of fibreboard is required to make the small (30 lb.) rather than the larger (40 lb.) carton used for fruit originating in the dollar areas (Central and South America); the additional board-feet results in more insulation and thus more heat generation and retention; and the smaller box is subject to more voiding in storage operations. Research was suggested to determine an optimum size and market oriented box for Dominican bananas, using the 40 lb. box as a frame of reference.

4. Quality Inspection in the United Kingdom

The consultants found the current Spalding reports from Geest Industries unacceptable because they are not designed to inform the producer-shipper (DBGA) as to what type and at what

point injuries are being recorded. A team of 2 specialists in banana quality grading was suggested to follow the samples from Dominica to their off-loading in the U.K. It would then be possible to place the blame for quality defects where it belongs rather than attribute it all to Dominican producers as is now done. The project would also form the basis for revising the Spalding reports to more adequately reflect actual conditions.

5. Transportation

The old Bedfords are due for replacement. The numbers and types required by Dominica's privately owned trucking industry was not determined by the consultants. Research addressed to this area was suggested as a high priority project.

6. Crown Pads

Crown pads often become unattached during transit. This may be caused by field packers not allowing sufficient time for latex flow, but some of the loss is caused by shocks during shipment. The proposed corporation or DBGA should contact the manufacturers of crown pads and work with them to find some sort of inexpensive hold-down device for the pads.

7. Geest Reception Terminals

The whole operational layout and product flow through the Geest Industries terminals are inefficient. Research and studies of operational procedures of the various materials

handling jobs were suggested. These studies would be made by outside consultants.

Containerization procedures were discussed and some studies suggested, perhaps in cooperation with containerized shipping companies. This would be sometime in the future.

8. Production

It is suggested that a plant pathologist and an agronomist experienced in banana production visit Dominica for approximately 1 week each year over the next 4-5 years to advise Extension and DBGA specialists on new and existing techniques, check spray cycles, and monitor for disease, fertilization and other production problems. These outside consultants would cooperate and work with Windward banana specialists (WINBAN) regarding spasmodic and recurring problems in banana production.

J. Recommendations

1. Field and Shed Packing

a. Allow 10-12 minutes for latex drainage before packing.

b. Schedule supervision and follow-up at least once per every 4 receptions.

c. Do not encourage producers or producer groups to become field packers if they harvest less than 26-30 tons per year, account being taken of seasonality.

d. Do not permit field packers to miss more than 2 receptions. To do so will result in yield and quality deterioration.

e. Penalize growers who ignore advice by removing their premium or by removing them from field pack status.

f. In line with paragraph d. above, encourage field packers to ship full pallet loads (at least 72 boxes) even if they have to pool their shipments.

g. Eliminate sleeving and field deflowering except in spots and time intervals where evidence indicates the necessity. The pathologist of this consulting team states that sleeving for Dominica is ineffective for flower and rust thrip control because the risks of infestation are much less than the costs of sleeving.

h. Research and test the feasibility of field collection stations at which point Geest Industries, Ltd. could take over ownership of the boxed bananas. This would involve moving port receptions to the interior.

2. Wet Pack Plants

a. Recommend that existing cooperative and DBGA plants be revised in design and modernized. Modernization would cost $30,334 per each plant, excluding financing of a loan.

b. Recommend that centralized wet pack plants be of sufficient capacity to handle at least 60 percent of Dominica's production. This would require 10 modernized wet pack plants and closure of 22 plants now operating.

c. Recommend that the present 30 pound box be redesigned to meet Windward Islands' type and size of bananas. Start with the 40 pound box as a benchmark.

d. When heading stems, recommend that headers use a longer heading board (about 30 inches) to avoid flexing of the stem that causes bruising from blossom ends of individual fingers.

e. Lean stems against a horizontal bar or hang them from an overhead bar or wire at roadside to avoid excessive bruising.

f. Continue practice of padding with leaves between hands of the stem.

g. Research transportation field to plant, i.e., types of vehicles, cost and financing.

h. Research to find efficient method of grading and accounting for stems, rather than dehanded fruit. This would relieve congestion at the receiving yard and speed-up product flow.

i. Dispense with field box harvesting and dehanding in the field.

j. Dispense with field deflowering.

k. Study transportation methods to ports of Roseau and Portsmouth. Try to encourge private truckers to replace depreciated trucks with those more specialized for bananas.

3. Port Activities and Ship Loading

a. Recommend that an in-line conveyor scale be tested and installed for receiving field pack fruit. If feasible, tie-in with DBGA's computer if and when the computer ties are concluded.

b. Consider changing to lift-truck and flatbed barges for Portsmouth, after taking into account socio-economic impacts.

c. Supervise and discipline crane operators in proper procedures for ship loading. They are carelessly damaging significant amounts of boxed bananas.

d. Study the cost and quality impacts of palletizing and low-lift loading at central boxing plants after modernization.

4. General Recommendations

a. Send a two-person team to England to follow up on boxes sampled for quality grading in Dominica. Revise Spalding reports to reflect findings.

b. Analyze the marketing and accounting practices of the present marketing agent (Geest Industries) in order to isolate high cost areas and questionable cost effective procedures. Port FOB (free on board ship) costs comprise an estimated 70 percent of total production and marketing through to the retail level.

c. Recommend that an agricultural economist experienced in forming, operating, and financing cooperatives be employed on a short-term consulting basis.

5. Privatization

a. Use current management as cadre. Consider leasing.

b. Cooperatives.

6. Disease Control

a. Install mini-weather stations in the seven (7) divisions: maximum-minimum rainfall, temperatures, and evaporation.

b. Record total number of leaves per plant as well as the standard "youngest leaf spot" (YLS). This gives early warning on local disease-inoculum pressure.

c. Only detrash and cut leaf tip infection off the plants.

d. Intercropping traps 20 percent of the Sigatoka sprays, but this is beneficial to such crops for general pest control.

e. Evaluate foliar fertilizer application in locations where infeasible to spray by aircraft.

f. Evaluate fertilizer spikes (JOBE) versus granular fertilizer on the steep slopes.

g. Sleeving of the fruit is not recommended at present time because of high costs, no peel disease, and flower and rust thrips infest the flower bud just as it emerges from the crown of the plant. Leaf scarring can be controlled by leaf fold-back. See text for more detail.

h. Immediate need for a minimum of ten (10) 4-wheel drive vehicles to transport disease assessors and motor-blow or backpack teams into the farms.

III. BOXING OPERATIONS AND COSTS

A. Field and Dry Pack Operations and Costs

1. Field Pack

Field packing was initiated as a means to improve the quality and efficiency of boxed fruit operations. It is designed to provide (a) cleaner fruit which is more acceptable in the market; (b) increased quantities of saleable fruits (fewer rejects); and, (c) time saved the grower on boxing days. Bunches are required to be sleeved and field deflowered and all dehanding and packing must be done at the farm in an approved manner. Approved methods are covered in detail by a manual for Field Packing Windward Island Bananas published by the Windward Island Banana Growers Association (WINBAN) and Geest Industries, Ltd.

The bunch is cut, dehanded, and the hands set aside and placed above the midrib section of a clean green banana leaf to allow the initial heavy flow of latex to drain. Absorbent crown pads, treated for crown rot control, are applied to the trimmed crown and set aside on a leaf or canvas packing table for selection and packing. The fruit is packed in made-up fibreboard boxes supplied from temporary storage at the grower's storage and dry-pack shed.

The full boxes are removed by "headers" to the grower's shed for temporary storage before loading onto trucks for transfer to the ports of Roseau or Portsmouth.

2. Dry-Pack at Grower's Shed

Because fibreboard boxes are susceptible to rain or water damage, a different method of packing must be employed during rainy periods. This method, although included under the general heading of field packing, is totally different and must be considered separately from the strictly defined field pack procedures. With the dry-pack procedure, bunches are cut, dehanded, placed on "header" trays holding up to 32 pounds, carried to the shed and placed on a table adjacent to a worker who trims the crown and passes it to another worker for the placement of crown pads. The fruit is then selected, packed into boxes and removed to a sheltered area within the shed from which it is loaded onto trucks for transport to the Geest Industries terminal, weighed, and eventually loaded aboard ship.

3. Premiums and Subsidies

Field and dry packing are done by individual or groups of growers that must conform to rules and operating procedures set down by Geest Industries, Ltd. Convinced that field packing results in improved quality, Geest and DBGA are paying substantial premiums to encourage it among farmers in the Windward Islands.[8/] These premiums include:

(a) Deflowering & Sleeving	1.0 cent/lb
(b) Dehanding	1.0 cent/lb
(c) Packing	3.0 cents/lb
(d) Premium (quality)	3.0 cents/lb
Total	8.0

8/ Although paid by Geest, the money comes by deductions from the Green Price (pre-ripening price in the U.K.).

Subsidies and premiums for any given method of production normally do not continue over any lengthy time span because any method adopted must eventually stand on its own merits and pay its own way. Consequently, subsidies paid to encourage field and shed packing should be ignored when comparing those methods and costs with established central boxing plants using wet-pack procedures. Quality premiums are relevant, however, and should be paid by Geest Industries to growers irrespective of the packing procedure used.

4. Labor Performance Standards and Costs

Labor performance standards, crew requirements, wage rates and total labor costs per hour are given in Table 1 for field and shed packings. Family labor may be employed for several jobs - particularly stem cutting and dehanding. For purposes of this report, however, family labor is charged at the going wage rate as shown in Table 1. It is also assumed that labor is utilized for a full 8 hours, an assumption that does not apply as a general rule. Labor rates are on a per day basis and are therefore fixed over the normal 8-hour day. This allows for spreading labor over various total volumes and will result in some economies of scale. Scale economies for fixed cost elements, including labor, management, buildings, and machinery will be discussed in a later section. For example, 15 boxes per hour for 8 hours amounts to 120 boxes total for a unit labor cost per box of $0.75. If only 60 boxes were packed, then total labor costs will still be at the daily rate of $90.00 giving a unit labor cost of $1.50 per box. Labor costs for the shed dry-pack operations amount to $110 per day because two additional workers ("headers") are required.

TABLE 1. FIELD PACK BANANAS. ESTIMATED LABOR PERFORMANCE STANDARDS, CREW REQUIREMENTS, WAGE RATES AND TOTAL COSTS PER 8-HOUR DAY. DOMINICA, 1984 [1/]

Job Category	Production per hour box equiv.	Workers required No.	Wage rate EC$/day	Total EC$/ day
Field Pack				
Cut stem & dehand(1)	15.0	1	20	20
Pad crowns(2)	15.0	1	15	15
Select hands & pack box	15.0	1	25	25
Head to Sheds(3)	5.0	3	10	30
Sub Total	-	6	-	90
$/box (120/8-hr day)	-		-	0.75
Stapling(4)	-	-	4.27/100 bxs	0.0427
Sub total/box				0.7927
Shed Pack(5)				
Cut stem & dehand(1)	15.0	1	20	20
Place on header trays(6)	15.0	1	10	10
Head to Shed(3)	5.0	3	10	30
Trim & Apply crown pads	15.0	1	15	15
Select & Pack(7)	30.0	1	25	25
Stacker & Utility	30.0 +	1	10	10
Total	-	8	-	110
$ box including stapling	-	-	4.25/100 bxs	0.9594
Sleeve Fruit(8) (112/day)	14	1	20	20
Deflower in Field(9)	14	1	20	20
Total	-	2	-	40
$/box -112 /8 hr day	-	-	-	0.357
Grand total Field pack	-	-	-	1.15
Grand Total Dry Pack	-	-	-	1.316

1/ Source: DBGA and Exp. Inc.

3/a

* Assumptions:

Production method :	4 year cropping; 1 year clear and replant
Mats/acre :	700
Pre-harvest loss:	10%
Bunch/mat/yr:	1.5
Average bunch weight:	40 lbs
Harvested weight/yr:	42,000 lbs.
less 10%:	37,800 lbs
less 20% replanting:	30,240 lbs.

Fruit/acre sold and accepted by DBGA = 27,220 lbs = 12.15 T.
(1T = 2240 lbs)

Cutting per year = 26

Weight harvested/cutting =1,163 lbs/acre = 29 bunches

(1) Cut stem and dehand = 15 box equivalent/hour

$$\frac{12 \text{ bunches/hr} \times 40 \times 0.9}{29 \text{ lbs box}} = 14{,}9 \text{ or } 15.0$$

(2) Pad crowns: gets hand from leaf and applies pad. Wait for initial heavy flow of latex to subside. (e.g. 55% of latex is discharged in 5 minutes, 84% in 10 minutes).

(3) Head to Shed: Varies greatly depending on terrain. In Dominica standard is 8 box equivalent per hour to roadside and 4 box equivalent/hour roadside to shed. Performance standard is 5 box equivalent/hour per header.

(4) Stapling: Paid $4.27 per 100 boxes. A field pack crew requires 120 boxes per 8-hour day. Although boxes are stapled in a central boxing plant or warehouse, the cost of this labor and materials should be charged against the field pack for their requirements.

(5) Shed packing: Sheds are located within a radius of approximately 1/4 mile and are used to store empty and full boxes. In rainy weather the fruit is also packed in these sheds.

(6) Place on trays: Trays hold about 32 lbs. of dehanded fruit, and are set aside for the header to carry to shed.

(7) Select and pack boxes at shed: 30 boxes/hour. This compares to 15 boxes per hour in field packing. Slower field pack results from increased travel time, stooping, and other delays attributable to terrain, etc.

(8) Sleeve fruit: 14 box equivalents per hour or 112 per 8-hour day.

(9) Deflower in field: 14 box equivalents per hour or 112 per 8-hour day.

5. Field Sleeving and Deflowering

As noted earlier, field deflowering and sleeving are required for field packed bananas. At present there is a field deflowering bonus of 1 cent per pound paid to field packers. This more than covers the deflowering labor costs of $0.0060 shown in Table 1, but will not cover both deflowering and sleeving.

Sleeves cost about $0.50 each. Assuming sleeves are used 2 times on bunches averaging 40 pounds, sleeves will cost $0.144 cents per 29-pound box equivalent. Ignoring distribution costs, labor and materials costs for sleeving and deflowering can total to $0.0173 per pound or $0.501 per box equivalent. At any rate, field deflowering is more time consuming than deflowering at the boxing plant and the difference should be charged to field pack costs. The same conclusion applies to sleeving. In this analysis full costs are charged to deflowering and sleeving for both field and dry packing. Any difference will appear in the comparative cost analysis to appear later.

6. Investment and Annual Fixed Costs

To be accepted as a bona fide field packer, the grower must construct a shed with space for empty and full box storage plus space for dry-packing. As noted earlier, dry packing is required during rainy periods to avoid water damage to the fiberboard boxes. In addition, required field deflowering and sleeving operations must often require a ladder, particularly for hilly areas. Boenders has estimated costs for sheds and

ladders at EC$1,500.[9] If financed over a 5 year period, amortization and interest would amount to about $390 per annum. Assuming an average of 72 box equivalents per cut, 25 cuts per year, costs of this loan would amount to $0.22/box. For 50 cuts or receptions per year, the costs would be halved ($0.11).

Investment costs will be substantial and will impact unfavorably on the development of field pack operations beyond current levels. At present there are about 319 field packers (including 7 groups). If each group contains 4-5 farmers, then 284-291 sheds must have already been built giving a total investment to this point of between EC$426,000 and EC$436,500. This is roughly equivalent to nearly 6 newly constructed conventional 3-line wet-pack boxing plants, excluding finance costs.[10]

In addition, made-up boxes are assembled at the various Central DBGA boxing plants. The field pack operators should pay for the box assembly and labor (stapler). Otherwise, box assembly costs represent a subsidy to field packers from DBGA plants. Stapling labor amounts to EC$4.27 per 100 boxes or 4.3 cents per box, paid on a piece-rate basis. Inclusion of these costs increases field pack costs from 0.75 to 0.793 per box packed, assuming 120 boxes packed per 8-hour day.

9/ P. Boënders, Marketing Development Manager, DBGA

10/ Adjusted to today's prices, a 3- line boxing plant costs an estimated $74,398. If 100 percent financed over 20 years at 8 percent, the costs are increased: $151,552 per plant to cover interest, amortizaton and loan origination charges.

Hauling charges to port amount to 3 cents per box per mile. With an average of 18 miles from DBGA boxing plants, a 3-ton load would be about 216 boxes or 216 x 18 x .03 = $116.64.[11/] For a 5-ton Bedford truck load, transport costs would amount to $194. Truck hauling costs amount to $0.54 per box.

Quality graders at Geest Industries are used by DBGA as a check on Geest samples and to provide quality control data for future reference. Most, if not all, other labor at the dock is paid for by Geest.

Geest Industries has pointed out several problems. First, trucks carrying field packs for several growers have to return to the weigh station for re-weighing as each packer's lot is completed. This means the truck must leave the unloading bay and thus causes delays for the field pack receiving crew. Furthermore, these re-weigh loads have priority over trucks lined up for initial weighing, a privilege that pleases neither the field pack truck driver nor the drivers of queued up trucks awaiting their turn at the scale. Costs imputed to these delays have not been conclusively determined, but can be substantial.

A second problem set down by Geest Industries is that field packed fruit tends to bunch at the end of a reception and results in less time for quality inspection by the Geest team.

Possible solutions to these and other dock reception problems are discussed later in this study.

11/ Trucks habitually "overload" by 25 to 30 percent.

7. Training and Supervision

At present, DBGA employs 16 District Field Officers and 7 Division Control Officers. In addition, there is a General Manager, Operations Manager, Field Pack Coordination Officer, Leaf Spot Coordinator, Marketing Development Manager, and Financial Control Officer that, along with support personnel, form the administrative structure of DBGA.

The Marketing Development Manager estimates that over 60 percent of the Extension Department's time is now spent supervising and training field packers, 10 percent on leaf spot, 10 percent on soil sampling and 20 percent administrative. These services cost approximately 1 cent per pound sold which means that nearly 2/3 cent per pound is taken up by the field pack operation.

Administrative costs are assumed to amount to a 0.20 per box packed and accepted, and are in accord with accounting records of DBGA.

8. Cost Summary

The foregoing discussion provides most of the identifiable cost data for field and dry pack operations. Additional data are required for estimating utilities including power and water, along with some incidental costs of outside supervision. If used, most of the electrical power involved would be the dry-pack shed locations and is considered small enough to be ignored. Water is not used and also can be ignored.

Given the data developed above, costs of field and dry-packing may be summarized as follows:

a. Labor

(1) Field pack

Total per 8-hour day	EC$ 90.00
per box - 120/8-hour day	0.793
(includes imputed charge for stapling of $0.0427/box)	

(2) Dry or Shed Pack

Total per 8-hour day	$110.00
per box 0.9167 + 0.0427	0.96

b. Other Costs - 25 Receptions; Field & Dry Packs

(1)	Sheds - $1,500 8 %, 5 yrs	$ 0.22/box
(2)	Administration & Training	0.20/box
(3)	Transport to port (assumes $0.03/box mile - 18 miles)	0.54/box
(4)	Sleeving & deflowering (labor)	0.357/box
(5)	Sleeves (2 times use)	0.144/box
(6)	Crown pads	0.2175/box
	Total	1.6785/box
(7)	Utilities	-----

c. Total Estimated Costs - Field & Dry Packs

	Per box	
(1) Field Pack		
(a) Labor	$0.793	
(b) Other	1.6785	
(c) Contingencies[12/]	0.0494	
Total	2.5209	
Cost/lb - 30 lb box average		$ 0.08403
Cost/lb - 29 lb box average		0.0868
(2) Dry Pack at Shed		
(a) Labor	$ 0.9600	
(b) Other	1.6785	
(c) Contingencies[13/]	0.0528	
Total	2.6913	
Cost/lb - 30 lb box average		0.0897
Cost/lb - 29 lb box average		0.0927

d. Subsidies

The above calculations do not include subsidies or premiums. Since subsidies are considered as temporary only, they should be excluded when comparing costs of different

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12/ Cost on damaged boxes, unscheduled delays, etc. estimated as 2 percent of total cost.

13/ Ibid.

methods. The quality premium of 2-3 cents per pound is not included as an offset to costs because fruit packed by all methods should be eligible to receive the premium.

If, however, subsidies of 5 cents per pound for field deflowering, dehanding, and packing are treated as offsets to costs of field and dry packing, costs would drop to $0.0268 per pound for field pack and to $0.0427 per pound for the dry pack.[14/]

If sleeving and field deflowering are eliminated, costs will drop by $0.0173 per pound for both field and shed packs.

These subsidies were devised to encourage growers to by-pass conventional central wet pack plants and turn instead to the field pack method. If field or dry packing demonstrates superior qualities over long periods, then a measure of the added revenue from quality premiums must be considered when comparing wet and field packs. At this point in time, this superiority has not been conclusively demonstrated to the consultants.

e. Limitations of Cost Estimating Procedures

The cost estimates given in Table 1 and summarized above were developed within a framework of assumptions and constraints.

14/ 29 lb. box

Perhaps the most severe constraint involved the assumption of full labor utilization for 8 hours per day. This assumption appears necessary in order to calculate costs per box and pound based on the hourly labor performance standards and corresponding requirements, because labor is paid on a per day basis. Thus, straight-time labor costs are fixed per day and must be paid irrespective of the number of hours worked within an 8 hour period. Therefore, the farmer will minimize labor costs per unit if he has sufficient volume (120 boxes per day) to fully employ his work force over 8-hour periods. Many field packers do not have sufficient volume of harvest to work a full 8-hour schedule. Even the larger producers may overrun the 8-hour volume requirements and thus must work part or all of a second day or employ two or more field pack crews.

Inability to work for a full 8-hour period introduces an upward bias to unit cost computations so that the cost estimates developed above must be considered conservative and somewhat below the actual costs of field and shed packing.[15/] Essentially the same limitations apply to cost estimates for deflowering and sleeving. Sleeve costs are based on an average re-use rate of two times.

The labor performance standards developed and used in estimating labor costs and requirements are subject also to wide variation depending on the terrain, level of training, and supervision. Nevertheless, the standards and costs developed are in accord with those provided by informed specialists and

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15/ With a 5-hour day costs per unit would rise to $0.118 per lb. If a 5 or 6-hour day is a "common" practice, then field and shed packing will not be cost competitive with centralized wet pack plants.

observations by the consultants. They should be interpreted as representing average conditions for Dominica.

In addition, certain costs were omitted or included in a "contingency" category. More specifically, these costs were for lost and damaged boxes and certain friction losses such as unexpected delays caused by intermittent rains and the consequent increased set-up and transit times between field and shed locations.[16/]

Subsidies and premiums were not included as offsets against costs. Premiums should be paid for wet pack as well as for field pack bananas and thus are ignored. Until a consistent pattern of quality improvement develops through either packing procedure, premiums should not be assigned one as opposed to the other. Subsidies for field packed bananas are paid to encourage field pack participation among farmers. Once having served as an initial catalyst, subsidies should be dropped and field packing allowed to stand or fall on its own merits.

f. Limitations and Potential Problem Areas of Field and Shed Packing

(1) Training and Supervision

At present there are 319 registered field packers scattered throughout the important banana production

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16/ Lost or damaged boxes at any part of the production/marketing chain are charged to the account of the DBGA.

areas of Dominica.[17] An additional 81 new farmers are projected by March, 1984.[18] All field packers are trained and supervised by 16 District Field Officers and 7 Division Control Officers. This endeavor requires about 60 percent of total extension for all banana production and marketing activities.

Supervision consists of personal contact and tutoring, backed up by follow-up procedures. The follow-up procedures involve a quarterly assessment called the "Field Pack Field Evaluation Form." The evaluation includes deflowering, sleeving, mat sanitation, weed control, density control, and toppings and snaps. If any of these categories are improperly done, the farmer is investigated and instructed on proper procedures designed to correct the deficiency. If the farmer does not correct the problem he can lose his field pack premium of $0.03 per pound.

In addition, Geest Industries make quality assessments for field packed fruit delivered to the terminal port facility. This inspection provides further data on quality characteristics by individual field packers. To this point in time, DBGA has done a good job in getting field packers to produce and pack high quality fruit.

17/ Source - Interview with Mr. Peter Carbon, Field pack coordinator, DBGA, January 24, 1984.

18/ Ibid.

Recent records data show that field packers are missing several receptions in a row, thus impacting unfavorably on quality and yield parameters. Because supervision will become more and more cumbersome, the consultants are not entirely confident that field pack quality will be maintained on a cost effective or efficient basis.

(2) Inflexibility

In most respects this problem is caused by the atomistic nature of production, given wide acceptance of the field pack procedure. The system will find it difficult to respond quickly to changing market conditions brought about by changes in quality grades, types of pack, transport, and the like.

(3) General - Missed Receptions and Diseconomies of Scale

At the present time Geest Industries imposes a 1-ton or 72 box minimum for field packers. Small farmers cannot meet this minimum and delay cutting for 2 to 3 and sometimes 4 week periods. This results in production and quality losses. Data obtained for the Valery variety in Honduras and Panama indicate that cutting on alternative weeks can reduce yields an average of 5.2 percent. In addition, problems of overgrade increase and more fruit may be rejected at the dock or arrive overripe in the U.K.

In 1983, there were 5,205 Dominican farmers producing 15 tons or less, and only 436 farmers that produced

more than 15 tons per year. The consultants believe that centralized boxing plants will be more cost effective for small producers. Groupings of up to 7 or 8 individual producers can serve to increase tonnage per cut. However, groups tend to be inherently unstable.[19/]

(4) Diseconomies of Scale

Imputed costs of training and supervision plus sleeving and deflowering amount to 30.5 percent of total costs and will offset some of field packing competitive advantages relative to centralized boxing plants. Problems of full labor utilization over less than 8-hour periods result in diseconomies of scale since costs are not spread over optimum output levels. Less than capacity loads in pick-up trucks (fixed now at $80/trip) will also result in high unit transport cost. Comparative costs between field pack and centralized boxing plants will be presented in detail later in this study.

(5) Market Power

The trend to field packing returns bananas producers to atomistic competition. This places a single buyer in a more powerful position with respect to the manipulation of prices or quantities and other market parameters.

19/ For example, small informal groups of dairy farmers in Wisconsin and Minnesota have a history of frequent breakdowns, a tendancy found also in small cooperative enterprises.

The formation of a Commercial Marketing firm to replace DBGA plus an independent entity to represent farmers places a buffer or another administrative layer between point of purchase and point of sale. This again adds to the bargaining power of the single buyer. The comments are not to be construed as opposition to restructuring as planned, but to point out that net gains to producers should be carefully reviewed. Most of the costs (up to 70 percent of the U.K. retail price) come after the boxes are delivered to Geest Industries shiploading docks at Portsmouth and Roseau. It is obvious that most of the impact of more efficient methods within Dominica will be small relative to overall production, packaging and marketing costs.

(6) Latex Staining

The consultants conclude that the major quality problem in field packing is latex staining. It is recommended that hands be allowed to exude latex for at least 10-12 minutes after dehanding. This procedure may be extremely difficult to enforce, thereby raising costs of supervision and running high risks of latex staining during ocean transit. Rates of flow of latex of dehanded fruit of the Valery variety were extensively researched in Honduras, Costa Rica, and Panama. Details of procedures and results are given in Appendix A.

B. Wet Pack Boxing Operations

1. General

During 1983 the Dominica Banana Growers Association (DBGA) operated 19 wet pack boxing plants. These plants dif-

fered not only in operating capacity and number of receptions per year, but also accepted bananas in six different forms. These six forms were: (1) bunches with flowers attached to the fingers; (2) bunches deflowered; (3) dehanded fruit with flowers delivered by truck; (4) deflowered, dehanded fruit delivered by truck; (5) deflowered, dehanded fruit delivered in 1.9 cubic foot field boxes which hold from 30 to 32 pounds of bananas; and, (6) dehanded fruit delivered in a field box with the flowers remaining on the banana fingers. In addition to these fruit receiving combinations, it is the responsibility of each wet pack boxing plant facility to separate short-finger fruit obtained from the apex hands and package these hands in special corrugated containers. The above combinations result in different labor, space and throughput requirements during a reception for each boxing facility.

There are two sizes of boxing plants operated by DBGA. The rated operating capacity of these two plant sizes are 2,500 and 4,000 packed boxes per reception.[20/] They are constructed with either two or three parallel lines, each capable of performing the operations necessary for each fruit delivery form. In actual practice, especially in the three-line 4,000 box plants, the special requirements for small fingered bananas and bananas that have not been deflowered are reserved for special areas. Since the percentage of each form of fruit can vary from plant to plant, as well as by each reception, these 19 plants have not been designed for discrete proportions of arriving fruit forms within the overall plant operating capacities.

20/ Receptions are 20 hours in duration.

The DBGA also receives boxed bananas from an additional 13 to 16 wet pack boxing plants which are operated by cooperatives and independents. Five of these plants are small with a rated capacity of 1,000 boxes per reception. The remaining plants have rated capacities similar to those operated by the DBGA. During 1983 the packed bananas sold by these cooperatives and independents to the DBGA weighed approximately 5.8 million pounds. This weight comprised 9.1 percent of the wet pack output sold by the DBGA.

Not all wet pack boxing plants operate the same number of days. During 1983, one facility operated only 13 times while six operated 50 times which was the maximum number of harvest periods. A distribution of the number of operating periods (receptions) is as follows:

Receptions	Percent
48-50	35
40-47	5
30-39	20
20-29	35
10-19	5
	100

For purposes of this report, two reception rates will be studied--25 receptions and 50 receptions.

2. Harvesting

There are 3 principal methods of harvesting currently being used in Dominica: (1) bunch or stem harvesting; (2) field dehanding and placed on a flatbed truck or lorry; and,

(3) field dehanding and placed in a plastic field box 1.9 ft^3 with capacity of 30-32 pounds of bananas.

a. Stem or Bunch Harvesting

With this method, the stem is cut and stacked next to the pseudo-stem or handed to a "header" for transfer to roadside. The performance standard for the stem cutter is approximately 16 box equivalents per hour (12.3 stems). This standard is subject to wide variation due to density of fruit, terrain, and distance from the mat to the farm road.[21/] The cutter is assisted by 2 headers who carry the stems or bunches to roadside at a rate of about 8 per hour. The stem is often harvested (cut) by the farmer. All labor in this report is charged at prevailing rates so as to assure comparability among methods. The rate used here is $20 per day. Headers are paid $10 per day. One cutter and 2 headers usually comprise the harvesting crew. Major problems with stem or bunch harvesting are quality related. Bruising of several hands can occur when proper head boards are not used, the stem is not padded before heading, and stems are carelessly stacked at roadside. Boënders suggests that headers be equipped with alpine pack frames and that the fruit be hung on rails or leaned vertically to a rack or bar.[22/] The consultants recommend that header damage

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21/ This compares to 24 stems per hour for plantation type farms in Honduras where fields are relatively flat and bananas transferred by cableways.

22/ Paul Boënders, Market Development Manager, DBGA, 12-month review of the banana industry, 1983.

be reduced by proper supervision and payment of quality premiums.[23/]

Stems are hauled to the boxing plant in one-ton pickups and long wheel base land rovers. The pickups have a rated capacity of 50-60 stems for which the farmer pays $0.50 to $0.60 per stem according to the terms of his contract.

b. Field Dehanding - Field Box

The stem is cut, dehanded, drained and packed in a field box and hauled to roadside.[24/] If properly packed and wrapped, it is possible to place 2 layers in the field box. However, fruit packed in 2 layers often bulges over the sides of the field box making it impossible to stack the boxes without bruising the fruit. In addition, latex is often allowed to drain over the fingers of the hands. Unless washed off quickly, the latex will congeal and the fruit rejected somewhere in the marketing chain or sold at a discount.

Field boxes are estimated to cost $35 which amortized over 5 years at 8 percent interest gives $0.01 per pound. Hauling charges for 1-ton pickups are $0.75 to $1.00 per full field box delivery and return of empties. Taking an average $0.875/box gives a cost per pound hauling charge of $0.03. Labor costs of cutting, heading, dehanding and packing field boxes are estimated as $0.4297 box equivalent or $0.0148 per pound.

23/ Any premiums paid must be market related.

24/ The dehanding and packing operation is often done at roadside, however.

c. Field Dehanding - Truck or Lorry Bed

With this method, stems are cut and brought to roadside for dehanding. The hands are often placed aside to temporary storage and then loaded onto a pickup or Bedford truck. The hands are packed in field debris and leaves, a practice that encourages the development of crown rot fungus during ocean transit. Although the system provides low cost transport to the boxing plant, marketing agents have requested it be discontinued. The consultants agree that this method of harvest and assembly is highly susceptible to latex staining and absorption of spores conducive to crown rot during shipment. Consequently, this method is not considered in this study.

d. Summary - Harvesting and Assembly Costs

Estimated labor and other costs are given in Tables 2 and 3 for stem and field box harvesting. Costs per pound are shown to be $0.0207 for stem as compared to $0.0148 for field box harvesting and assembly. Field box harvesting requires one more worker plus interest and amortization costs for the field box.

Setting aside quality consideration, bunch or stem harvesting is the lower cost method. As will be demonstrated later, stem handling can result in further savings at the plant receiving yard--primarily by relieving congestion, reducing space and permitting better sanitation in the yard area.[25/]

25/ Refer to section on boxing plant revision.

TABLE 2. WET PACK BANANAS. HARVESTING AND ASSEMBLY LABOR AND COSTS, DOMINICA, 1984 [1/]

Job Category	Prod. per hour Box equiv.	Workers required No.	Wage Rate EC$ per day	Total Cost EC$ per day
Stem Harvest				
Cut + Aside	16	1	20	20
Head to roadside	8	2	10	20
Total		3		40
EC$/box (128 boxes/day)				0.31
EC$/lb. labor (29 lb/box)				0.0107
Field Dehand to Field Box				
Cut + Aside	16	1	20	20
Head to Roadside	8	2	10	20
Dehand + Pad crown	16	1	15	15
Total labor		4		55
EC$/box (128 boxes/8 hr/day)				0.4297
EC$.Lb labor (29 lb/box)				0.0148

[1/] Source : DGBA and Experience, Inc.

TABLE 3. WET PACK BANANAS. FARM TO BOXING PLANT
HAULING AND FIXED COSTS, DOMINICA, 1984

Method	Truck Capacity		Unit cost/ lb	
	Stems	Field box	Stems	Field box
Hauling				
Stems	55	-	$0.01	
Field boxes		40		$0.03
Fixed Cost				
Stems			nil	
Field boxes				$0.01
Total (Harvest + Hauling)				
Stems			$0.0207	
Field box				$0.0548

3. In-Plant Boxing Operations

Bananas are received at the boxing plants in combinations of the six forms described above. Bunch or stem fruit is stacked in the receiving areas in piles belonging to a particular grower. The grower and his fruit transporting vehicle remain at the boxing plant until his bunches have been dehanded, weighed and the weight recorded.[26/] The grower is then provided a record of this accepted fruit weight and he then leaves the boxing plant area. For growers delivering dehanded fruit packed in a truck or in the special field boxes, their unproductive wait time is similar to that experienced by the growers delivering bunch fruit. Each grower waits until his load of fruit has been accepted and the weights recorded. The consultants observed up to 43 growers waiting at a single boxing station.

Trash, leaves, and unacceptable bananas accumulate at a rapid rate around each packing station. Small piles of stem fruit, as well as the dehanded fruit, are exposed to sunlight, high temperatures and contamination. Latex staining of dehanded and field box delivered bananas also occurs at this point. Other studies have indicated that these varieties of bananas will exude 2.6 grams of latex per kilogram of accepted fruit. Therefore, a packed box equivalent of dehanded fruit will exude an additional 34 grams of latex from the time it is placed into the field box until the time it is accepted at the wet pack boxing stations. A significant portion of this latex can get onto the outer whorl fingers of the field pack and truck packed

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26/ Contract truckers unload and leave. Farmer may stay on to receive his weight totals.

fruit. Only minor amounts of this deposited latex is visible when the wet hands are packed into cartons. Some additional latex flow occurs when stems and clusters (partial hands) are trimmed at the plant.

After dehanding and trimming, accepted fruit is placed into special fibreglass trays and the filled trays are lifted onto scales to obtain the weight of the accepted fruit. Trays are then lifted from the scales and the bananas are carefully dumped into a concrete delatexing tank. Bananas are allowed to stay in these deflowering and delatexing tanks from five to ten minutes while surface water containing the latex flows into two large drain pipes. This surface water cannot reach the drain pipe areas at a rate faster than the fruit moves from one end of the tank to the other. A fresh water supply delivered to the delatexing tanks replaces the overflow water. At some boxing stations, a shortage of fresh water and/ or water pressure did not allow for the proper removal of latex from freshly dehanded stems.

The next in-plant operation was to manually transfer fruit to a different, clean water supply tank where it was transported to the fungicide treatment area. When possible, these tanks were supplied with fresh water allowing a final delatexing operation. Hands and clusters of bananas were manually removed from these tanks, placed into a fungicide dip and manually placed onto a table for the draining and packing stage.

The packing operation starts with the packer securing the bottom section of a fibreboard container from an adjacent location. The container bottom has an inside dimension of 20 x 13 x 7 inches. In the center of this 275 pound test bottom is a folded 18-inch center divider which is held to the sides of the carton with eight staples. Most of the stacking strength

of the entire box is at this point. Twelve additional staples hold the bottom flaps in position. The center divider covers up a portion of the 9 1/2 x 2 7/8 inch opening, leaving two 2 3/8 x 2 1/4 inch openings. In addition, there are four 1 1/2 inch diameter ventilation holes and two 3 1/2 x 1 3/8 inch hand holds. The packer then secures a 48 x 30 inch sheet of light-weight plastic and lays it over the empty bottom portion of the box. This plastic sheet is supposed to be ventilated, but in actuality the approximately 0.5 mm holes become virtually useless for ventilation during the box packing operation. There is a surplus of film for the size of the carton and film blocks much of its own ventilation possibilities. The carton top is contructed similar to the bottom with four ventilation holes, two hand holes and a 9 1/2 x 2 7/8 inch opening in the center of the top. The top is held together with eight staples.

The packer selects six to eight hands and/or clusters and attempts to fill the container with 30 pounds of bananas. Clusters are required to have at least 5 fingers by Geest Enterprises. A sample of 30,000 packed boxes from 32 boxing stations resulted in an average packed box weight of 28.9 pounds. Even at this weight the shallow height of the carton results in packing damage from crowns being forced onto underlying fingers. It was evident that the dimensions of this carton will not allow for a 30 to 32 pound pack without permitting additional clustering. After the carton has been filled as much as possible, the packer slides the box out of position and prepares for the next packing cycle.

The box stacker or a helper places a cover over the packed fruit and codes the carton for future plant identification purposes. He then stacks the carton in a temporary holding area. Later the carton is stacked onto a truck for transporting to the port receiving facilities.

4. Costs of Wet Packing

Regardless of the boxing plants' capacity, DBGA plant costs fall into six basic components. The cost components are boxing plant labor, assembly and transport to plant, transportation of employees, plant cleaning, overhead, and depreciation and other costs.

a. Accounting Record Costs

Boxing plant costs per 1,000 packed boxes are shown in Table 4 for the 3rd quarter of 1983. Due to the variation in number of boxes packed per reception and the range in operating costs per boxing plant, the economies of scale in the larger boxing plants did not show up in the third quarter data. Costs per 1,000 packed boxes varied from $933 to $2,289 for the 2,500 box capacity plants, while the larger plants varied from $1,003 to $1,845 per 1,000 boxes. Additional transportation charges varied from $123 to $1,031 per 1,000 boxes depending on the distance to port.

To eliminate variations in site requirements, construction costs and boxing plant capacities, new three-line plants were designed to allow standardized comparisons among wet plant alternatives as well as other boxing methods discussed in this report.

b. Standardized Costs

Replacement costs were calculated for a new three-line boxing plant. Cost data shown in Table 5 reflect 1982

TABLE 4. WET PACK BANANAS. THIRD QUARTER 1983
BOXING COSTS BY DBGA PLANT AND RATED CAPACITY, DOMINICA.[1/]

PLANT & RATED CAPACITY	Boxing Plant Cost (EC$)	Boxes sold at 29 lbs	Cost per 1000 pkd boxes	Transport to wharf per 1000	Total cost/1,000 boxes
2,500 boxes					
Glanvillia	$ 9918	5633	$ 1761	$ 123	$1884
Vieille Case	21850	14989	1458	380	1838
Hermans	21261	12482	1703	668	2371
Vauxwall	21022	22521	933	620	1553
Carholm	33255	34855	954	496	1450
Canefield	8150	3561	2289	197	2486
Wtd. average	---	---	1228	497	1725
4,000 boxes					
Blenheim	$ 15275	10092	$ 1514	$ 189	$1703
Hodges	16726	9983	1675	393	2068
Constant Spring	30325	29109	1042	470	1512
Londonderry	23359	21113	1106	520	1626
Marigot	27964	27285	1025	576	1601
Hatton Garden	32745	32638	1003	686	1689
Carib Reserve	21767	13824	1574	1031	2605
Castle Bruce	36877	31832	1158	735	1893
Rosalie	34377	18630	1845	728	2573
Layou Park	37116	34377	1080	410	1490
Hillsborough	32760	26110	1255	277	1532
Macoucherie	23471	17541	1338	395	1733
Geneva	22246	17119	1299	421	1720
Wtd. average	--	--	1226	525	1751
All plants	--	--	1226	516	1742

1/ Source: Calculated from DBGA accounts

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construction costs that were updated to December 1983, using the Dominica cost-of-living index.

This boxing plant represents construction costs for an 86 ft. by 43 ft. three-line boxing plant which reflects the packed box rates of the 19 plants operated by the DBGA. The constructed building and required equipment costs total $74,398.[27/] The production of packed box equivalents total 80,400 boxes per year (1,608 boxes per 20-hour reception). This production rate reflects all the idle and unproductive time, limited fruit availability time, and front end receiving area problems encountered during 1983. Labor utilized in this plant consists of three lines of 13 employees working a 20-hour reception at a 1984 labor cost of $645,000 per line. Cost components per 1,000 packed boxes are as follows:

Item	EC Cost per 1,000 Boxes	%
Cutting & transport to road	$ 310.00	11.6
Hauling stems to boxing plant	290.00	10.8
Labor	1,252.00	46.7
Labor transportation	69.00	2.6
Plant cleaning	107.95	4.0
Depreciation, interest	106.26	4.0
Administrative overhead	6.70	0.3
Transportation to wharf	540.00	20.0
Total	$2,681.91	100.0

The resulting costs are $0.0925 per pound for wet packed bananas, based upon 29 pound boxes.

27/ The investment of $74,398 is the cost with 100 percent equity capital. If this amount were borrowed at 8 percent over a 20-year term, interest plus loan origination costs would amount to 77,154 giving a total cost of $151,552 if loan were carried to term.

TABLE 5. WET PACK BANANA PLANTS. ESTIMATED MATERIAL AND INSTALLATION COSTS FOR A STANDARDIZED 3-LINE BOXING PLANT, DOMINICA, 1984[1/]

Item	Cost[2/]	Years Depreciation	Annual Cost
Concrete flooring	$ 6,054	20	$ 303
Reimpactment with wire	2,125	20	106
Reinforcement steel	770	20	38
Backfill and stone	3,500	20	175
Footings	2,370	20	118
Offices and block work	1,480	20	74
Washing tanks, concrete	2,220	20	111
Transfer tanks, concrete	6,750	20	337
Store room and doors	1,751	20	87
Beams	180	20	9
Roofing, purlins, galvanize	15,050	20	752
Doors	350	20	17
Form work	510	20	25
Nails	2,115	20	106
Plumbing and labor	1,105	20	55
Electrical and labor	2,407	20	120
Toilets	1,820	20	91
Diesel generator	7,500	10	750
Water supply pipe	1,600	20	80
Water pump	7,300	10	730
Scales	3,000	10	300
Tables	352	10	35
Stapler	1,240	10	124
Misc. material	2,849	20	142
	74,398		
Interest at 8%[3/]	77,154		
Total (amortization + interest, & loan organization costs)	$151,552		

1/ Plants have capacity of 1,608 bxs/20-hr reception or 80,400 bxs/annum.

2/ All costs in EC$. US $1 = 2.7 EC$

3/ This is for a 100% loan ($74,398) over 20 years.

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5. Revised Design and Costs of Modernizing Boxing Plants

A new three-line boxing plant was designed to improve packed fruit quality, eliminate receiving congestion, reduce idle and unproductive time and increase worker efficiency. This revised boxing plant involves major construction changes throughout most of the operating areas. Costs are broken out for components of a conventional three-line plant, plus the additional costs for the revisions (Table 6). These revisions include:

(1) Changing the plant receiving area. The roofed area was increased an additional 50 feet in length and 10 feet in width to allow a total of 2,650 ft^2 (53' x 50') of covered space for the receiving station. Total dimensions of the revised design thus becomes 6,348 ft^2. Twelve overhead pipe lines supply a total of 204 stems of hanging fruit at all times. Stem fruit is suspended from rollers and spaced 3 feet on centers. Two overhead lines supply each dehanding line. A latch arrangement allows each stem to be moved into the dehanding area. All stems are deflowered while hanging in the receiving area. The deflowering operation is adjacent to the dehanding stations. The three foot spacers not only protect bunches from damaging each other, but also allow room for the deflowering labor. One man is assigned to each two overhead lines and is responsible for returning rollers to the front of the receiving area. He is also responsible for seeing that each grower has at least two identification tags which are attached to the first and last stem of his lot.

(2) Scales have roller tables on each side at a height to match the scale rollers.

TABLE 6. WET PACK BANANA PLANTS. MATERIAL AND INSTALLATION COST FOR A REVISED AND MODERNIZED 3-LINE BANANA BOXING PLANT, DOMINICA, 1984[1/]

Item	Cost	Years Depreciation	Annual Cost[2/]
Concrete flooring	$ 6,054	20	$ 303
Reimpactment with wire	2,125	20	106
Reinforcement steel	770	20	38
Backfill and stone	3,500	20	175
Footings	2,370	20	118
Office and block work	1,480	20	74
Washing tanks, concrete	2,220	20	111
Transfer tanks, concrete	6,750	20	337
Skimmers for six tanks	5,450	20	272
Store room and doors	1,750	20	87
Beams	429	20	21
Roofing, purlins, galvanize	35,150	20	1,757
Form work	510	20	25
Nails	2,465	20	123
Plumbing & labor	1,965	20	98
Electrical and labor	2,407	20	120
Toilets	1,820	20	91
Diesel generator	7,500	10	750
Water supply pipes	1,600	20	80
Water pump	7,300	10	730
Platform scales and rollers	6,000	10	600
Spray attachment	450	10	45
Circular tables and pads	675	10	67
Tables	352	10	35
Stapler	1,240	10	124
Dehanding connections	600	10	60
Spreaders and rollers	800	10	80
	$104,732		
Interest[3/]	108,611		
Total	$213,343		

1/ Plants have capacity of 2,700 bxs/20-hr reception or 135,000 bxs/annum.

2/ All costs in this report are EC$. 1 US$ = 2.7 EC$.

3/ Interest, amortization and loan organization costs. Interest at 8% per annum over 20 years for a 100% loan.

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(3) Both water tanks in the line have side water overflows to skim off latex at any point along the water transportation stage. These side skimmers are approximately two inches lower than the sides of the water tanks and are attached to the inside walls of the tanks. Skimmers drain at the ends of the tanks and the latex is removed with the drainage water. An ample fresh water supply keeps the water level approximately 1/16 inch above the inside edge of the skimmers. The sides of the skimmers including the end of the tanks should be lined to protect the bananas from abrasion damage.

(4) After fungicide treatment, hands and clusters are placed on large circular, padded tables that are rotated by the packer. The tables are sloped approximately 2-3 inches per foot of width. This arrangement allows the packer to have a larger number of hands to choose from while the final latex exudes onto this covered table. The table is rinsed frequently to remove any accumulated latex.

(5) A roller conveyor is used to move fruit out of the packing area for closing and marking filled containers. Empty cartons are supplied from an overhead conveyor to each packer.

(6) Filled box storage areas are located close to truck loading bays so that boxes can be loaded directly with a minimum of handling. Eventually, this area should be palletized so that palletized loads can be directly handled with a low-lift electric transporter.

(7) A fresh water spray attachment is constructed near the end of the second water tank. This allows for a washing off of any latex which might remain attached to the banana hands.

(8) Two grades of fruit can be packed, as well as short fingered fruit, from this plant design. With the skimmers and final spray rinse in tank, one tank can be divided into two segments for superior quality and small finger fruit.

(9) Additional investment costs for these improvements are $30,334 ($104,732 - $74,398) over the conventional "standardized" plant, excluding costs of financing a loan. If financed 100 percent, additional costs would amount to $61,791 for the "modernized" plant.

Production rates per man hour, as well as plant productivity per line, will change with the new receiving and packing area layouts. Production rates per man-hour are based on standards achieved in other geographical areas, as well as from time studies and ratio delay studies conducted by the consultants during field trips in Dominica. Standards are based on an 18-hour work period during the 20-hour reception. Standards have been applied to each job, thereby allowing start-up and wait time at the end of the reception (Table 7). One additional worker was added to each line to assist in the first receiving and deflowering area.

Cost components per 1,000 boxes for this redesigned three-line boxing plant are as follows:

TABLE 7. WET PACK BANANA PLANTS. MAN DAYS PER RECEPTION AND COSTS PER 150 PACKED BOX EQUIVALENT FOR A REVISED 3-LINE MODERNIZED BANANA BOXING PLANT, DOMINICA[1/]

Operation	Man days per reception	Labor costs
Hang fruit on cableway	3.81	$ 8.27
Transport along cableway	1.20	2.89
Deflower	3.84	14.63
Dehand	5.46	14.63
Move in water tank	2.73	6.78
Select quality (maximum 2 grades)	4.41	11.29
Apply fungicide	2.58	4.62
Place fruit on rotary tables	0.78	1.40
Place tray on conveyor	0.30	0.72
Place fruit in trays	1.02	2.53
Weigh trays of fruit	0.90	2.76
Slide full trays	0.30	0.74
Dump trays	0.33	0.82
Pack fruit (2 sizes)	3.36	7.43
Push packed box	0.42	0.93
Close box and mark plant number	2.55	4.33
Place box in temporary storage	1.71	2.78
Wait time	4.80	10.80
Idle time	0.99	2.23
Job regulated wait time	0.51	1.15
Watchman		2.26
Utility man/pump man		1.94
Box builder		6.40
Box stacker		0.93
Forelady		2.95
Receiving foreman		3.88
Recorder		2.64
	42.00 [2/]	$ 122.73

1/ 1984 labor rates obtained from the DBGA
2/ Rounded

Item	Cost per 1,000 Boxes[1]
Cutting & transport to road	$ 310.00
Hauling stems to boxing plant	290.00
Labor	818.20
Labor transportation	69.00
Plant cleaning	107.95
Depreciation, interest	87.84
Administrative overhead	6.70
Transportation to wharf	540.00
Total	$2,229.69

(1) Total output per plant is 2,700 boxes per 20-hour reception giving 135,000 boxes per annum.

The resulting costs are $0.0768 per pound of accepted bananas.[28/]

Up to this point in the analysis of wet pack boxing operations, the transportation costs from the plant to the wharf have been maintained as a constant between the two plant designs. Later in this report, these transportation costs will change when plants are relocated or closed.

At present, box costs of $3 each are included in the U.K. wholesale market price. The cost of lost or damaged containers should be less in the wet pack boxing operation;

28/ If harvesting and hauling to plant and dock costs are omitted, actual in-plant boxing costs drop to $0.0375 per pound of accepted fruit as compared to $0.0522 with the conventional "standardized" plant discussed earlier.

however, data was available only for the quantity of packed boxes accepted by Geest Industries, not on the number of boxes delivered to each type of boxing facility, or the number lost or unaccounted for.

a. Impacts

- One of the major impacts of the redesigned wet pack boxing station is the reduction in idle and wait time. The costs of unproductive time (idle and wait) were reduced from $24.86 to $14.80 per plant per reception.
- Output per plant rose from 1,608 to 2,700 boxes per reception.
- The labor force was increased three workers per plant.
- Latex staining should be significantly reduced by: (a) eliminating field box and dehanded fruit delivery; and, (b) utilizing side skimmers on all tanks to minimize latex accumulation during the in-plant washing and transportation phases.
- The cost per 1,000 packed boxes reduced from $2,681.91 to $2,229.69, or from $0.0925 to $0.0768 per pound--a 16.9 percent reduction.

IV. COMPARATIVE COSTS - FIELD, SHED AND WET PACK

A. Cost Comparisons - Discussion

The foregoing analyses supply all the data needed for a cost comparison among the methods considered. The cost comparisons include all major components and operations, but omit price subsidies and premiums. Family labor is costed at going wage rates for the jobs involved. The costs are compared based on current or existing plants and methods and are summarized in Table 8.

The table shows that field packing is $0.0057 per pound lower than in the existing central boxing plants. However, shed packing is slightly more ($0.0002) than in Dominica's existing DBGA plants. When the centralized plants are revised in design and operations, however, the unit costs become lower than field and shed packing ($0.01 and $0.0159, respectively). If sleeving and deflowering were dispensed with, field and shed packing costs per pound would drop by $0.0173 or nearly 2 cents per pound. In terms of cost competitiveness alone, field and shed packing combinations would then be lower and therefore more cost effective, provided labor is utilized over a full 8-hour period.

However, a big plus for centralized packing lies in more cost effective supervision and in the high probability that quality control could be maintained at consistently high levels.

Because the results thus far show close cost relationships among the methods considered, several scenarios are explored in the following section. These scenarios involve cost estima-

TABLE 8. BANANA BOXING COSTS. UNIT COSTS PER LB. FOR PACKING BANANAS BY DIFFERENT METHODS, DOMINICA, 1984[1/]

Cost Item	Field Pack	Shed Pack
Field and Shed Pack	EC$ per lb	
Harvesting and packing	0.0273	0.0331
Shed or Bldg, Depr. + Int.	0.0076	0.0076
Adm + training	0.0069	0.0069
Transport to port	0.0186	0.0186
Sleeving and deflowering	0.0123	0.0123
Sleeve cost (2 uses)	0.0050	0.0050
Crown pads	0.0075	0.0075
Contingencies	0.0016	0.0017
Total	0.0868	0.0927
Central Wet Pack Plants	Existing Plants	Revised Plants
Stem harvest	0.0107	0.0107
Assembly - Haul stems to plants	0.0100	0.0100
Plant labor	0.0432	0.0282
Labor Transportation	0.0024	0.0024
Plant Cleaning	0.0037	0.0037
Depreciation, Interest	0.0037	0.0030
Admin, Overhead	0.0002	0.0002
Transport to port	0.0186	0.0186
Total	0.0925	0.0768

1/ Source: DBGA and Experience, Inc. and preceding tabulations

tions for various combinations of wet pack boxing and scenarios depicting costs with a combination of wet and field packing.

These scenarios are presented because the consultants feel that only the larger producers will turn to field pack due to scale and other economies. In Dominica, there were 5,205 farmers (92 percent of all banana producers) that produced 15 tons per year or less in 1983. These farmers produced 53 percent of a total Dominica production of 28,767 tons (purchased weight). There were 436 "large" producers above 15 tons per year. These farmers produced the remaining 47 percent of Dominica's total production.

As noted earlier, there are 317 field packers operating in Dominica as of the end of January 1984. The target is 400 by the end of March. This number, together with some groupings, will just about account for all the "large" (above 15 tons/ annum) in Dominica.

Given the above, it is important to estimate boxing costs for a combination of field and wet pack methods.

V. THE COST OF ALTERNATIVES

A. Scenarios - Descriptions

In an attempt to ascertain the total boxing costs for handling Dominica's banana crop, four scenarios were studied.

1. Scenario I

That Dominica can maintain an annual production level of 64,000,000 pounds (28,571 tons) of accepted, boxed bananas.[29/] All of this production will be boxed in wet pack boxing stations currently operated by DBGA that have been modernized to meet the production standards shown in Table 4 at the December 1983 price level.

2. Scenario II

That the total production of the Dominica banana industry be wet packed at a level of 19,500,000 pounds by the Cooperatives (the approximate July 1982 to June 1983 level) and the remaining fruit boxed by DBGA. All single and double line Cooperative plants would be modernized to the revised three-line plant capacity and all DBGA plants needed would be modernized to handle the remaining 44,500,000 pounds.

29/ Long tons are defined as 2,240 pounds.

3. Scenario III

That 60 percent of the Dominica production of bananas be wet packed in modernized three-line plants and 40 percent field packed.

4. Scenario IV

That varying percentages of the Dominica production of bananas be wet packed and field packed, utilizing the most cost effective plants for each production level.

It is assumed that for each of the scenarios above that an ample supply of clean water is available for each wet pack boxing plant. It is also assumed that the two-line wet pack stations operated by the Cooperatives can be modernized at the same cost per square foot as modernizing the two-line DBGA plants.

B. Discussion

1. Scenario I

At a production level of 64 million pounds (28,571 tons), it would require 16.3 modernized three-line boxing plants. However, to meet a fifty reception schedule with seasonal fluctuations, a 2,556,500 pound excess capacity was incorporated into the analysis. This resulted in revising 17 DBGA facilities. Two boxing plants, Herman's and Vauxhall,

would be closed. Both of these plants are in Division 3. The Londonderry plant can service Herman's growers, while Marigot services Vauxhall's.

Expenditures to modify the 13 existing three-line plants would total $419,900, while additions and modifications to four two-line plants would be an additional $174,160 (Hermans and Vauxhall would be closed). The costs are in addition to the outstanding indebtedness of approximately $645,800 as of December 31, 1983 for all 19 plants.[30/]

The total expenditures, including existing plants and new expenditures, to meet Scenario I specifications would amount to $1,239,860 (See Table 9). This compares to the "standardized" costs given in Table 5 of $1,264,766 ($74,398 x 17 plants).

Costs per 1,000 boxes, broken down by individual cost categories, are given in Table 10. The unit costs with Scenario I are $0.071 per pound. This compares to $0.0768 per pound estimated earlier for revised and modernized plants. This small discrepancy arises primarily because the earlier estimates contained investment costs for two additional plants (19 as compared to 17) which resulted in slightly higher annual depreciation charges. Excess capacity of 2,556,500 pounds would amount to additional economies if utilized occasionally.

The capacity of these 17 plants would be 45,900 boxes per reception, including the 2,556,500 pounds built-in excess capacity. This capacity appears adequate for the foreseeable future. Capacity can be increased by operating more than 20 hours per reception.

30/ Remaining on books as the undepreciated values.

TABLE 9. BANANA BOXING PLANTS. SCENARIO I, ESTIMATED EXPENDITURES TO UPDATE EXISTING DOMINICA BANANA GROWERS ASSOCIATION'S WET PACK BOXING STATIONS

Plant Name	Value to date[1/]	New Expenditure
	----------EC Dollars----------	
Two-Line:		
Glanvillia	23,600	43,540
Vieilla Case	22,600	43,540
Hermans	100,600	2/
Vauxhall	33,500	2/
Carholm	101,000	43,540
Canefield	58,500	43,540
Three-Line:		
Blenheim	22,600	32,300
Hodges	8,200	32,300
Constant Springs	30,800	32,300
Londonderry	39,700	32,300
Marigot	17,000	32,300
Hatton Garden	18,100	32,300
Carib Reserve	28,000	32,300
Castle Bruce	24,500	32,300
Rosalie	14,700	32,300
Layou Park	43,700	32,300
Hillsborough	19,300	32,300
Macoucherie	19,500	32,300
Geneva	19,900	32,300
TOTALS	645,800	594,060

1/ As of 12/31/83 from updated 12/31/82 DBGA accounting data.
2/ Slated for closing under Scenario I.

6/a

TABLE 10. BANANA BOXING PLANTS. SCENARIO I,
COSTS PER 1000 BOXES, DOMINICA, 1984

ITEM	Cost per 1000 boxes	Percent
Cutting and transport to road	$ 310.00	15.0
Hauling stems to boxing plant	290.00	14.1
Worker transportation	37.23	1.8
Boxing plant labor	809.93	39.2
Plant cleaning	59.50	2.9
Existing depr., int. and overhead	34.26	1.7
New depreciation and interest	60.16	3.0
Transportation to warf	454.42	22.0
Overhead	6.70	0.3
TOTAL	$2,062.20	100.0

Average cost per lb.: $0.071

64/8

2. Scenario II

Under this plan, 19.5 million pounds of bananas would be packed by 6 wet pack plants owned by Cooperatives, and the remaining 44.5 million pounds would be packed by 12 plants owned by the DBGA. Excess capacity of 248 box equivalents per plant per reception was built into the plant design to provide for seasonal fluctuations and future production increases.

Current annual depreciation and interest on 13 cooperative plants is $62,170. To upgrade six of these plants, an additional investment of $58,386 would have to be made.

Table 11 gives estimated costs per 1,000 boxes packed as specified by Scenario II.

The weighted average unit cost of Scenario II is $0.073 per pound.

Scenario II would reduce the present 32 wet pack boxing stations to 18 (Table 12). After the current highway construction has been completed, boxing plants such as Layou Park, Hillsborough, Riversdale and Warner could deliver boxed fruit to either Roseau or Portsmouth. All the selected plants are assumed to have ample water and are located close to the major highways.

3. Scenario III

With this alternative, 10 modernized wet pack boxing plants will be required to handle 38.4 million pounds of packed bananas. These ten plants have a total annual capacity of 39.2 million pounds to rpovide for minor seasonal fluctuations in

TABLE 11. BANANA BOXING PLANTS. SCENARIO II,
COSTS PER 1,000 BOXES, DOMINICA, 1984

ITEM	COST PER 1000 BOXES	
	D.B.G.A.	COOPERATIVES
	(30.47%)	(69.53%)
Cutting and transport to road	$ 310.00	$ 310.00
Handling stems to boxing plant	290.00	290.00
Worker transportation	34.80	40.57
Boxing plant labor	809.93	809.93
Plant cleaning	59,50	59.50
Existing depr., interest & overhead	34.26	44.37
New depreciation & interest	55.02	72.06
Transport to wharf	436.54	550.10
Overhead	6.70	6.70
Total	$2,036.75	$2,183.23

Weighted average $ 2,138.58

Weighted average costs per lb.: $0.0737

TABLE 12. BANANA BOXING PLANTS. SCENARIO II, RECOMMENDED PLANTS AND TOTAL COSTS FOR 12 DBGA PLANTS AND 6 COOPERATIVE PLANTS, DOMINICA, 1984

Geographical Area	COST PER 1000 BOXES: Farm to Boxing Plant	COST PER 1000 BOXES: Boxing and Transport to Wharf	Total Cost[1]	Desiged Capacity as a % of 1983 output
Division 1:	$	$	$	%
Glanvillia	620	931	1,551	555
Blenheim	620	1,133	1,753	428
Dublanc	620	1,188	1,808	858
Division 2:				
Hodges	620	1,340	1,960	362
Division 3:				
Londonderry	620	1,495	2,115	181
Marigot	620	1,577	2,197	154
Hatton Garden	620	1,769	2,389	129
Division 4:				
Castle Bruce	620	1,845	2,465	115
Senecou	620	1,930	2,550	1,283[2]
Division 5:				
Rosalie	620	1,773	2,393	207
La Pleine	620	1,889	2,509	370
Division 6:				
Layou Park	620	1,490	2,110	106
Hillsborough	620	1,288	1,908	149
Riversdale	620	1,664	2,284	503[3]
Warner	620	1,382	2,002	762[4]
Division 7:				
Macoucherie	620	1,354	1,974	209
Geneva	620	1,218	1,838	176
Bagatelle	620	1,416	2,036	2,714[5]

1/ Built-in excess capacity of 7,189 pounds or approximately 248 box equivalents per plant per reception.

2/ Only 22 receptions during 1983

3/ Only 27 receptions during 1983

4/ Only 21 receptions during 1983

5/ Only 23 receptions during 1983

65

production. The remaining 40 percent or 25.6 million pounds will be field packed. Due to the geographic areas that have already started dry pack boxing, present clean water supply, proximity to highways and unit operating costs, the ten wet pack plants selected are: Glanvillia, Blenheim, Hodges, Londonderry, Castle Bruce, Rosalie, Hillsborough, Layou Park, Macoucherie and Geneva. The plants would provide a combined excess capacity of 750,000 pounds or 25,860 boxes. Total new investment in the 10 wet pack plants is $334,240 (Table 13).

Table 14 shows the costs per 1,000 boxes for the 60/40 ratio of wet and dry pack methods. Unit costs are shown to be $0.069 per pound for the 10 wet pack plants and $0.0868 per pound for the 40 percent packed dry. Weighted average cost per pound for both methods combined is $0.076.

4. Scenario IV

If wet pack boxing plants are selected on a basis of efficiency or minimum cost alone, the Dominica 60-40 percentage combination results in a unit cost of $0.076 per pound as shown in Table 14. The average cost of wet pack operations for varying percentages of wet pack output is shown in Table 15.

New expenditures for plant and equipment vary with the percentage of total Dominica production being wet packed. These changes in investment costs and annual fixed charges are shown in Table 16.

TABLE 13. BANANA BOXING PLANTS. SCENARIO III, 60 PERCENT WET PACK AND 40 PERCENT FIELD PACK. INVESTMENT COSTS AND ANNUAL FIXED CHARGES, DOMINICA, 1984

Boxing Plant	New Expenditures	New Depreciation and Interest	Existing Depr. and Interest
Glanvillia	$ 43,540	$ 9,731	$ 2,710
Blenheim	32,300	7,219	3,110
Hodges	32,300	7,219	4,510
Londonderry	32,300	7,219	4,070
Castle Bruce	32,300	7,219	4,970
Rosalie	32,300	7,219	4,790
Hillsborough	32,300	7,219	1,110
Layou Park	32,300	7,219	4,330
Macoucherie	32,300	7,219	2,860
Geneva	32,300	7,219	5,282
Totals	$334,240	$74,702	$37,742

TABLE 14. BANANA BOXING PLANTS. SCENARIO III,
COSTS PER 1,000 BOXES, DOMINICA, 1984

ITEMS	COST PER 1000 BOXES	
	Wet Pack (60%)	Field Pack (40%)
Cutting and transport to road	$ 310.00	See previous
Handling stems to boxing plant	290.00	field pack
Worker transportation	40.00	analysis (Table
Boxing plant labor	809.93	8) for cost
Plant cleaning	48.56	components
Existing depr., interest & overhead	34.26	
New depreciation and interest	55.33	
Transportation to wharf	394.85	
Overhead	6.70	
	$1,989.63	$2,517.20
Cost per lb.:	0.069	0.0868
Weighted average cost per lb:	$0.076	

TABLE 15. BANANA BOXING. TOTAL COST PER POUND OF BOXED BANANAS FOR VARYING PERCENTAGES OF WET AND FIELD PACKED VOLUMES, SCENARIO IV, DOMINICA, 1984

Percent Wet Pack	No. Wet Pack Lbs	No. Field Pack Lbs	No. Plants	Total Cost per Lb: Wet Pack 11/	Total Cost per Lb: Field Pack	Total Cost per Lb: Weighted Average
	-------Millions--------					
10 1/	6.4	57.6	2	$ 0.054	$0.087	$ 0.084
20 2/	12.8	51.2	4	0.058	0.087	0.081
30 3/	19.2	44.8	5	0.059	0.087	0.079
40 4/	25.6	38.4	7	0.061	0.087	0.077
50 5/	32.0	32.0	9	0.064	0.087	0.075
60 6/	38.4	25.6	10	0.063	0.087	0.073
70 7/	44.8	19.2	12	0.066	0.087	0.072
80 8/	51.2	12.8	14	0.068	0.087	0.072
90 9/	57.6	6.4	15	0.070	0.087	0.072
100 10/	64.0	0.0	17	0.072	0.000	0.072

1/ Glanvillia and Canefield

2/ plus Blenheim and Geneva

3/ plus Hillsborough

4/ plus Vieilla Case and Hodges

5/ plus Macoucherie and Constant Springs

6/ plus Layou Park

7/ plus Londonderry and Carholm

8/ plus Marigot and Hatton Gardens

9/ plus Carib Reserve

10/ plus Rosalie and Castle Bruce

11/ includes under utilized capacity

TABLE 16. BANANA BOXING COSTS. SCENARIO IV, INVESTMENT COSTS AND ANNUAL FIXED CHARGES, DOMINICA, 1984

Percent Wet Pack	New Expenditures	New Depreciation and Interest	Existing Depr. and Interest
10	$ 87,080	$ 19,462	$ 7,203
20	151,680	33,900	15,595
30	183,980	41,119	16,705
40	259,820	58,069	24,415
50	324,420	72,507	30,535
60	356,720	79,726	34,865
70	432,560	96,676	45,735
80	497,160	111,114	53,643
90	529,460	118,333	56,733
100	594,060	132,771	66,493

VI. BOXED FRUIT TRANSPORT AND PORT OPERATIONS

A. Field Pack Transport

1. Main Roads

Highways leading from banana producing areas to the ports of Roseau and Portsmouth are in very bad condition. At the present time, it is impossible to haul boxed fruit to terminal ports without serious bruising and friction scarring. All main roads are being upgraded and repaved by governmental assistance programs of the U.S., Canada, and the U.K.[31/] Road improvement alone will result in much higher quality packs for Dominica bananas, irrespective of the method of pack or transport.

2. Rates

Farmers are responsible for arranging transport of their field pack bananas to port. At present, DBGA contributes 3 cents per box mile based on the distance of boxing plants to port. The 3 cents per box mile is now being questioned by private truckers because they have realized that it is time per trip rather than mileage that is relevant. It is doubtful that the "cents per box-mile" concept will be an acceptable criterion in future negotiations. Pickups now charge on a per trip; not on a weight or number of boxes basis. When truckers are paid on a per trip basis, it is essential that full-load shipments be made so as to minimize unit shipping costs. For

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31/ Some funding is provided by a loan from the World Bank.

example, a full truck load costing $X per unit will cost $2X per unit if loaded to only one-half capacity.

Because truckers are currently paid on a box-mile basis, there is no real incentive for drivers to drive carefully in order to avoid bruising the fruit. An incentive based on pre-sampling before haul in combination with the customary quality inspection at dock side should work, but will be costly in terms of time and accounting.

3. The Time Factor

Boxes are picked up and loaded at packing sheds owned by field packers. With less than truck-load amounts at each station, turn around and loading times for truckers can be substantial. A 3-ton Bedford has a "list" capacity of 216 boxes. Table 1 shows that a field pack operation can pack 120 boxes per 8-hour day; many will pack less. This means that the trucker must stop at least two times to fill out his load. Since truckers habitually overload by about 30 percent, more stops--preferably at adjacent sheds--are necessary.

Because the farmer makes his own arrangements for transport of field packed fruit to dock, it is probable that individual truckers may be contracted to serve widely dispersed locations, thereby adding to turn-around and loading times.

4. The Geest Industries Port Facilities and Operations

a. Field and Shed Packed Fruit

Field or shed pack bananas are delivered to Geest Industries receiving docks and are weighed in at the port's

weigh station. The truck then proceeds to a field pack reception bay and the fruit is manually unloaded and stacked aside to pallets. A sample is taken from each grower's lot and inspected for quality by a Geest Industries employee. After each grower's lot is unloaded, the truck returns to the weigh station for re-weighing in order to account for the weight of each lot. The truck has priority over other loaded trucks that are awaiting their turn at the scale. This method of accounting for the individual grower lots is time consuming and completely unacceptable for efficient materials handling.

The consultants, in discussions with Paul Boenders, DBGA Marketing Development Manager, suggest a conveyor/in-line weighing system that would accurately record each lot's weight without the delays caused by reweighing trucks. This simple system involves a 10 foot roller conveyor feeding an in-line scale plus another 10 foot roller conveyor for takeaway of the weighed fruit. The scale could have a cumulative memory device for cumulating box weights for each lot and a master memory for recording the weights of all fruit received. DBGA is now planning to connect a computer terminal to serve the main weigh-in station at the Roseau port. A tie-in with the electronic scale at the field pack bay could also be installed quite easily and at low cost. Otherwise, another worker would be required to table or record weights of each box in a given lot and adding up all boxes to obtain the total lot weight.

At Roseau, individual boxes would be off-loaded to the roller feed conveyor, placed on scale, weight recorded, and moved to the set off conveyor from which the boxes would be palletized and moved by a standard lift truck to temporary storage for later transfer to the wharfside ship-loading area.

At Portsmouth, the same method could be used to record field pack lot weights. After palletizing and removal to temporary storage, each box is moved manually via human chain and repalletized in the lighters for transfer alongside ship. This method could appreciably reduce costs and improve quality because less handling is involved.

B. Wet Pack Transport

1. Existing Method

At the present time boxes are manually loaded onto trucks (usually Bedfords) and hauled to Roseau or Portsmouth depending on their location relative to these ports.

At the port terminal, the trucks queue and are weighed at the port's weigh station. Trucks then move to receiving bays in the Geest Industries long house or receiving shed and are manually off-loaded and palletized. A lift truck then transfers the loaded pallets to temporary storage within the shed to await removal to ship-side. A Geest Industries employee inspects samples of the boxed bananas for quality characteristics. If the lot sampled falls below standard, it may be rejected and returned to the boxing plant for disposal by the farmer who grew it. The DBGA also samples for quality parameters for development of quality control information and as a check on Geest Industries quality and reject reports.

At Portsmouth, the initial procedures are the same as for Roseau, except the boxes are removed from pallets manually and moved by human chain to lighters where workers repalletize them for towing to ship-side.

2. Trucks

Most of the bananas are now transported in 3 or 5 ton Bedford trucks. Many of these trucks are 15 years of age and are literally worn out. The trucks are privately owned and operate via contractual arrangements with DBGA and individual field packers. Although these trucks must soon be replaced, the consultants were unable to estimate the number in use and consequently the private capital outlay required.

It is recommended that a technical AID project be authorized to study the truck replacement problem with respect to: (1) type of vehicle best suited; (2) estimated quantities needed; (3) replacement costs; and, (4) terms of payment. The consultants consider this to be a high priority project.

3. Ship Loading

The consultants observed loading operations at Roseau and Portsmouth. Palletized fruit is transferred from alongside ship by large cranes. The pallets are secured by V-boards about 1 x 6 inches, tied down to secure the boxes during the lifting operation. The crane operator then lifts the pallet to a position over the hold and lowers it to a lift truck for stacking. Because of the ship's conformation, some of the boxes must be stacked unpalletized--particularly along the sides of the hold that are curved and cannot accomodate pallets.

The operation of the cranes left much to be desired and unquestionably resulted in serious bruising of the fruit. The bruising is caused by the crane's operation. After being secured to the cable, the full pallet is lifted slowly for the

first 3-4 feet, and then accelerated suddenly to a high speed, the initial shock amounting to g-factors that can pressure bruise the fruit. During the lift, a number of boxes were dropped into the water. And finally, the pallet was lowered to the deck roughly, and at times boxes were impact damaged during descent. Improved supervision of the crane operator could result in better loading procedures.

In addition, quantities of fresh grapefruit were loaded in holds containing bananas. All citrus fruits exude large quantities of ethylene gas, causing accelerated ripening of bananas. This practice should be avoided in the future in order to reduce ship-ripes on arrival in the U.K.

The consultants recommend that a sub-project be developed, financed by Geest Industries, to investigate: (1) weigh-in and recording efficiency of receiving and inspecting field pack fruit along the lines proposed by the consultants; (2) complete change-over to palletized handling at Roseau and Portsmouth; (3) in-line with (2) above, eliminate the human chain loading of lighters; (4) socio-economic study of the impact of cargo loading, unloading, and other handling procedures.

The consultants are cognizant that adopting cost reducing techniques often results in serious social problems caused by unemployment and the lack of alternative job opportunities. Thus, the socio-economic impacts of improved and efficient procedures should be considered as suggested in the above paragraph.

VII. PRIVATIZATION

A. Background

The DBGA is to be replaced by a statutory corporation by Act of Parliament. The Dominican Banana Company Act failed to pass in October 1982, primarily because of producers' concern over the word "company" which they associate with a history of exploitation. It is anticipated that the legislation will be enacted by May 1984 under a new name (Dominica Banana Corporation) but organized essentially the same way and with the same responsibilities. The corporation's responsibilities involve: (1) the purchase and sale of all export quality bananas produced in Dominica; and, (2) the fostering of other privately owned commercial enterprises with responsibilities for cost effective disease control, boxing operations, production forecasting, and internal transportation and communication.

Another organization tentatively entitled the Dominican Banana Producers Association (DBPA) will act as the producers' representative and be completely independent of the corporation. This division into two separate entities will replace the currently operating Dominica Banana Growers Association (DBGA) that represents both commercial and farmer interests.

B. Discussion

1. Boxing Plants

The major question is, who will invest in the interests of privatizing the industries? An admittedly preliminary review by an advisor to Prime Minister Charles indicates that

enough people are interested and have the aptitude to proceed with divestiture of most of the boxing plants in Dominica. No names were specified, so conclusions as to any rapid privatization of boxing plants must be taken as very provisional.

The operational boxing plants all have plant supervisors and foreladies, thus providing a cadre of trained management for individual plants. If some sort of leasing, rather than purchasing, agreement can be worked out, it is probable that some of the existing management personnel could be interested in taking over several of the plants. Businessmen and local Dominican financiers are of an unknown quantity, but are not necessarily available for leasing or investing in boxing plants.

The advent of field and shed packing analyzed in this report already provides a basis for by-passing boxing plants entirely. If field and shed packing can be supervised adequately to provide good export quality boxed bananas, Dominica will continue to expand these methods to handle 40 or 50 percent of total production.

Another commonly accepted procedure for privatizing agricultural activities is by forming cooperatives. Of the 32 boxing plants now operating (January 1984), 13 are cooperatives. These plants have not been performing well in either dimension of quality or cost. One reason may be because these plants are relatively independent of DBGA and have not received an equivalent amount of training by extension and DBGA specialist personnel.[32/] The poor performance to date does not

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32/ All boxing plants have received less extension and specialist help because of the increasing numbers of field packers (317 in January 1984).

preclude cooperatives from consideration as a practical means of privatizing the Dominican banana industry.

Senior management and specialist personnel are now working in DBGA and could be expected to move easily into the structure of the new corporation. A General Manager, Marketing Development Manager, Financial Manager, and Operations Manager are already on site.

2. Disease Control

The consultants believe that leaf spot and other disease control should be left under the supervision of the proposed commercial corporation. Monitoring for disease as well as scheduling spraying cycles and the like must be centrally controlled because of the specialized personnel required and large capital outlays for equipment.

3. Other Production and Marketing Inputs

These activities are best handled by a central organization to insure proper advice, some degree of control over applications, and to provide a better system of inventory control.

The separation of the functions of DBGA as presently organized will meet some farmer opposition. This was made fairly evident by the failure of Parliament to pass an Act in October 1982, or in 1983. Farmers interviewed by the consultants on this project seemed to oppose formation of the new corporation--some quite vehemently. Most of the opposition

involved the fear that grower interests would suffer by the re-structured industry.

The DBGA management has profited greatly by the leadership and ideas generated by the BDD management team.

C. Recommendations

1. Develop a fall-back strategy in the event Parliament does not pass the banana industry restructuring act. This could include sharpening up the Board of Directors of DBGA by encouraging more active participation of the business and finance members and by appointing DBGA executives, including BDD managers, to the Board.

2. Provide strong basis for improving cooperative boxing plants performances by passing legislation tying them in more closely to assistance by Extension and the proposed corporation's specialist personnel.

3. Do not encourage field packing for production below 30 tons per annum per grower or grower groups. Otherwise, supervision and follow-up will become too cumbersome and quality will decline. Enforce quality maintenance by stiff penalties, e.g. dropping a membership and premium eligibility for non-conformance.

4. Provide premium for quality packers that send their fruit through central boxing plants as well as for field packers.

5. Plan to retain the existing BDD management for the next 3-4 years if possible.

6. Aid DBGA in paying off present loans. Because of large outstanding loans, DBGA is helpless to make needed capital outlays for improvements. If the new statutory corporation is formed, do not saddle it with DBGA's debt burden. Otherwise, it too will be shackled and helpless to make essential capital outlays necessary to make cost effective improvements.

VIII. AID ASSISTANCE PROJECTS

A. Areas of Assistance

The areas of assistance can cover most, if not all, of the activities in producing, assembly, field and central packing, transport to port, and port FOB marketing. The highest priority should be given to all marketing activities and procedures used by Geest Industries and WINBAN.

1. Stem Fruit Grading and Purchasing

The purchasing of accepted hands of bananas causes additional handling, a lack of uniformity from one packing area to another, and a significant delay in the product flow through the plant. A study should be made to determine a method of paying growers on an accepted stem basis. The full stem could pass through an in-line scale installed on the cable way adjacent to the dehanding station. Samples throughout the 20 different districts in Dominica could be made to determine the weight of rejected hands, clusters, and fingers. Stems could be quality graded at the dehanding area into a premium and standard grade and the grower paid accordingly.

The research involved is complicated. A way must be found to assure the grower that he is receiving full and merited pay for his lot so as to eliminate the necessity for him to wait several hours to get confirmed acceptance of dehanded bananas. The discarded bananas at the dehanding station would become the property of the boxing station and allow the

company to investigate uses for hog feed or starch manufacture. Specialist personnel, supported by the newly formed statutory corporation (or DBGA) and Extension would required:

1 Grade & Quality Specialist	40 person days
1 Industrial Engineer or Efficiency Expert	30 person days
1 Livestock Nutritionist	30 person days
Total	100 person days

2. The Banana Box Syndrome

The 30 pound capacity fiberboard carton now in use is unacceptable. Large hands will not fit into the carton without pressure and abrasion damage--particularly with the limited amount of clustering now allowed (greater than or equal to 5 fingers). Twenty-eight staples are required for assembly and, along with sharp edges, cause abrasion damage in transit. The box is smaller than competitor's which means that (1) more board feet are required to box a given total volume; (2) the additional board means more insulation and thus allows the generation and retention of more heat; and, (3) the smaller surface area results in voids at all storage points, i.e., truck loads, holds of ships, and temporary storage points and the like. Research on a new, larger box should be completed. A good starting point would be ascertaining whether or not the standard 42 pound carton now used for dollar area fruit from Central and South America would be better suited for Dominican (Windward Island) fruit. The consultants were informed that Geest Industries, Ltd. has developed a demand for the present 30 pound carton. However, dollar fruit off-loaded by Elders & Fyffe is in a standard 42 pound carton. The claim that a rigid, inflexible market for the small carton is unacceptable.

The consultants believe that the research could easily be handled by one objective Fruit Handling Specialist with local supporting personnel, e.g. WINBAN. The project should be financed by the British government, not USAID. The expatriate specialist would need 50-60 person days to perform tests for several receptions in producing areas and make quality evaluations at the off-loading port in the U.K.

3. Quality Inspection in the U.K.

One or more specialists in quality grading should be sent to England to sample boxed fruit arrival conditions. Spalding reports currently used by Geest Industries are not designed to inform the shipper (DBGA) as to what type and at what point injuries are being recorded--inland handling, container design or water shipments.

Preferably, the first samples quality tested at the point of origin should be followed and retested at the port of destination. This procedure would identify the types of injuries and the points at which the injuries actually occurred. This procedure could identify where the injuries occured and, and the same time, identify who must pay for fruit rejected at the U.K. destination.

It is recommended that a team of two outside Fruit Handling (bananas) Specialists be employed for at least 4 receptions and U.K. off-loadings.

2 Banana Handling Specialists	50 days each

4. Marketing

Increasing marketing efficiency from the port reception at Roseau and Portsmouth on through ship-loading and ocean shipping to the retail market is the first priority. The marketing activities, reported costs, billing procedures, discounts, premiums, and the like should be studied by an independent consulting agency.

At present, marketing activities beyond Dominica represent a very large percent of the total production and marketing bill (variously estimated as amounting to 70 percent). Most of the 'fat' or inefficiencies of the Dominica end of the equation have been remedied or can be remedied if funds for modernizing methods suggested by the consultants can be obtained.

1 Materials Handling Specialist-Ports	2 person months
1 Marine Transportation Specialist	4 person months
1 Accounting Specialist	6 person months
1 Marine Economist	6 person months
1 Agricultural Economist	6 person months

It is desirable that the specialists have some experience with bananas, but this is not a critical factor in their selection.

5. Transportation

Most of the 3 and 5 ton Bedford trucks must be replaced shortly. Pickup trucks, often used for field pack and local stem assembly, are not ideally suited because of small capacities and corresponding high unit transport costs. Roads are

now being upgraded and redressed by U.S., Canadian, and British companies.

An assistance project for Dominica to aid in selecting correct and efficient vehicles for in-district assembly and transfer to port should be undertaken. A Banana Handling and Transportation Specialist should be employed to assist the new corporation or DBGA in persuading the private trucking sector to purchase types of vehicles and accept procedures suitable for Dominica.

1 Fruit Handling & Transportation Specialist 60 person days

6. Crown Pads

Crown pads attached to dehanded crowns often detach and fall off during handling and transit. A large part of the problem is due to latex flow pressure for hands that have not been allowed sufficient drain-time for latex. Some of the problem is the pad itself. The DBGA should contact the manufacturer of the pads and attempt to devise some inexpensive type of pad hold down that is not time-consuming or injurious to the fruit.

7. Geest Reception Sheds

a. Existing Methods

The whole layout and operational aspects of the Geest Industries reception terminals should be studied by material handling specialists. One serious shortcoming is the current handling of field packed fruit discussed elsewhere.

Another is the feasibility of increasing lift truck assistance and moving to palletized loads. The human chain and lightering procedures at Portsmouth should be changed. Some means of enforcing crane operator discipline is needed at both ports.

2 Material Handling Specialists for a total of 25 days

b. Containerization

Although Geest has no container ships, there should be some study of containerization as it would impact on banana handling. The French are already using container ships for their overseas territories (e.g. Guadalupe and Martinique) and might cooperate with Dominican banana industry representatives in such a study. The consultants know that substantial handling and shipping savings could be effected by containerization. This would require a Marine Materials Handling Specialist for approximately 30 person days.

8. Production

Production assistance lies in areas of proper soil analyses to determine fertilization requirements and cycles. Because Dominica is mountainous, with bananas growing on steep (less than or equal to 30°) slopes, a problem of drain-off of nutrients arises that would eventually contaminate streams and rivers. Continuing follow-up assistance for disease monitoring and control is also recommended, as well as continuous monitoring for soil infestations such as nematodes, root borer, etc. A Plant Pathologist and Banana Agronomist would be required for assisting Dominica for a week each during each year - at least over the next 4 years. These outside consultants would also work very closely with WINBAN specialists.

IX. SIGATOKA DISEASE MANAGEMENT IN DOMINICA - TODAY'S STATUS AND RECOMMENDATIONS[33/]

Export banana farms of Latin America are large (200-1,000 acre size), and are planted only on flat valley terrain composed of alluvial soils. Dominica is the complete opposite, small farms (1-20 acre size) with 90 percent of them planted on the slopes (30 degrees or less) of the mountain valleys which represent the typical topography of this island. There is little flat valley land available for agricultural use. To say the least, the Dominicans have done a unique agricultural job via their utilization of this arable, but rugged-slope terrain.

Unfortunately, banana leaf spot lives hand-in-glove with this unique banana cultural system. This disease represents Dominica's most important and costly crop protection item. For this region, the disease is termed yellow Sigatoka (*Mycosphaerella musicola*), and is controlled by applications of spray oil/fungicides. The theme of this section deals directly with the overall "at site" analysis of Sigatoka disease management under Dominica conditions.

A. The Target - Fungus Pathogen Relationship

1. The Target

Banana leaves develop internally and emerge at approximately 7-10 day intervals only from the top of the plant (See

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33/ Prepared by Robert H. Fulton, Tropical Crops Consultant, Experience, Incorporated, Washington, D.C.

Appendix B). The pseudostem (trunk) is formed from the constricted petioles (sheaths) of these leaves. Prior to flowering, the individual plant may produce 30 or more leaves. At the time of flowering (i.e. shooting), from the top of the pseudostem, the plant has an average of 12-15 intact leaves. From this moment on, this now fruiting plant will not produce any more viable leaves.

The young plants initiate new leaves singly, which arise as straight, coiled cylinders from the centers of the next youngest leaves. Within a few days, these new leaves are completely unfurled. The degree orientation of each new leaf formed (15-60 degrees) is such that within time a complete circular canopy of leaves is evident and repeats itself. These whorls of upright (youngest) to horizontal or less (older) leaves interlace with other banana plants to form the typical canopy of varying density (i.e. plant populations).

As based on the foregoing leaf development, then termination at flowering, it is obvious that the control goal is to keep these leaves healthy for their photosynthate activity to bring the fruit to export maturity 90 to 110 days later, approximately.

2. The Fungal Pathogen

The field biology, etiology and aerodynamics of this fungus are somewhat complex. Briefly, the pathogen passes its entire life cycle on and inside the leaf tissues. It produces both asexual (conidia) on the leaf surfaces for splash dispersal and sexual (ascospores) borne inside perithecium (embedded in the leaf tissues) for airborne dissemination. It is the latter, the airborne ascospores, that are the major infective

spores. It is their mass numbers, moving as spore clouds (waves) impacting on the upright leaves, that mandates fungicide dosages and frequency of applications.

All leaves on fruited plants are equally susceptible; but it is their angle presentation to these waves of ascospores that determines the quantity, locations of impaction, and numbers of leaf infections.

The day-to-day seasonal production/dissemination/infection by the Sigatoka pathogen are keyed to the weather parameters of rainfall, dew and temperatures.

3. Rain Influence

Conidia (sporulate more on upper leaf surface)

- Tri-dimensional splash dispersal to other leaves within the canopy profile.
- Water film is required for germination.

4. Ascospores

- An increase in perithecium production 18 days (approximately) after 2-4 days of consecutive light rains.
- Film of water on leaves for moving/mixing spermatia to enhance fertilization for ascospore production.

- Water soaking of perithecium bearing leaf tissues is required for ascospore discharges (i.e., each perithecia consists of 100-120 sacs of 8 spores, each which blast-off in order, through a pore in the cap of the perithecium).

- A water film for ascospore germination is required, tube development and subsequent leaf stomata penetration.

5. Dew Influence

Similar to rain, for both spore types, but further enhances/complements the overall infection cycle of conidial sporulation, ascospore discharge. This all especially so during the nocturnal formation hours.

6. Temperature Influence

This field parameter is a rather major key in field etiology.

- Temperatures of 21°C, or less, result in a definite slow-down of fungal activity (i.e., production, growth *et al.*), even though rains occur.

- Increases of field temperatures from 26°C and above likewise increases fungal activity and spot development.

7. The Relationship

Bananas cannot be produced commercially without Sigatoka control.

- o Medium to severe infection grades result in unfilled fingers, lighter grade hands, premature ripening in the field or in transit.

- o Fruit produced in high infection grade zones (i.e., hot spots) are physiologically 1-2 weeks older than fruit from good control areas (i.e., they are termed stale fruit or sinkers).

- o Plants are more subject to stress, earlier leaf fall (doubling) and secondary foliar diseases.

- o In finality, the name of the game is good, sound transportable fruit.

B. Control Status Today in Dominica

The control status in Dominica today is very good. The operational field personnel involved (Managers, DCO's, Extension supervisors, lancemen, maintenance *et al.*) receive our best compliments. The foregoing is based on consideration of the entire set of factors--terrain, rainfall, wind, no flagging, varieties, plant densities, intercropping, high trees, equipment classes, and staff handling of the demands of high disease pressure periods. Good Sigatoka control is accumulative and a team effort.

As cited, there exists a multiple of attendant factors that influence final control. Interwoven into this fabric, at every step, is the continued operational need for fine tuning to yield cost savings. The mechanism of our approach reviews and covers the five major units, namely, climatic zones, disease monitoring, cultural aspects, application of equipment, and chemical tools, with recommendations and/or project suggestions.

1. Climatic Zones

Dominica has the highest rainfall of the Windward Island group and correspondingly more sprays per year. The island banana culture is divided into 4 zones as based on rainfall which in turn influences the positioning of the spray teams and overall logistic support.

Rainfall Intensity (annual inches)	Spray Cycles (no./year)
50 - 100	9 - 12
100 - 150	12 - 16
150 - 200	16 +
+ 200	

It is obvious that one key to spray cycle forecasting and response time for intercycles is that of local zone weather data. This will give a better handle on the frequency, intensity, and rain accumulation coupled with temperature and evaluation criteria.

Interestingly, to date, continued and actual tie-in via graphing of weather versus disease pressure versus spray programs on a commercial basis in the industry is still not a com-

mon practice. Such information, now and over time, will depict and verify the efficacy of spray programs as influenced by the zonal weather divisions, and serve as a tool for cutting spray cycles.

2. Recommendations

- o Aerial photographs to develop zonal maps of farm groups to assist pilot(s) and staff with daily orientations. Also, for future deployment of mini-weather stations to include hot spot zones of high disease.

- o Installation of mini-weather stations within the residential confines of each D.C. Officer; a total of seven.
  - Maximum:Minimum Thermometer
  - Plastic or metal tube rain gauge using embossed lines or a calibrated wood stick for daily measurement
  - Evaporimeter (WINBAN design)

- o This mini-station to be the responsibility of each DCO as to daily recordings, graph compilation with minimum maintenance, surveillance, and capital outlay.

- o Reporting of data to be done each week for central tabulation - graphing (Roseau) and within the local divisional zones as well. This is a good form of training for the DCO et al. to develop and know the characteristic weather/disease profiles of the area.

- Graph paper types commonly used in the industry are obtained from CODEX BOOK CO., Norwood, Massachusetts.

3. Disease Monitoring

The keystone of knowing when, where and effect of spraying lies in the field disease monitoring or assessment survey system. The DBGA Extension staff employs the well recognized and useful method of Stover and Dickson. Essentially the extension personnel, trained in Sigatoka symptoms, assess pre-determined farm reference areas every fortnight and record the YLS (youngest leaf spotted) on 50 or more tall, non-flowering plants within the fixed reference area.

Dominica has 117 such reference points which were selected not only as representative of a local zone but to include "hot spots" (i.e., known high-disease pressure points due to soil drainage and micro-climatic conditions). Monitoring is particularly important for opening (less) cycles or closing (intercycle) spray applications. For example, the DBGA employs the following YLS guideline for spray cycle timing:

Average YLS	Spray Cycle (days)
Less 8	14
8 - 10	21
More 10	28

The YLS readings verify the disease intensity, but do not inform us as to the local inoculum pressure. Simply, is the place clean or are the leaves positioned below the YLS

reading loaded. We solve this by adding the parameter of "total number of leaves per plant". If the total number of leaves recorded is the actual YLS, the reference point is clean. If not, investigate, for a potential disease blow-up could be pending, ground spray assistance is needed or cultural practices are lagging.

4. Recommendations

- Record the total number of leaves per plant checked for YLS (youngest leaf spot).

- If all leaves on a given plant are clean, record the YLS for that plant as the overall average number of leaves in that reference point. Do not record as zero; that is cosmetic.

- If, as you graph, the total number of leaves takes a decided decline as from 11 to 9, for example, then you know the farmer is excessively pruning off leaves on the non-fruited plants. This is highly dangerous, since the plants you check for YLS are just ready to flower, and the grower is unnecessarily cutting off phosynthate leaves required to bring his fruit to maturity. In twin, with these graphs you can clearly demonstrate to the grower and/or farm groups the fallacy of excessive leaf pruning.

- Record YLS/total number of leaves separately from "hot spot" areas. Do not place this data into the general overages, as the results YLS etc. will be diluted and you will not know the real disease pressure conditions. Generally, "hot spots" will trigger off 4-6 weeks in advance of the other zones.

C. Cultural Aspects

The following practices relate to the overall Sigatoka control program and the points cited are recommendations for consideration.

1. Leaf Pruning

Normal detrashing of the pseudostem (i.e., doubled dry leaves) is suggested. For both plant types (± fruit), Sigatoka leaf tip infection can be also pruned off (only the leaf tip area). Since the leaf tip will fall bottom side-up, the upper leaf surface has the higher percentage of perithecia.

Excessive leaf pruning, which opens the canopy structure, is directly responsible for poor leaf coverage by aircraft. Why? Solar radiation heats up the exposed soil areas. Then during the nocturnal and early A.M. hours, heat exchange or release occurs via upward air currents. These disrupt the spray droplet pattern (early A.M. application) descending into the banana canopy.

2. Intercropping

Intercropping is a necessary style of agriculture for overall economics and nutrition on the island. In the upper canopy structure are coconut, citrus and cocoa; while in the lower canopy are Dasheen and Taro. The crops in the upper canopy trap about 20 percent of the aerially applied products (i.e., also include forest trees, bamboo and upward air currents at slope peaks). The lower canopy crops also receive some aerial spray as well as a portion of the spray from ground applied equipment.

Note: In Dominica, approximately 10,000 acres of bananas in production cover an area of 13,000 acres. All of the chemical control products used today and into the foreseeable future are not detrimental to the cited other crops. In fact, they are beneficial, are used for disease control, and are registered for such crops in other world areas.

3. Fertilization

In the world banana industry, fertilizers as N_2, zinc, and NPK complete are applied via aircraft or over-head irrigation. Banana leaves do take up fertilizer. Depending on the island zone and the intercrop, we calculate again that around 15-20 percent of the fertilizer will go on non-target crops.

Soil application of fertilizer is a real practical problem because of the steep slopes and high rainfall conditions. Also, a banana plant in fruit acts like a giant funnel, as the last 6 leaves developed prior to flowering are erect in

a conical-funnel shape. This easily traps rain droplets, which then flow down the pseudostem and flood over the soil surface next to the banana mat. Granules of fertilizer or nematicides can be, and no doubt are, transported down the slopes of this water flow.

Note: We would suggest the evaluation of fertilizer spikes (i.e. JOBE Company) which are pushed into the ground. The action of soil moisture slowly releases the nutrients with minimal soil surface run-off.

4. Sleeving of the Fruit

This practice is not recommended for Dominica fruit because the costs of sleeving are much higher than its benefit at the present time. In Dominica, fungal diseases of the banana peel are nil. Flower thrips infestations occur as the flower bud is just emerging from the crown of the plant. Thus, sleeving of the fruit bunch 15 to 18 days later will have little consequence on flower thrips control. Rust thrips (*Chaetanophothrips sp.*) infestations occur just as the bunch emerges in the throat of the plant. Again, sleeving will have not real effect on control. In the Philippines, the pyrethroid DECIS is injected into the flower bud just as it emerges. Fingers are damaged during this hypodermic injection, but in this case the risks outweigh the costs and must be done for effective control.

Fruit peel diseases were not cited by DBGA as problems. Where these diseases occur, polyethylene bags are predusted with MANCOZEB Wettable Powder (2 grams per bag) before sleeving. This fungicide decomposes to CS_2 vapor which kills the fungal pathogens on the peel, namely Johnston Fruit

spot, Pyricularia, Grisea, Brown spot, Diamond spot, Fusarium roseum and Cercospora hayi. This is done in Central America only in certain times of the year and in certain banana divisions.

In Central America, flower thrips and scab beetle are controlled by treating sleeves with MANCOZEB wettable powder at season where problem exists. The MANCOZEB WP is dusted on inside walls of the sleeve. DURSBAN (Dow Chemical Co.) is incorporated into the bag during extrusion. DURSBAN is released as a vapor (like dog flea collars) for flower thrips and scab beetles. DECIS is used for control of rust thrips, as mentioned above.

In Latin America, sleeving is a common practice: (1) to prevent leaf scarring damage; (2) to prevent sun scorch of fruit along the roadways and large drains; (3) for marketing--to know how much fruit is bagged per week to determine fruit availability 10-13 weeks hence; and, (4) to allegedly bring the fruit to export grade up to seven days earlier. Please note that in Latin America the lower "false" hands are broken off before sleeving. All "false" hands are broken except one finger at the small apical hand. This prevents stalk (peduncle) rot by maintaining the physiological flow of nutrients to this zone and assists in balancing the fill-out fingers in the apical area of the bunch.

D. Application Equipment - Support

In Dominica, the control of yellow Sigatoka is successfully achieved by employing both ground equipment application (i.e.,

motor-blows) and aerial spraying (i.e., Turbo Thrust). Both techniques are compatible and required as they support each other in the control scheme on rugged terrain.

1. Logistic Support Vehicles

a. Discussion

Forty (40) percent of the banana farm terrain requires 4-wheel drive vehicles to transport (a) extension disease monitoring staff, and (b) the motor-blow ground support application teams. Ironically, these vehicles are a must, during the high rainfall-disease pressure periods of June to December.

There are seven (7) Banana Divisions on the island and each Division has the same problem of the rock-mud farm roads during the Sigatoka season.

b. Recommendations

- Obtain ten (10) 4-wheel drive vehicles,
- For maintenance support, it will be necessary to outfit a repair center, i.e., drill press, lathe, extractors, threaders and attendant hand tools and car lift.

2. The Aircraft

a. Discussion

The Turbo Thrust owned by DBGA is one of the best aircraft used for Sigatoka control in the banana industry. It is economical, can carry a large pay-load (400-500 U.S. gallons), is fast for less ferry-application time, and today's mechanics are more knowledgeable of turbines (airline industry). The aircraft is stationed at Melville Hall in the open, several 100 meters from the Atlantic ocean surf/salt air.

b. Recommendations

- Construction of a hangar for overall protection, not only from the elements but man/animal as well. It is a $40,000 investment plus 6 micronaires units used for application.

3. Resident Pilot

a. Discussion

All aerial sprays are done by pilots from other country areas. They usually come in for 4 days at a cost of EC$ 8,000. The situation is such that they do not become thoroughly familiar with farm areas and terrain. The presence of a "resident pilot" would assure better cycle timing, intercycles, use for potential foliar fertilizer applications, and for loan to other Windward Island Sigatoka spray needs if a crisis arose. Then too, as cited, the DBGA-D.C. Officers could

plan via maps, at site observations with the pilot, better approaches and actual numbers of swaths required per farm zone area.

b. Recommendations

- o Employ a resident pilot.
- o Via maps and at site work, with the pilot both on the ground and during application, observation to determine swath numbers, approaches and guides for application. This for overall coverage improvement since no flagging is done and/or possible to perform.

4. Hi-Speed Spray Tank Blender

a. Discussion

The present spray tank at Melville Hall fits today's needs of only pure oil cycles or spray oil plus SIGMA oil concentrate (Thiophanate systemic). The objective is to improve formulations, control and costs; th the need for a Hi-Speed Blender.

About 35 percent of all Central America banana areas use this mixing tool to incorporate/suspend wettable powders (WP's) into the standard SPRAYTEX banana spray oil (i.e., MANCOZEB, BENOMYL). Because of its speed and tool disc grinding action, we note stable suspensions for 2 days. (See section on chemical control tools for biological activity).

b. Recommendations

- To construct a 250 gallon blender for use at Melville Hall. This entails a tank, a 4-7 HP motor, shaft, 2 circular discs with teeth edges.

- For small-scale use by motor blows, a blender would be a Jiffy mixer unit (California) driven by a 3/4 HP drill. This for use in 50 gallon drums.

5. Motor-Blow Ground Support

a. Discussion

The motor-blow or back-pack mist sprayer is the ideal tool for Sigatoka control support on 50 percent of the farm areas. It is also used to strengthen control in "hot spots" and borders - edges on aerially applied farms.

Two brands are used, namely the SOLO (German) and the HARDIE (Norwegian). Because these misters are in constant use by 5 men each of 10 teams (50 misters plus 20 spares, approximately), there is indeed rigorous need for maintenance and parts. The repair shop in Roseau for these rigs, as well as the vehicles, leaves a lot to be desired.

In the world market there are several other misters. Two come to mind as possible alternatives for field evaluation, namely, JACTO (Brazil) and HUDSON (USA).

b. Recommendations

- To develop a competent repair center with tools, extractor and threader for mister maintenance.

- To develop an inventory supply and/or local manufacturing of commonly needed parts.

- To evaluate at site with one or two of the teams the cited mister models JACTO and HUDSON. The field comparison to include throw (distance of droplet movement) ease of handling and complexity of repair.

- To train at least two individuals in mister repair and maintenance. This will be of further value in keeping spray cycles on schedule and of course infrastructure occupational training.

E. Chemical Tools for Control

We are now at the last phase and the pinnacle of the Dominica-DBGA control program. The foundation structures attendant to this control have been thoroughly covered (i.e., monitoring, weather, etc.) The specifics that follow, per chemical tool, are all supported by experimental and developmental research in Central America utilizing spray settling towers, rain weathering machines, fungal dosage - responses on leaf tissues *et al*.

1. TEXACO SPRAYTEX CT (Banana Spray Oil)

This is the cornerstone of the program and the most employed produce. This oil is specifically designed/distilled for use on banana against Sigatoka. The major control portion of the oil lies in a narrow distillation range (640°-690°). Our recent analysis showed over 90 percent in that range. Simply, those fractions below 640° do not control, whereas those above 690° control but do exhibit toxicity. Those between 640° to 690° are ideal in control.

Spray oils, either TEXACO or other brands are used throughout the world banana industry, either applied pure or in integrated spray schedules. Some of the spray oil attributes follow as used pure, hi-speed blends and in emulsions.

2. Physicial

- Ideal for low volume as is a non-evaporant and produces uniform droplet sizes.

- Spreads and sticks on the non-polar waxy leaf surfaces.

- Moves into the leaf; a must with systemic fungicides for foliar penetration.

- Changes the leaf surface tension causing dew-rain to rapidly run off. Thus carrying conidia and spermatia off the leaf (reducing inoculum potential as well as covering the sexual sperm count of the fungal pathogen).

3. Biological

- Reduces (up to 35 percent) ascospore germination and germ tube development.

- Delays lesion development (streaks to spots) for periods of 7 to 9 weeks as dependent on dosage/ frequency.

- Reduces appresorial development by 30 percent.

- Reduces perethecia formation 40 percent in mass infected leaf areas.

4. As Used by DBGA

- Dry months are February through May, and use rate of pure oil would be 1.1 - 1.3 Imperial gallon/acre at 4 to 6 week cycles.

- Wet season of June through to part of January; a use rate of 1.3 - 1.6 Imperial gallon/acre as dependent on disease pressure at 14 to 21 day cycles.

- Ten (10) cycles are planned as the basic for 1984, all employing spray oil. This is correct and recommended. Please note that 1.3 Imperial gallons equates to 15 litres/hectare, but subtract 20 percent for non-target crops and we have 12 litres/ hectare. This is not in excess when considering the frequency and disease pressures encountered.

- The ground spray support cycles are unique in that they are used in the worst terrain, hot spots, and importantly, the product - spray oil - is applied for the most part directly onto the lower leaf surface of the banana. This is the surface that has 90 percent of the stomas, the door through which Sigatoka penetrates the leaf. Thus we are further nailing the enemy right in the infection court.

- A point for the novice: even though most infections occur on the lower leaf surface, the spray coverage herein is excellent in low volume sprays. Why? Spray droplets impact on the banana leaf aerodynamically the same way the airborne ascospores do. Both banana leaf surfaces are exposed to chemical sprays from the candela position until in leaf 6 position. From leaf 7 on down, they are into the canopy profile. Obviously, the most susceptible leaves are the youngest due to their erect orientation receiving the brunt of ascospore impaction in the nocturnal hours and aerial/ground support sprays in the morning.

F. Today's Disadvantages - A Solution

Besides all of the advantages of spray oil, we know that it needed more activity as a protectant (stop spore germinations) and direct anti-sporulant of conidia. In the 1960's - 1980's, pure oil, hi-speed blend with MANCOZEB WP protectant fungicide was used throughout Panama and part of Costa Rica. Its use is spreading today, because of low volume cost dynamics and via

motor-blow with the Plantain growers. Dr. Fulton's lab studies 1981-83 verified the control we noted in the field:

Formulations Applied	Tenacity 1" Rain	Black Sigatoka Ascospore Kill
MANCOZEB WP (water)	5%	7%
MANCOZEB WP (oil-in-water emulsion)	20%	52%
MANCOZEB WP (pure oil hi-speed)	55%	93%

MANCOZEB WP, besides acting in the protectant capacity to improve the spray oil efficiency, will also serve (1) as a safener; (2) to deliver the minor elements manganese/zinc; and, (3) to retard potential fungal tolerance to the systemic fungicides employed.

G. Systemic Fungicides

BENLATE OD (Benomyl - DuPont) and SIGMA (methyl-throphanate - May & Baker, British) have been used at varied frequencies (6-8 times per year) in the Windward Islands since 1975. Their role, as good control agents of Sigatoka, continues since tolerance by the fungus has not yet occurred. It was the DBGA plan for 1984 to alternate BENLATE OD (wettable powder form) with CALIXIN (Tridemorph - BASF) to further reduce the potential hazard of fungal tolerance. In the industry, a systemic is blended (tank-mix) with a protectant to reduce the tolerance consequence.

WINBAN has monitored for tolerance in the Windward Islands (leaf collection-ascospore discharge - laboratory procedure), but the facilities at WINBAN (staff/space/equipment) are not conducive to monthly surveys. Hopefully, they could monitor twice a year.

Today in Central America, CALIXIN EC used at a dosage range of 0.5 - 0.6 litres per hectare in spray oil and tank-mixed with MANCOZEB WP is the standard practice. This systemic is of the sterol class, and to date no tolerance problems have been reported. The product does cause leaf yellowing, in the mid-rib area as dependent on solar radiation intensity.

It is obvious that monitoring for BENLATE tolerance on a quarterly basis (minimum; especially in the Carholme, Layou, Castle Bruce and sections of the Wesley districts wherein more cycles of the systemic fungicide have been applied) is a must if the DBGA continues with this systemic.

H. Protectant Fungicides

The use of MANCOZEB WP (manufactured as DITHANE M-45, ROHM & HAAS CO., Philadelphia, or MANZATE 200, DuPont, Wilmington, Delaware) is the standard protectant employed in the integrated pure oil or oil emulsion spray schedules in Latin America and the Philippines.

The field dosage rates vary with the formulation and of course, local disease pressure.

Formulation Mixes - Hi-Speed	Dosages Acre	Hectare
1) Cocktail		
CALIXIN or	0.2 - 0.25 lt	0.5 - 0.6 lt
BENLATE OD	115 gm	280 gm
MANCOZEB WP	400 - 700 gms	1.0 - 1.75 kg
Spray oil	2.5 - 4.8 lt	10 - 12 lt
2) Hi-Speed		
MANCOZEB WP	500 - 800 gms	1.25 - 2.0 kg
Spray oil	2.5 - 4.8 lt	10 - 12 lt

NOTE: 0.2 or 0.5 lts, for example, means 200 or 500 mls. Likewise, 0.5 or 0.8 lts means 500 or 800 mls.

Spray oil emulsions are still employed at 23 to 80 litres/hectare (2.5 - 3.0 gpa U.S.). However, this is not low volume and problems of water evaporation from the formulation mix curtails spraying periods per day.

I. Chemical Recommendations Overall

If we assume the Hi-Speed Blendor is contructed:

- To employ the oil plus MANCOZEB only in the worst area (Carholme) as this will quickly identify that we can cut spray cycles in this large hot spot region.

- To alternate the oil plus MANCOZEB with the oil plus systemic cycles during the critical high disease pressure periods.

- To arrange a tour for the key Windward Island field Sigatoka managers and the WINBAN Sigatoka director to visit Central America (i.e., Costa Rica). This to observe at site the varied mixing tanks, blendors, systems of graphing, et al. leading to Sigatoka control. Today's WINBAN Sigatoka director is Dr. J.S. Lawrence, who is fluent in Spanish, and thus a plus for such a tour project.

J. SUMMATION

1. Sigatoka Disease Management

- Control status today is very good and this after coming out of the hi-pressure periods of October to December.

- Fine tuning of the five major areas is reviewed not only as concerns today's yellow Sigatoka, but as further preparation for black Sigatoka now rampant in Central America and Colombia.

2. Weather Influence

- Installation of mini-weather stations in the seven (7) divisions; maximum-minimum temperature, rainfall and evaporimeters.

- Weekly graphing of same to cross overlay with the spray cycles and disease assessment data.

3. Disease Monitoring

- To further record total number of leaves per plant as well as the standard YLS. This is the key for early warning on local disease - inoculum pressure. Also to inform if excessive leaf pruning is occurring on non-flowered plants.

4. Cultural Aspects

- Only detrash and cut leaf tip infection off the plants.

- Intercropping traps 20 percent of the Sigatoka sprays, but this is beneficial to such crops for general pest control.

- Evaluate foliar fertilizer appli[illegible] herein feasible via aircraft as this is a [illegible] used in the industry.

- Comparatively evaluate fertilizer spikes (JOBE) versus granular fertilizer on the steep slopes.

- Sleeving of the fruit is not recommended because of cost, no peel diseases, flower thrips infest the flower bud just as it emerges from the crown of the plant and leaf scarring can be nullified via leaf fold-back. The risk-benefit is in favor of non-sleeving.

5. Application Equipment and Support

- Immediate need for a minimum of ten (10) four-wheel drive vehicles to transport disease assessors and motor-blow teams into 40 percent of the almost inaccessible farms.

- Outfit a car and motor-blow repair and maintenance center (i.e., extractors, threaders, drill press, lathe *et al.*)

- A modest hangar for a EC$40,000 investment (plant & micronaires) to protect the aircraft from salt air/ man/animals.

- Need for a resident pilot to better time cycles, intercycles, fertilizer applications and basic knowledge of the area - we don't flag.

- A psychological scheme to convince farmers to allow cutting of tall, solitary, large trees which are interfering with spray coverage and could eliminate the only costly aircraft plus pilot.

- Construct a Hi-Speed Blender for *low volume* introduction of wettable powder protectants in pure oil as a cost savings measure as concerns control and less cycles.

6. Chemical Tools for Control

- To evaluate pure oil plus MANCOZEB WP in the most severe Sigatoka region of Carholme as the mechanism to cut spray cycles.

- To arrange a tour of key Sigatoka personnel (Windward Islands and WINBAN) to visit Central America (i.e., Costa Rica) to see at first-hand mixing tanks, blenders, the systems of graphing data *et al*. This can easily save months in initial training time.

APPENDIX A

Latex Flow Studies[1]

One of the major quality aspects of delivering boxed bananas to the United Kingdom concerns latex staining on ripened fruit. This staining reduces fruit market acceptability by discoloring the banana peeling.

Latex flow studies had been conducted in Honduras, Costa Rica and the Republic of Panama by one of the Consultants. These studies, on both Gros Michel and Valery bananas, consisted of 1,073 hands of fruit. The Valery sample size was 507 hands of bananas. Differences were found in the latex flow rates for Gros Michel and Valery bananas. However, no statistical difference (analysis of variance) was found between countries for the same variety of fruit at the 0.05 percent confidence level. The Dominica banana is quite similar to the Valery.

The average total latex flow for Valery hands is expected to be 2.62 ($\pm$ 0.11) grams of latex per kilogram of fruit when the fruit is dehanded from one to ten hours after stem harvest. For stems held 22 to 27 hours after harvest before dehanding, the flow rate is expected to be 1.59 grams per kilogram of fruit or approximately 39 percent of the freshly cut total latex flow. For a 29 pound packed box equivalent, the latex flow in Dominica is expected to be approximately 34.5 grams of latex.

Of equal importance to the total flow of latex is the elapsed time over which the flow persists. This data for Valery bananas is shown in Table A-1.

One noticeable trait of Valery flow rates, with regard to stem fruit held 22-27 hours before dehanding, is concerned with the length of exuding time. After ten minutes of delatexing, 84 percent of total latex flow had been released. For freshly cut stems, only 73 percent of the total flow (1.90 grams) had been exuded. Some hands continued to release small amounts of latex for 150 minutes. However, 35.8 percent of all Valery hands ceased to flow after 30 minutes; 66 percent after 60 minutes; and 84.9 percent after 90 minutes.

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[1] Studies conducted by Robert H. Dawson on Valery and Gros Michel variety bananas in Costa Rica, Honduras, and the Republic of Panama.

Freshly cut Valery can be expected to release 72.6 (± 2.17) percent of available latex within 10 minutes of dehanding. Converting percentages to actual weight, after 10 minutes from dehanding freshly cut Dominica fruit can be expected to release an additional 0.72 grams of latex per kilogram of fruit.

Maximum likelihood estimates calculated on latex flow periods from 30 to 150 minutes show that Valery fruit dehanded from one to five hours after stem harvest can be expected to finish exuding latex in 138.4 minutes.

Best linear unbiased estimators were calculated of the percent of latex exuded per time period for stem fruit dehanded within one to five hours after stem cutting. Due to the nature of the curves, two second degree polynomials were calculated: one equation for the 2-6 minutes flow period, and a second equation covering flow rates for the 30 to 150 minute period. These equations are:

(1) $Y = 18.700 + 12.129(X) + (-0.778)(X\ 2)$ $R = 0.979$

(2) $Y = 76.401 + 3.404\ (Z) + (-0.123)(Z\ 2)$ $R = 0.867$

where:

Y is the percentage of total latex flow
X is the time period from 2 to 6 minutes
Z is the time period from 30 to 150 minutes, and 30 = 1, 31 = 2, etc.
R is the coefficient of correlation

The solutions to these equations for latex flow period from two to 43 minutes are shown in Table A-2.

Table A-2 illustrates how critical drainage time is to maintaining a quality packaged product. If, during the field pack operation, dehanded fruit is allowed to drain only four minutes, then for each 1,000 packed boxes one can expect 15,606 grams of latex to exude onto the boxed fruit and the plastic box liner. Much of the latex which collects on the plastic liner can be transferred to the bananas during vibration periods of the transporting phase from the farm to the wharf. If, however, dehanded fruit is allowed to drain in the two water tanks with side skimmers (a total of only 1,200 hands and clusters) for 30 minutes, then available latex is reduced to 7,010 grams per 1,000 packed boxes. A further reduction of 2,450 grams of latex would be accounted for during the fungicide application period and the rotary table drain period (approximately 2.5 minutes). This elapsed time of 32.5 minutes reduces the amount of remaining latex to 0.35 grams per kilogram of bananas.

Officials in other banana companies have indicated that 0.50 grams of latex per kilogram of fruit is an acceptable level of remaining latex for a premium grade of fruit. Separate studies were conducted by the Consultants to determine the relationship between available latex and time from stem cutting of Valery fruit. Four hundred Valery hands were studied. The results of this study are shown in Table A-3.

If the DBGA should decide to package two grades of fruit, as the modified boxing plant design allows for, then a decision need to be made as to the acceptable level(s) of latex staining.

Table A-1 Latex exuded from hands for Valery stem fruit dehanded at different time periods, when latex flow is recorded in grams per kilogram of bananas

Latex drain period from dehanding	Percent of total latex flow	
	1.5 hours[a]	22-27 hours[b]
Minutes	----------Percent----------	
2	39.8	48.4
4	54.5	66.3
6	63.6	75.0
10	72.6	84.1
30	85.3	94.4
60	92.8	97.9
90	97.1	98.9
120	99.1	99.1
150	100.0	100.0

[a] Sample size is 254 hands.

[b] Sample size is 253 hands.

Table A-2 Latex flow percentages for Valery hands after dehanding from one to five hours after stem harvest, Honduras, Costa Rica and the Republic of Panama[a/]

Minutes after dehanding	Percent of total latex flow
2.00	39.846
2.25	42.052
2.50	44.160
2.75	46.171
3.00	48.085
3.25	49.902
3.50	51.621
3.75	53.243
4.00	54.758
4.25	56.196
4.50	57.526
4.75	58.759
5.00	59.895
5.25	60.934
5.50	61.875
5.75	62.719
6.00	63.466
10.00	72.600[b/]
30.00	79.681
31.00	82.716
32.00	85.505
33.00	88.048
34.00	90.345
35.00	92.396
36.00	94.201
37.00	95.760
38.00	97.073
39.00	98.140
40.00	98.961
41.00	99.536
42.00	99.865
43.00	99.948

a/ Sample size is 254 hands

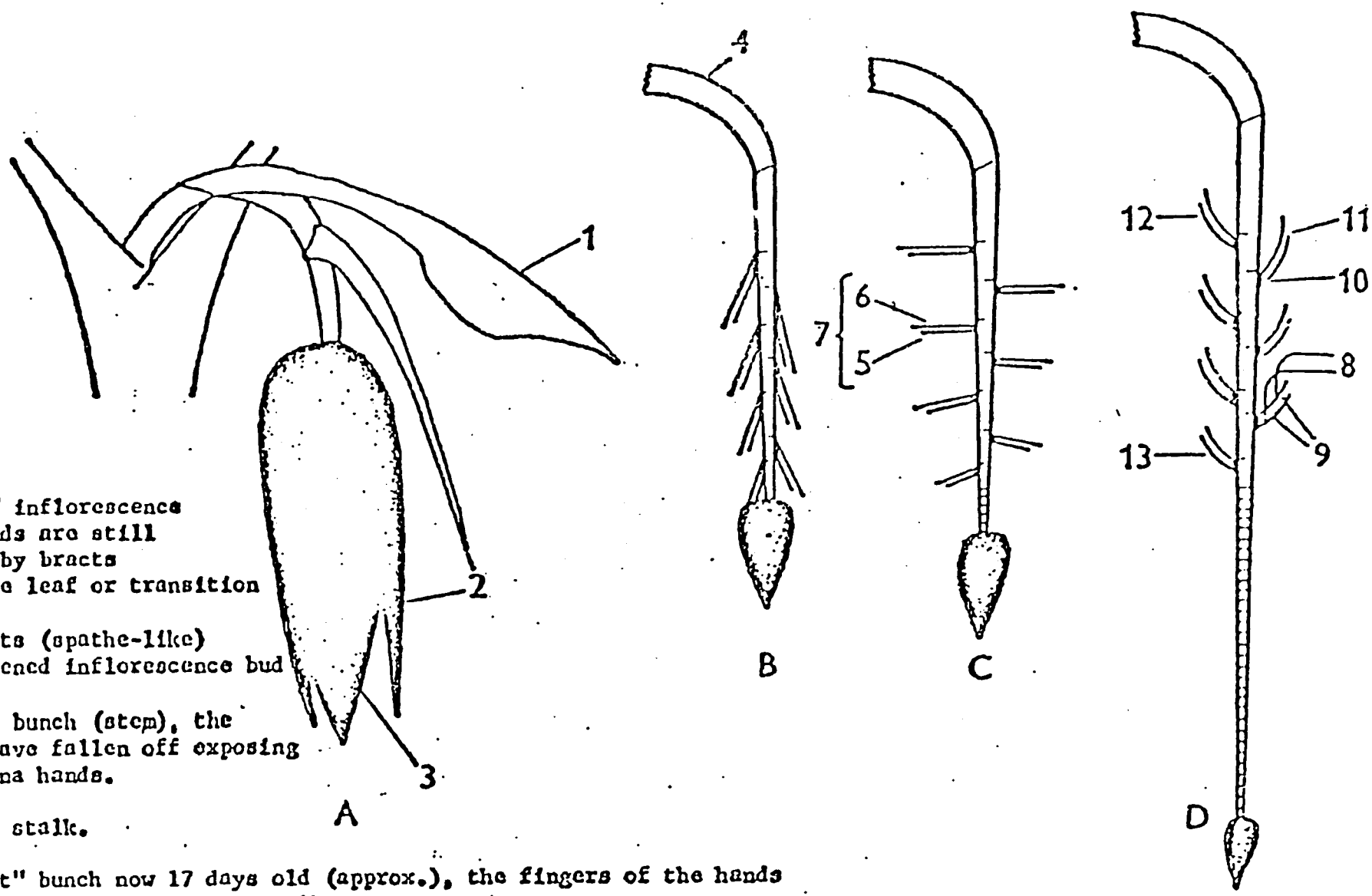
b/ Actual value from Table A-1.

Table A-3 Grams of remaining latex per kilogram of Valery fruit available for exuding from stem fruit held various lengths of time before dehanding, Honduras[a/]

Length of latex flow in minutes	Grams of latex and hours from harvest					
	2	4	10	22	26	30
	Grams					
6	1.11	1.05	0.72	0.42	0.36	0.30
10	0.83	0.79	0.54	0.27	0.23	0.19
30	0.45	0.42	0.29	0.18	0.15	0.13
60	0.22	0.21	0.14	0.04	0.03	0.03

[a/] Two to 10 hours calculated at Y = 3.27 + (-0.123)(X) + (-0.000454)(X 2) and 20 to 30 hours at Y = 1.94 + (-0.123)(Z).

DEVELOPMENT OF A BANANA STEM



KEY:

A "shot" inflorescence bud, hands are still covered by bracts
1) Spade leaf or transition leaf
2) Bracts (spathe-like)
3) Unopened inflorescence bud

A "shot" bunch (stem), the bracts have fallen off exposing the banana hands.

4) Main stalk.

The "shot" bunch now 17 days old (approx.), the fingers of the hands are at right angles to main stalk.
5) Outer whorl of fingers
6) Inner whorl of fingers
7) Complete hand

D - Bunch now at time of harvest, fingers of hands oriented upwards.
8) Inner side of fingers.
9) Outer side of fingers.
10) Finger stalk.
11) Finger tip.
12) Proximal hand (large)
13) Distal hand (small)

From: D.S. Meredith
Trans. Brit. Mycol. Soc. 44:265-284

APPENDIX C

Itinerary

T	Jan 3, 1984	Reed arrives in Barbados
W	Jan 4	Reed confers with Szadek and Baucom (USAID officers)
Th	Jan 5	Reed arrives in Dominica. Met with Paul Boenders, DBGA.
F	Jan 6	Met with officers of DBGA
S	Jan 7	Field
Su	Jan 8	-
M	Jan 9	Met with Prime Minister Charles and Finance Minister Lazar
T	Jan 10	At DBGA
W	Jan 11	Met Robert Dawson, 2nd member of Experience, Incorported consulting team
Th	Jan 12	Field - field pack and boxing plants with Peter Carbon
F	Jan 13	Field - with Luke Prevost. Also visited Portsmouth shipping terminal & ship loading
S	Jan 14	Field - Reed & Dawson
Su	Jan 15	-
M	Jan 16	Office
T	Jan 17	Field
W	Jan 18	Field
Th	Jan 19	Field
F	Jan 20	Roseau Port
S	Jan 21	Office
Su	Jan 22	-

M	Jan 23	Met Robert A. Fulton, Plant Pathologist member of Experience, Incorporated team
T	Jan 24	Reed & Dawson analysis and write-up. Fulton to field with Michel Roberts.
W	Jan 25	All team in Field
Th	Jan 26	Office analysis - Short field trip. Fulton in Field and Office.
F	Jan 27	Office
S	Jan 28	Office
Su	Jan 29	Visited Boeners
M	Jan 30	Office & DBGA. Fulton leaves
T	Jan 31	Office & DBGA
W	Feb 1	Office & Field
Th	Feb 2	Office
F	Feb 3	Dawson leaves
S	Feb 4	Reed gives presentation of study to DBGA Board & Management
Su	Feb 5	-
M	Feb 6	Reed leaves for Barbados
T	Feb 7	Reed gives presentation to USAID and BDD
W	Feb 8	Reed leaves Barbados

ROBERT H. REED

EXPERIENCE,® INCORPORATED

Fields of Expertise

Agricultural economics -- Agricultural policy and planning -- Food marketing and processing, especially fruits and vegetables

Academic Training

B.S. Agricultural Economics, University of California, Berkeley, 1949
M.S. Agricultural Economics, University of California, Berkeley, 1950
Ph.D. Agricultural Economics, University of California, Berkeley, 1960

Language

Spanish, Portuguese - good
French - fair

Affiliations

American Association of Agricultural Economists
American Economic Association
American Society of Agricultural Engineers

Publications

Over 40 technical publications plus many articles for popular and technical magazines.

Professional Experience

1980 - present	Associate, Experience, Incorporated
1965 - present	UNIVERSITY OF WISCONSIN-MADISON -- Emeritus Professor of Agricultural Economics (1981-present); Associate professor, then Professor (1965-81)
1968 - 1972	Professor and Agricultural economist, University of Wisconsin/USAID contract, Porto Alegre, Brazil
1961 - 1965	Agricultural economist, Marketing Economics Research Division, U.S. Department of Agriculture, Berkeley, California

1955 - 1960	Agricultural economist with the U.S. Department of Agriculture, and Associate in the Experiment Station, University of California-Berkeley
1953 - 1955	Management trainee, then Plant foreman, California Packing Corporation (now Del Monte Corporation)
1952 - 1953	Assistant agricultural economist, University of Hawaii, Honolulu
1940 - 1945	U.S. Army

Consulting Activities

Dr. Reed has participated in the following Experience, Incorporated assignments:

- Bolivia -- Nov-Dec 1983 -- Team leader of a two-person team which conducted an analysis of a proposed citrus and tropical fruit processing facility in the Chapare and Cochabamba regions of Bolivia. Report entitled Technical Considerations and Requirements for Processing Tropical Fruits in the Chapare and Cochabamba Locations, submitted to USAID/La Paz and Dillman Enterprises.

- U.S. -- 1983-84 -- First, member of a five-person task force of industry members led by Experience, Incorporated to conduct a study for Curtice-Burns, Inc. as a part of revamping and redesigning their product mix to include specific attention to the profitability of growing and processing tomatoes. In a separate but subsequent assignment, was charged with developing section of a report on tomato processing operations, equipment and costs including concentrates processed asceptically. Report plus analytical and statistical appendix was submitted in January 1984: A Study of the Processed Tomato Business as it Pertains to Curtice-Burns, Inc.

- Burma -- April-Nov 1982 -- Marketing specialist of a six-person team charged with analysis of the production, processing and marketing of a wide range of tropical products. Products included pineapple,

mangoes, mangosteen, guava, papaya, lychee family, durian, jackfruit, cashew nuts, tropical fruit salad, ginger, and water chestnuts. Also made a financial and economic analysis of the establishment of a can manufacturing facility in Burma.

Dr. Reed's experience relevant to the economics of banana production, processing and marketing:

- 1978 -- Consultant with Hunt-Wesson Foods to assess the production, world trade and policy aspects of the commerical banana industry, with emphasis on bananas from Central America. Studied investment and operating costs of facilities and marketing opportunities in the U.S. and Europe. Reported on United Brands, Castle & Cook and Del Monte operations, and banana facilities and plantations in Central America and the Philippines.

- 1976 -- Consultant with the Organization of American States to study tropical and cold weather production and marketing feasibility in Ecuador. Bananas were considered for the Esmeraldos Valley of the Coast, but were ultimately deemed infeasible due to heavy and established production north and east of Guayaquil. Oranges, passion fruit, and avocados were other tropical fruits included in the analysis.

- 1968 -- Consultant with the World Bank for evaluation of the Magdalena River Project in Colombia. Feasibility studies were made for processing, shipping, and marketing pineapple, bananas and other tropical fruits and vegetables. Harvesting and handling procedures for boxed bananas for the U.S. and European markets were recommended to INCORA, the development arm of the Colombian Government.

- 1960-61 -- Research Economist and Fruit Handling Specialist with the Tropical Division of the United Fruit Company, La Lima, Honduras. Was involved with research and development of the banana boxing program. Duties included the development of investment and operating cost estimates for wet and dry packs of destemmed hands of bananas. Analyzed procedures on smaller field-scale packaging and in centralized large-scale packing houses. Additional analyses were made for field-to-plant harvesting and assembly, empty box warehousing facilities, scheduling, transportation to dock, port facilities and operations. Developed experimental designs for biological experiments and made economic studies of problems in marketing bananas and plantains.

ROBERT H. FULTON

EXPERIENCE,® INCORPORATED

Field of Expertise

Protection programs and agro-chemical usage related to plantation crops in temperate, subtropical and tropical regions

Academic Training

B.S. Botany/Chemistry, Michigan State College, 1950
M.S. Plant Pathology/Entomology, Michigan State College, 1951
Ph.D. Plant Pathology/Horticulture, Michigan State University, 1954

Language

Spanish - excellent
Portuguese - good

Affiliations

American Phytopathological Society (APS) -- Committee participation - International; Chemical Control; Placement; and Tropical Crops
Caribbean Division of APS -- Coordinator of Coffee Leaf Rust and Banana Black Sigatoka Leaf Spot Symposia
Latin American Society of Phytopathologists (ALAF)
Organization of Tropical Nematologists (OTAN)
International Seed Pathologists

Professional Experience

1983 - present Associate, Experience, Incorporated

1969 - present ROHM and HAAS COMPANY

1976-present -- Technical/Client service manager, Latin American Region

1976-present -- Banana/Tropical crops research manager, Pacific Basin Region

1969-76 -- International fungicide production manager and liaison coordinator for worldwide fungicide development

1965 - 1969 Director, Northeastern Brazil Operations, IRI Research Institute, Brazilian Ministry of Agriculture, Recife, Pernambuco, Brazil

1959 - 1965 UNITED FRUIT COMPANY

1964-65 -- Senior pathologist, Central Research Laboratories, Norwood, Massachusetts

1959-64 -- Principal pathologist, Tropical Research Division, La Lima, Honduras

1954 - 1959 Assistant professor of Fruit Diseases, Department of Botany and Plant Pathology, Michigan State University

Publications

About 75 scientific papers and 24 field technical manuals.

ROBERT H. DAWSON

EXPERIENCE,® INCORPORATED

Fields of Expertise

Marketing economics -- Fruit handling, packing and shipping

Academic Training

B.A. Economics and Law, University of Washington, 1957
32 hours towards Ph.D. in Agricultural Economics, University of California, 1964-66
20 hours towards Ph.D. in Agricultural Economics, Oregon State University, 1969-72

Language

Spanish

Affiliations

Western Agricultural Economics Association
American Agricultural Economics Association
National Institute of Packaging, Handling and Logistic Engineers
American Society of Agricultural Engineers
Canadian Agricultural Economics Society

Professional Experience

1984 - present	Associate, Experience, Incorporated
1967 - present	Agricultural economist, Natural Resource Economics Division, Economic Research Service, USDA. Concurrently, positions of Instructor (1966-79) and Assistant Professor (1979-), Agriculture and Resource Economics Department, Oregon State University
1963 - 1966	Agricultural Economist, Marketing Economics Division, Economic Resarch Service, USDA. Concurrently, Research Associate, California Experiment Station, Berkeley -- Leader of Western Regional Project WM-47. Studied marketing, market demand and prices, and marketing practices, and location and production competition among selected horticultural crops.

1960 - 1963	Agricultural Economist, Division of Tropical Research, United Fruit Company -- Economic feasibility of alternative containers, handling methods, and shipping methods for marketing different varieties of bananas and pineapples. Focussed on the economics and feasibility of an efficient boxing program for marketing bananas, including the development of optimum box ing plant designs and operations required to handle banana production in four Central American countries. Also responsible for policy and administration associated with post-harvest research program.
1957 - 1960	Research associate, Food Industries Research and Engineering Corporation, Yakima, Washington -- Commodity analyses and the economics of fruit handling alternatives for the major deciduous fruits grown in the U.S.

Consulting activities

In addition to his overseas work with Food Industries Research and Engineering and the United Fruit Company, Mr. Dawson has been requested by governments and firms for special short-term studies and consultation. The following countries represent involvement in this type of work: Argentina, Belize, Canada, Costa Rica, Ecuador, France, Guatemala, Honduras, Italy, Mexico, Netherlands, Nicaragua, Panama, and Spain.