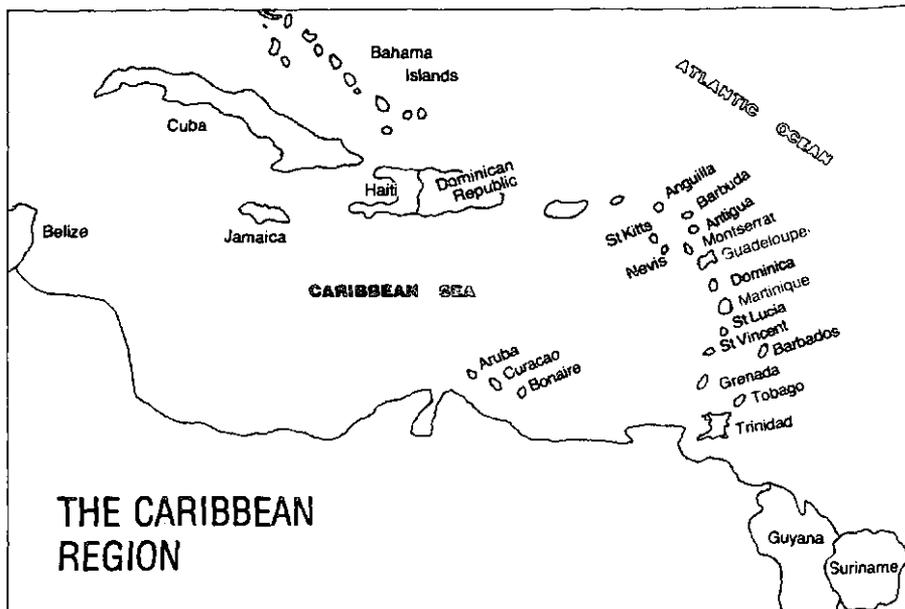


**C**ARIBBEAN  
**D**EVELOPMENT  
 AND  
**C**O-OPERATION  
**C**OMMITTEE



LIMITED  
 CDDC/CCST/ARPM/CRP.5  
 20 September, 1983  
 ORIGINAL: ENGLISH

ECONOMIC COMMISSION FOR LATIN AMERICA  
 Subregional Headquarters for the Caribbean  
 CARIBBEAN DEVELOPMENT AND CO-OPERATION COMMITTEE  
 CARIBBEAN COUNCIL FOR SCIENCE AND TECHNOLOGY  
 Workshop on Agricultural Research Policy and  
 Management in the Caribbean  
 Port of Spain, Trinidad  
 26-30 September 1983



AGRICULTURAL RESEARCH PROJECTS

Submitted by

Caribbean Countries at the Puerto Rico Conference on Agricultural  
 Priorities in the Caribbean Basin - 15-21 August, 1982; Cerromar  
 Hotel, Puerto Rico

Organized jointly by the United Nations Economic Commission for Latin  
 America (UNECLA) Subregional Headquarters for the Caribbean and the  
 Caribbean Council for Science and Technology (CCST) with support from the  
 International Service for National Agricultural Research (ISNAR), the  
 Swedish Agency for Research Co-operation with Developing Countries (SAREC),  
 the International Development and Research Centre (IDRC), the Commonwealth  
 Foundation, the University of the West Indies (UWI) and the Government of  
 Trinidad and Tobago.



**UNITED NATIONS**

ECONOMIC COMMISSION FOR LATIN AMERICA Office for the Caribbean



PROGRAMACIÓN APROBADA POR FAISES DE LOS PROYECTOS  
"PRIORIDADES AGRICOLAS PARA LA CUENCA DEL CARIBE Y CENTROAMERICA Y PANAMA"

(Gran AID \$400,000.00)

Nº Países, Proyecto, Institución y Coordinador	Presupuesto Asignado (US\$ Miles)	Cuenta Asignada
<p>1. <u>Barbados</u></p> <ul style="list-style-type: none"> <li>- Organic Fertiliser Trials on Sugar Cane (Nº 28)</li> <li>- Agricultural Services Ltd.</li> <li>- Stanley Glyne Hunte, St. Michael</li> </ul>	24.1	
<p>2. <u>Costa Rica</u></p> <ul style="list-style-type: none"> <li>- Estudio Fitoquímico del Género Clusia (Nº 36)</li> <li>- Departamento de Química, Universidad Nacional</li> <li>- Manuel E. Moya, Heredia</li> </ul> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> <li>- Investigación de nueve especies vegetales de alto valor agroindustrial (Nº 39)</li> <li>- Museo Nacional</li> <li>- Rafael Angel Ocampo S., San José</li> </ul>	25.0	
<p>3. <u>Dominica</u></p> <ul style="list-style-type: none"> <li>- Dehydration and Packaging of Sorrel Cabyces (Nº 23)</li> <li>- The Women's Desk, University of Home Affairs, Industrial Relations and Housing</li> <li>- Claudia Bellot, Botanic Gardens, University of Agriculture, Roseau</li> </ul> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> <li>- Maturity Indices for Avocado and Avocado Pears (Nº 24)</li> <li>- Produce Chemist Laboratory</li> <li>- Urban N. Martia, Roseau</li> </ul> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> <li>- Solar Dryer (Nº 26)</li> <li>- Produce chemist Laboratory</li> <li>- Claudia Bellot, Botanic Gardens, Roseau</li> </ul>	16.5	
<p>4. <u>El Salvador</u></p> <ul style="list-style-type: none"> <li>- Sorgo de Grano para Consumo Humano (Nº 12)</li> <li>- Instituto Salvadoreño de Investigación Agraria y Pesquera (ISIAP)</li> <li>- René Clará V., San Salvador</li> </ul>	20.0	
<p>5. <u>Jamaica</u></p> <ul style="list-style-type: none"> <li>- Storage of two sweet potato cultivars (Nº 7)</li> <li>- Ministry of Industry and Commerce Storage and Infestation Division</li> <li>- Dorothea Sibblis, Kingston 10</li> </ul>	6.2	
<p>6. <u>Nicaragua</u></p> <ul style="list-style-type: none"> <li>- Nuevas fuentes de aceite y grasa Nº 34)</li> <li>- Dirección General de Técnicas Agropecuarias</li> <li>- Julio R. Andino, Managua</li> </ul> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> <li>- Estudio biométrico de 32 selecciones de Pejibake (Nº 35)</li> <li>- Dirección General de Técnicas Agropecuarias</li> <li>- Julio R. Andino, Managua</li> </ul>	28.4	
<p>7. <u>Panamá</u></p> <ul style="list-style-type: none"> <li>- Banco de Germoplasma de Frutales Tropicales y subtropicales (Nº 29)</li> <li>- Instituto de Investigación Agropecuaria</li> <li>- Ruben Darío Reyes J. Panamá</li> </ul> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> <li>- Investigación Agropecuaria e Industrial del Pixbae (Nº 30)</li> <li>- Instituto de Investigación Agropecuaria</li> <li>- Ruben Darío Reyes J. Panamá</li> </ul> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> <li>- Investigación Agronómica Industrial del Marañón (Nº 32)</li> <li>- Instituto de Investigación Agropecuaria</li> <li>- Ruben Darío Reyes J. Panamá</li> </ul> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> <li>- Investigación de los Sistemas de Producción de Plátano (Nº 33)</li> <li>- Instituto de Investigación Agropecuaria</li> <li>- Rafael Sattler, Panamá</li> </ul>	25.0	

AGRICULTURAL PRIORITIES IN THE CARIBBEAN BASIN

Projects not Approved

<u>COUNTRY</u>	<u>PROJECT - INSTITUTION</u>	<u>AMOUNT REQUESTED</u>
JAMAICA	The Microbial Fermentation of Waste Green Banana Peel for the Production of Microbial Protein to be incorporated into Animal Feeds. Scientific Research Council. - G. Foderingham.	129,485 (2 Yrs)
	Evaluation of Local Plants for Useful Chemicals. Scientific Research Council. - J. A. Wright.	167,224 (2 Yrs)
	Essential Oils. Scientific Research Council. - J. A. Wright.	158,248 (2 Yrs)
	Ethanol Production from Agricultural Feedstocks. Scientific Research Council. - Al Binger.	189,783 (3 Yrs)
	Production of Latex and Adhesives from Local Plants. Scientific Research Council. - Al Binger.	152,800 (3 Yrs)
	A Potential for the Expansion of non Traditional Tree Crops in Jamaica. Ministry of Agriculture. - R. J. Baker.	790,785 (2 Yrs)
	Commercial Production of Cassava for Jamaica. Ministry of Agriculture. - R. J. Baker.	301,045 (2 Yrs)
EL SALVADOR	Cultivo del Gandul para alimentación del Ganado. Ministerio de Agricultura y Ganadería. - José Soto Gómez.	N. A.
	Expansión de la Producción de Grasas y Aceites Comestibles (Soya, Cacahuete, Girasol y Ajonjolí). Ministerio de Agricultura y Ganadería. -	26,700 (1 Yr )
	* Evaluación de Variedades de Ajonjolí por su Resistencia al Daño de Plagas y Enfermedades. Instituto Salvadoreño de Investigación Agraria y Pesquera (ISIAP). - Rafael Reyes.	48,000 (2 Yrs)
	* Diseño, Construcción y Evaluación de Equipos para Procesar Productos Alimenticios a Nivel Casero. Instituto Salvadoreño de Investigación Agraria y Pesquera (ISIAP). - Jorge Alberto Ortiz Durán.	18,040 (2 Yrs)
* Investigación e Incremento de la Producción del Cultivo de Papa para Semilla. ISIAP. - Heriberto Rosa Santos.	51,422 (2 Yrs)	

\*) Those projects were presented too late.

COUNTRY	PROJECT - INSTITUTION	AMOUNT REQUESTED	
EL SALVADOR	* Determinación de Alternativas para el Aprovechamiento Industrial de los Excedentes de Producción de Tomate por los Pequeños Productores de El Salvador. ISIAP. - Ana Leonor del Carmen Molina de Rivas.	38,000	(2 Yrs)
	* Evaluación de la Incidencia y del Daño de Plagas y Enfermedades en Variedades de Cacahuete. ISIAP. - Muriel Delmi Alas de Velis.	27,000	(2 Yrs)
	* Investigación, Fomento y Producción del Cultivo del Aguacate. ISIAP. - René Pérez Rivera.	40,000	(2 Yrs)
	* Fermentación de Subproductos Agropecuarios y Agroindustriales para la Producción de Fuentes Proteicas Alternas en El Salvador. Centro de Desarrollo Ganadero, Soyapango. - Rolando Martínez Melara.	45,000	(2 Yrs)
*) Those projects were presented too late.			
NICARAGUA	Perspectivas de uso de Especies Arbóreas para Alimentación del Ganado. Instituto Nicaraguense de Recursos Naturales y del Ambiente (IRENA). - Mauricio Araquistain C.	33,524	(1-1/2 Yrs)
	Algunas Prioridades del Cultivo de Plantas Tropicales en Nicaragua. Dirección General de Técnicas Agropecuarias. - José Ramón Peralta V.	1,000,000	(2 Yrs)
SAINT LUCIA	Experimental Banana Processing Mini-Plant. National Development Corporation. - Charles Flemming.	310,000	(1 Yr)
	An Agricultural Diversification Project for the Windward Islandas through Banana and Plantain intercropping with Food Crops (Peas, Beans, Peanuts, Potatos, Corn and Tubbers). Windward Islanda Banana Grower Association (WINBAN). - Mureli Rao (Private organization).	65,000	(2 Yrs)
TRINIDAD & TOBAGO	Cassava Cultivation. C.E.S. Centeno, Via Arima, Trinidad. - Anthony Seesahai.	N. A.	
GUATEMALA	Proyecto de Investigación en Oleaginosas. Instituto de Ciencia y Tecnología Agrícola (ICTA). - Bladimiro A. Villeda Sagastume.	361,684	(3 Yrs)
	Evaluación y Conservación de Germoplasma de Cacao. Instituto de Ciencia y Tecnología Agrícola (ICTA). - Edgar Ríos Valladares.	100,290	(2 Yrs)
	Investigación Agrícola y Producción de Semillas. Instituto de Ciencia y Tecnología Agrícola (ICTA). - Bladimiro Villeda Sagastume.	12,766,700	(4 Yrs)

COUNTRY	PROJECT - INSTITUTION	AMOUNT REQUESTED
PUERTO RICO	The New Frontier: Sea, Land and Self-Effort. Lillian Martínea Development Consultants. - Abdón Martínez (Private organization).	25,000 (4 Mths)
	Corrugated Boxes and Selected "Kraft" Paper as a Feed Fiber Resource for Lactating Dairy Cattle. Agricultural Experiment Station of the University of Puerto Rico, Mayaguez. - Paul R. Randel.	25,000 (1 Yr )
DOMINICA	Banana <sup>RAISIN</sup> Project. Point Michel Women in Action Group. - Patricia Peltier (Ministry of Home Affairs).	3,695 (1 Yr )
	Banana Vinegar. Produce Chemist Laboratory, Division of Agriculture, Botanical Gardens. - Claudia Bellot.	10,000 (2 Yrs)
BAHAMAS	The Feasibility of Native Corn Production as a Food Staple and Constituent in Animal Feeds. Ministry of Agriculture, Fisheries and Local Government. - Leon Stan Smith.	24,000 (2 Yrs)
GRENADA	Research of Fruit Crop Production. Mirabeau Propagation Station.	N. A.
HAITI	Plante Pilote de Technologie Alimentaire et Petit Laboratoire de Microbiologie. Department de L'Agriculture, Des Ressources Naturelles es du Developpement Rural. - Danielle Avian Calvin.	39,969



# AGRICULTURAL SERVICES (BIO-DYNAMICS) LTD.

MANUFACTURERS OF BIO-COMPOST® FERTILIZER CONCENTRATE

OFFICE: BANK HALL CROSS RD., ST. MICHAEL, M 12, BARBADOS

CABLES: AGSERVICE BARBADOS

PHONE: 65011, 60024

4th October 1982

Dr. Sarah Milner,  
Director, Barbados Office  
of the General Secretariat,  
Bank Hall, St. Michael,  
Barbados.

Dear Dr. Milner,

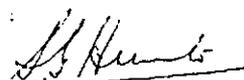
RESEARCH PROPOSAL FOR SUPPORT  
BY THE OAS - CBI PROJECTS

I have pleasure in submitting the attached Proposal for the favourable consideration of your Committee and the Director of the Department of Scientific and Technological Affairs.

I am convinced that the requested funding by OAS will result in positive and lasting benefits to Barbados and the region.

Should you require any further information on the subject I will be most pleased to furnish it.

Sincerely Yours,

  
S. Glyne Hunte  
Director.

SGH/sf

FORMAT FOR SUBMISSION OF RESEARCH PROPOSALS FOR POSSIBLE  
SUPPORT BY THE ORGANIZATION OF AMERICAN STATES (OAS)

TITLE OF PROJECT

ORGANIC FERTILISER TRIALS ON SUGAR CANE

IN BARBADOS & JAMAICA

PRINCIPLE INVESTIGATOR

Name: Mr. Stanley Glyne Hunte  
Title: Director,  
Address: Agricultural Services (Bio Dynamics) LTD.  
Bank Hall Cross Rd., St. Michael Barbados  
Telephone: 650<sup>11</sup>, home 62472

INSTITUTION (NAME AND ADDRESS)

Agronomy Research Unit, Sugar Producers Association, Barbados

Sugar Industry Research Institute, Mandeville, Jamaica.

Duration of the Project: 18 months  
Total Budget Request: \$ 10,100      First Year: \$ 8,500  
Second Year: \$ 1,600  
Contribution of Institution or of Country: \$ 8,000

Signatures



Principal Investigator  
(typed name, title and date)

S.G. Hunte,  
Director,

5th October 1982

Authorizing official (date)  
Performing institution  
(typed name, title, address  
and telephone)

Dr. J.C. Hudson,  
Head, Agronomy Research Unit  
Edgehill, St. St. Thomas  
Barbados

TEL: 50075

Address of Fabcon Inc: 965 Mission Street, Suite 730,  
San Francisco, CA 94103, U.S.A. Tel: 957-0333

THIS PROJECT IS SUBMITTED TO THE ORGANIZATION OF AMERICAN STATES (OAS)  
FOR THEIR SUPPORT IN THE FURTHERANCE OF AGRICULTURE  
IN BARBADOS AND JAMAICA AND OTHER SUGAR  
PRODUCING COUNTRIES.

Title

Supplemental Fertilising of Sugar Cane using Composted Filtermuds  
and Bagasse and Poultry or Animal Manures &/or chemical nitrogen;  
or in short, Organic Fertiliser Trials on Sugar Cane.

Background and present state of knowledge

There are many papers available from varied sugar technologists to show that Filter Press muds (FPM) or Filtermuds, as now more generally called, is a beneficial additive to cane lands. The degree of usefulness depends on how it is applied and the use made of it in the cropping cycles. These papers generally treat of FPM as the straight product from the factory; but in the case of the French researchers using a composted product from the grape wastes, called Cofuna, it was found that this inoculant when combined with FPM at the rate of approx. 10% by weight resulted, after some months, in a valuable substance called S.B.Cofuna, which when applied to the furrows in which the cane plants were grown resulted in some definite and positive increases in both tonnage yields and improved juice quality. These tests were carried out in Mexico by Dr. Roger Humbert and also in the Phillipines and Hawaii. More recently, sugar producers in the Phillipines have been working with this same product and have reported consistent results. The stage has been reached in the Phillipines that some producers are prepared to use composted material from their own FPM and bagasse on at least 1000 hectares of cane land this season.

Now there are certain drawbacks to the use of the "Cofuna" inoculant; firstly, it is expensive because about 10% of the weight of the other ingredients has to be applied and puts the cost for this additive alone at around \$70.00 US per ton. Secondly, the predominant bacteria in this culture are anaerobic digesters and this requires much water having to be applied and also an extended time of 3 to 4 months or longer for the compost to be ready for application to the fields.

It has been demonstrated that the aerobic process of composting is better suited for these raw materials and will result in a richer product as a soil conditioner (the condition in a soil is aerobic anyhow) and the time taken to convert the raw materials into a finished compost is about 6 to 8 weeks. Also the resistant lignins in the bagasse are more susceptible to breakdown by the aerobic microbes than by the anaerobic organisms. It is also more feasible to add poultry or other manures for aerobic composting than for the other method. And if it is necessary to add inorganic nitrogen (such as sulphate of ammonia or urea to provide the necessary nitrogen to balance the carbon content) then it is feasible to do this easily with aerobic composting.

Composting of sugar-factory wastes has been carried on in Barbados for some years by Agricultural Services Limited, and a good product has been made using the filtermuds, bagasse, poultry manures, other manures plus some specially developed bacterial cultures imported from laboratories in the USA who have specialised in the manufacture of these cultures containing many beneficial microorganisms.

About 3 years ago some custom composting was done for one large sugar plantation and over 100 tons of compost was applied to all the young plant canes at the plantation. However no controlled tests were done for comparison purposes, so that while good yields were experienced both in the first year and in the second year, this instance can not be quoted as a positive example of definite benefits. Likewise some isolated tests have been done and in most cases the results were good- especially in the case of market vegetables and in fruit trees and household plants etc.

What has never been done up to the present is to carry out controlled trials on strips of sugar cane fields to measure and report on the degree of difference between treated and untreated strips.

The reasons why this project is considered urgent and important to the Sugar Industry in Barbados and Jamaica and elsewhere may be summarised as follows:

1. Declining yields from cane lands is a serious handicap to efficiency in the industry, especially cost-efficiency.
2. The unabated scourge of cane fires in Barbados is rapidly depleting the residual organic matter levels and destroying the soil's microlife tending to erosion & reduced water-holding capacity of our soils.
3. The high cost of imported fossil-fuel fertilisers is a constant drain on foreign exchange reserves as well as contributing to the high cost of production of sugar. It is reliably estimated that after a few years (say 3 to 4) that the need for the artificial fertilisers could be reduced by 50% when composted sugar wastes are used regularly.
4. The results of usage of this or a similar product in other places fully justifies trials being done in Barbados and Jamaica to prove that improved soil structure and tilth as well as increased yields and better quality juice can also be realised in these tropical areas.
5. The cost of producing this compost is comparatively low, for the raw materials belong to the Sugar Industry already (i.e. the FPM and the Bagasse (and in the case of Jamaica, the distillery wastes too) and poultry manures can be got for the cost of transport, at least in Barbados, and the cost of the cultures is about only \$7.00 US. per ton. The cost of manufacture should be not more than \$15.00 US/ton so that the whole operation may result in a total of say \$30.00U.S. per ton. As this is applied at the rate of say 2 tons per acre, it will be seen that the cost of this product could be in the region of \$60.00 per acre.
6. The addition of compost at planting time, and also at land preparation

Benefits accruing from the Study

Based on the projections stated above the following is a rough estimate of the potential benefits from using Compost as a supplemental fertiliser:

Present cost of applying ½ ton 22-0-22 per acre	- \$ 150.00
Less Saving of 50% when Compost is used	<u>75.00</u>
	75.00
Add Cost of say 2 tons/Acre Compost, applied	120.00
	<u>195.00</u>
Total Cost	
Less Present costs	<u>150.00</u>
Increased cost by using compost	45.00
Value of say 10% on Cane Yields (Plant canes)	
Increase of say 4 tons per acre @ \$55./ton	<u>220.00</u>
Increased Revenue, on Plants canes, per acre	175.00

Increased cost: \$45.  
Increased Revenue \$175.  
Ratio: Almost 4 times..

It is estimated that the annual importation of Sugar Cane fertilisers into Barbados is around \$6,000,000 per annum. The saving under a compost-usage programme could be in the region of \$3,000,000 in foreign exchange per year, less the cost of imported inputs.

Assuming that the imported cultures for the treatment of say, 50,000 tons of Compost amounted to some \$250,000., then the foreign exchange savings would still be very considerable.

It is in mind that some pulverised municipal garbage could be used to supplement the supply of chick-poultry litter. Provision, however, should still be made to use some sulphate of Ammonia to balance the C/N ratios.

It will be realised that in the event that our cane production can achieve the increase of around 10 to 15% then this exercise will be well worth the effort.

Plan of Work

For the purpose of clarity, work plans will be given for Barbados and Jamaica separately.

BARBADOS. Special batches of Compost will be made in Barbados at the work site of Agricultural Services Ltd. in ST. Thomas. The FPM are already on site and fresh supplies of bagasse were needed as well as fresh poultry litter. Transport costs are involved to get the material to the composting yard. These ingredients are pushed into long

windrows by a front-end loader tractor in the proportions as determined by the Director of the project. The Compostmaking machine, a specialised turning machine specially built and designed for this purpose, is the property of Agricultural Services Lt. . . This machine is capable of processing a large tonnage of material every hour, and by means of its fast-revolving drum it shreds and pulverises and aerates the ingredients into one homogeneous mass and leaves it in the shape of a large windrow behind the machine. At this early stage the bacterial inoculant is added and the fermentation begins with the pile getting hot and steamy. Control of moisture and aeration is essential and turning must be done at the correct times. All this results in a completely different product from that originally started with, and in 6 to 8 weeks the compost is ready to be applied to the fields.

JAMAICA. There is no turning machine (Compostmaker) in Jamaica, and there is some difficulty in obtaining sufficient chicken manure for our trials. So Sulphate of ammonia will be used as the main nitrogen source, and a greater proportion of FPM to compensate. Bagasse will also be used as well as the bacterial sprays, supplied by the same Laboratory in the USA. The ingredients will be dumped on site and a front-end loader articulated rubber-wheeled tractor will make up the piles in the correct proportions as determined by the Project Director, and after moistening with water from a nearby stream, these piles will be mixed up as much as possible and then formed into windrows of the right size for maximum heat generation. It is proposed to carry out production at two sites in Jamaica, so trials may be tested on different soil types etc. in that country.

QUANTITIES. In Barbados it is expected that up to 50 tons of Compost will be utilised in the tests, and in Jamaica up to 100 tons may be used.

When the Compost is ready, this will be handed over to the Agronomists at the two centres. In Barbados the Agronomy Research Unit of the Sugar Producers Association (ARU) and in Jamaica the Sugar Industry Research Institute (SIRI) will undertake the field trials. The most suitable methods, using machines and manual methods, will be employed. The general idea is to treat the cane planting pieces with a compost "tea" just prior to placing the plant pieces in the furrows, and then to add dry compost to the furrow in the area where the cane roots will grow. Means will be found to turn over some soil so that the compost will be covered and put into contact with the soil - where it is most effective. There are some fertiliser spreaders on hand that will be adapted to this operation. Where manual methods are used for planting, the compost will be applied by the handful when the cane piece is being put into the ground and pressed down by foot.

It is also in mind to apply compost to the bottom of the furrows when the furrow bed is being made up, i.e. some months before planting. This will be tested on fields that have been badly burnt over the years, in a test to determine if the compost can rebuild humus and organic matter more rapidly.

In addition to the field work, it will be necessary to back up the trials with laboratory controls. Soil samples & leaf samples will be taken at the appropriate times and tests carried out on the check plots as well as the treated areas.

### Personnel and facilities available

At the ARU in Barbados, the Agronomist Mr. H.G. DeBoer has made provision in his timetable to carry out these tests on cane fields. He will be assisted with a trainee-employee, and the ARU will provide all the necessary transport and supervision of the trials. All materials, except the compost, will be supplied by the ARU.

Soil and foliar tests will be done either in Barbados at the Government Agricultural Laboratory or at the Sugar Industry Lab. Where necessary, tests will also be done at the SIRI in Jamaica on the Barbados samples for confirmation etc.

In all these trials Mr. Glyne Hunte will maintain close contact and be available for any services as may be required. This is especially envisaged in the area of physical supply of the compost and the means of application with fertiliser spreaders etc. Experiments in the dipping of the cane piece in the liquid compost mixture will also be specially supervised by Mr. Hunte.

At the SIRI, Mr. Mike Shaw will be directly responsible for the trials in that Island. He will be assisted by his Agronomist Dr. Rao. Dr Rao is particularly interested in the use of FPM in sugar-cane trials, he having researched this product very much in recent years. Included in the supporting documents to this proposal is a paper on the subject by Dr. Rao.

Mr. Mike Shaw has definite ideas on how this compost may be applied and he will be investigating all these methods in the context of the cane planting practices in Jamaica. It is realised that the scale of the sugar industry in Jamaica dwarfs that of Barbados, and the involvement of the SIRI in this project is very welcome.

Mr. Glyne Hunte will supervise the manufacture of the Compost in Jamaica, and this will necessitate the visit to that Island on three or four occasions. In addition Mr. Hunte intends to witness some of the techniques used in Jamaica for the application of the compost to the fields.

It is necessary at this stage to mention the interest in this whole composting project of Fabcon Incorporated, of San Francisco, California, U.S.A. The president of this Company, Mr. Jack Casey, is deeply interested in developing the manufacture of sugar-factory-produced fertiliser as an integral part of a concept that he has authored, and which he is actively promoting both in the USA, in the Phillipines and in Jamaica and Barbados.

His concept is what is called the 3-F system. FOOD - FERTILISER - FUEL are the three products he sees are necessary to make the Sugar Industry viable again. His Company, Fabcon, are the suppliers of the well-known UNIGRATOR and the LOTUS MILL, two innovations that have greatly increased the milling rate and primary extraction of the juice at the first crushing. Fabcon Inc. is also heavily involved in supplying chemicals and general supplies for the manufacture of sugar all over the world, and is well known in the Sugar world.

Mr. Jack Casey believes that sugar factories can be profitably reorganised so that a distillery can be added on, and a fertiliser operation undertaken using the byproducts.

His ideas, which are based on sound engineering principles and boiling house practices, calls for a reduction in steam use for the recovery of sugar from the diluted secondary juices, for the elimination of the centrifugals for the curing of "C" sugars, and the full utilisation of the Bmolasses with the low quality juice for the manufacture of alcohol on the spot. He states that there will be economies in steam usage, and the conversion of some of the surplus energy could be put into ELECTRICITY GENERATION, especially if bagasse driers are installed which could mean that a 35% moisture bagasse is supplied to the boilers for increased efficiency.

Under this 3-F system, Sugar would be produced, and also Alcohol. Alcohol both for RUM manufacture and also for GASOHOL. Then the third component will be a COMPOSTED FERTILISER. This will be made from the FPM, some Bagasse and the concentrated lees or wash from the distillery. These lees will be concentrated in a specially designed clarifier which will take off the overflow for vegetable gardening irrigation and the underflow will go to the compost piles. This heavy residue will be rich in potassium, as well as in other plant nutrients. As already stated, poultry manures or other manures or nitrogeneous chemical salts will be used to ensure a good compost.

The above resumé is given in this proposal to show that our product has attracted international recognition and is being actively researched in other places. But these trials in Barbados will be vital for the needed development at this stage, as both assisting a local business to become more established and to provide a very worthwhile input to our main industry in Barbados with definite advantages to Jamaica, and other sugar producing countries in the CBI basin and elsewhere.

One further word as to the Jamaica connection. Mr. Casey visited Jamaica right after having discussions on this subject in Barbados with Mr. Hunte. While in Jamaica, where Fabcon has a subsidiary factory and joint-venture with Mr. Derek Corsby, he found considerable interest on the part of Mr. Mike Shaw from SIRI, and this led to the decision to start the manufacture of this sugar-based compost in Jamaica. Mr. Casey then engaged the services of Mr. Hunte to direct the operations. Mark Casey, the son of Jack Casey has recently joined Fabcon Inc, and is now Manager of their Bio-Earth Division. Mark Casey came to Barbados to meet and consult with Mr. Hunte, and then went on to Jamaica where he was joined by Mr. Hunte for the necessary preparations for the trial production of compost.

#### Expected Duration.

Field trials should commence in Barbados in the coming planting season in November 1982, and in Jamaica from December onwards. The first evaluation of the leaves will be undertaken when the plants are 4 to 5 months old, and then at later stages. Visual scans will be taken at regular intervals. Canes planted in Barbados in November will be reaped in the year after next (1984) i.e approx. 15 months after planting. In Jamaica the canes will be reaped approx. one year after planting. Interim REports will be available after 6 months and at 6 months intervals thereafter, with tests completed and final reports available within 18 months from November 1982.

BUDGET PROPOSALS:

BUDGET FOR ORGANIC FERTILISER TRIALS - U.S.DOLLARS

Ref No.	Item of Expenditure	Requested from the OAS.	Private Funding
<b>1. SALARIES &amp; WAGES</b>			
a) i.	Barbados Project Director	500	1,000
ii.	Contribution to ARU	2,000	-
iii.	Compost manufacture wages	600	600
iv.	Plantation Wages	175	100
b) i.	Project Director for Jamaica Trials	500	1,000
ii.	Contribution to SIRI	500	-
iii.	Compost manufacture wages	200	600
iv.	Plantation Wages	200	200
<b>2. SUPPLIES &amp; EQUIPMENT</b>			
a) BARBADOS			
i.	Bacterial cultures	350	-
ii.	Composting materials	400	250
iii.	Transport costs	500	250
iv.	Hire of Equipment	275	200
v.	Compost turning expenses	300	300
vi.	Delivery to Agronomists	-	50
b) JAMAICA			
i.	Bacterial cultures	700	-
ii.	Composting materials	400	300
iii.	Transport costs	450	-
iv.	Hire of Equipment	-	1,500
v.	DELIVERY to AGronomists	-	100
vi.	Turning Expenses	500	500
<b>3. LABORATORY EXPENSES</b>			
A (	BARBADOS	200	-
b (	JAMAICA	300	-
<b>4. TRAVEL EXPENSES</b> - Plane travel & per diem to Jamaica/return Barbados			
		750	750
<b>5. ADMINISTRATIVE COSTS</b>			
		300	300
		<u>US\$ 10,100</u>	<u>8,000</u>

PROPOSED PROJECT TO DETERMINE METHODS OF  
PROLONGING THE STORAGE LIFE OF TWO SWEET  
POTATO CULTIVARS ( Ipomoea batatas)

Institution: Ministry of Industry & Commerce Storage  
& Infestation Division.  
20 Hope Road, Kingston 10.

Principal Investigator: Dorothea Sibblis  
Title: Food Storage Officer  
Address: 20 Hope Road, Kingston 10.  
Telephone: 926-7107, 67450 or 67177

Duration of Project: One year

Total Budget Request: J\$11,174.00 US\$6,277.53  
First year - J\$11,174.00 US\$6,277.53  
Second year - J\$ N/A

Contribution of Institution or of Country - \$ .....

Signatures

.....*D. Sibblis*.....

D. Sibblis (Miss)

Food Storage Officer  
.....

.....3/2/82.....  
(Date)

.....

D.C. Graham

Chief Food Storage Officer  
.....

Storage & Infestation Division  
.....  
(Performing Institution)

.....  
(Date)

20 Hope Road, Kingston 10.  
926-7107, 67450, 67177  
.....  
(Address & Telephone)

INTRODUCTION:

Sweet potato is widely grown in most parts of Jamaica and is particularly common in the parish of Manchester. It is however affected by several different diseases in the field, some of which affect the storage life of the tubers and cause great economic losses. Common fungal diseases that affect the storage life are those caused by Cercospora ipomoea, Fusarium oxysporium of sp batatas (stem rot) and Ceratocystis fimbriata (black rot). This means that the crop has a very short storage life (2 to 3 days) and this is lower if bruising has occurred during harvesting.

Curing has been considered as the most effective means of extending the storage life of sweet potato, but it can be considered time-consuming. As a result, sweet potatoes have been cured in certain parts of the United States but there is an inherent problem in Jamaica in that, quite a few cultivars are grown and there is as yet no finalized classification of these cultivars. Successful exportation of this crop has never been achieved and institutions which deal with the exportation of this crop have in recent times, discarded over 75% of the produce due to the extensive spoiling which results.

Although most<sup>of</sup>/the previous investigations have been carried out on a small scale, i.e. in the laboratory, work on curing on a large or commercial scale has been attempted by our major marketing division of agricultural produce (the Agricultural Marketing Corporation, A.M.C.). As mentioned above, due to the lack of classification of the various cultivars, accurate curing temperatures and the minimum number of days necessary for curing to commence, have not been achieved.

In order to cure effectively, it is necessary to establish the proper conditions. This has been a problem in that equipment used for curing have to be of a highly precise nature (i.e. maintain correct temperature and relative humidity) and be in very good operation order before curing can be successful. Units that are frequently non-operational cannot be used. This has been a major problem both in laboratory experiments and in experiments done on commercial scale.

A combination of these factors or any individual factor can be responsible for the success of the project and therefore all these problems have to be eliminated if the project is to be successful.

The use of fungicides and sprout-suppressants are also being investigated to be used as alternative methods to curing.

### Goals and Objectives

Indepth examination of two cultivars of sweet potatoes in order to find:

1. (a) the temperature at which curing occurs;  
(b) the storage temperature;  
(c) the storage life.
2. (a) the amount and type of fungicide to be applied;  
(b) the amount and kind of sprout suppressant to be applied.

### Work Plan

#### A. Temperature, Relative Humidity (rh), Time

Temperature	29 - 40 <sup>0</sup> C	(Curing)
"	10 - 14 <sup>0</sup> C	(Storage)
RH	98 - 100%	
Time	1 - 7 days.	

Each tuber will be investigated using the above temperature, rh and time range. During harvesting most of the tubers are wounded and these wounds serve as points of entry for post-harvest pathogens. Once the tubers are cured, ( a process of wound healing) or closing wounds, there is a prevention of entry of these harmful pathogens and this results in an increase in the storage life of the tuber, since there is no spoilage. Microscopic examination of tubers will determine whether and when curing has commenced, as cured tubers have a layer of tissue (periderm) which is easily identified under the microscope. It is important to discover curing and storage temperatures, the rh and how long tubers should be cured for, as previous experiments have indicated that these factors vary widely and depends on the particular cultivar.

#### B. Fungicides and Sprout Suppressants

Investigation of the effect of four (4) fungicides at three (3)

levels of concentration, and the use of methyl ester of naphthalene acetic acid in acetone on the storage life of the tubers.

Tubers when harvested develop conditions known as "stem rot" and "black rot"; this not only gives the tubers an unattractive appearance but the tissues become soft and hence unmarketable. Identification of the correct fungicide and the right amount should eliminate this problem and increase the storage life of the tubers.

Sprouting is a major factor in the storage of sweet potatoes as it causes considerable losses eg weight loss, since the surface of the sprout is much more permeable to water than the skin of the tuber and in addition to the loss of material in the sprout, there is greatly increased evaporation of water. Elimination of sprouting during storage would minimise weight loss and loss of material.

#### C. Packaging and Transportation

A study of the following packing materials -

- (i) carton boxes
- (ii) polyethylene bags
- (iii) paper bags
- (iv) polypropylene bags
- (v) moist coir
- (vi) moist saw dust.

Determination of the most efficient packing material to be used results should indicate which material gives increased storage life.

Trials involving stacking tubers loosely in boxes or in bags from the field, tubers are generally loosely stacked on trucks, this results in bruising and wounding and these wounds serve as points of entry for post-harvest pathogens. It is hoped that by using alternative packaging arrangements this problem will be eliminated or at least minimised and therefore result in an extension of the storage life of the crop.

There will also be an examination of the shipping of cured tubers in the various packaging materials by commercial exporters. This should show that it is now possible to ship tubers after these treatments and not lose the produce, since the storage life is greatly extended.

D. Consumer Acceptance

Cured tubers have what is referred to as a "stale look". Therefore cured tubers and tubers in other treatments will be placed in supermarkets and other retail outlets in order to determine consumer preference.

Benefits to the country

The primary benefit to the country is that curing will serve to put into motion facilities which now exist for the export of this crop and also if it is successful, it will improve the quality of the product. On the local market, a greater amount if not all the tubers which are currently being produced will be used and the farmer will be able to sell his produce at reasonable price and not leave it in the field to spoil as is being done now as there is not adequate market for it. Although there is in some areas year-round production of sweet potatoes other areas do not have this; when there is surplus, prices are very low and the farmer loses, if the project is successful, tubers can be stored in times of surplus with minimum loss and minimum spoilage.

At present, only small amounts of sweet potatoes are exported, export is only by air and this is extremely expensive. If tubers can be successfully cured, exportation by sea becomes possible because of the increased storage life of the crop. This will result in increased foreign earnings to the country. Curing will eliminate the high losses currently being experienced by exporters.

Co-operative Arrangements with other Institutions in Jamaica

Arrangements have been made with the following:

Institution/Person

Address/Telephone no.

Exporters

A.M.C.	81 Spanish Town Road
Barry Pottinger	Priory St Ann - 0972-2449
Manchester Packers (Mr. Thomas)	Grove Road - Mandeville - 0962-3237

Farmers

Winston Davidson  
B. Gunter

c/o Mandeville P.O.  
c/o Mandeville P.O.

Pathologist

Mr S. Edmond

Ministry of Agriculture (Pathology  
lab) Hope Road - 927-9823

Taxonomist

Ministry of Agriculture  
Research Development

Hope Road - 927-9831

Biographical Data on Principal Investigator

Qualifications

B.Sc. in Natural Science in Chemistry and Botany - University  
of the West Indies - Mona.

Work Experience

Place - Post-Harvest Physiology Laboratory - Storage and Infestation  
Division of the Ministry of Industry & Commerce. This laboratory is  
engaged in applied research in post-harvest agriculture and deals with  
the protection, preservation, handling, transport and storage of fruits,  
vegetables and root crops (FVRC) (perishables) with the view of increas-  
ing their storage life.

During the period (1 year 10 mths.) identification of the best temp-  
eratures and the proper packaging material for the successful exportation  
of cho choes has been achieved. Work is currently being done on crops  
such as yellow yams (Discorea spp.) to eliminate fungi infection by use of  
particular fungicides; limes (Citrus spp.) to delay ripening and  
preserve the green colour in them as during exportation, they ripen  
before reaching their destination.

### Post Food Storage Research Officer

Work involved carrying out research into post harvest handling of FVRC's within the disciplines of physiology, biochemistry pathology and technology in order to determine optimum environmental condition i.e., temperature and relative humidity under which each produce should be stored and to establish the maximum length of storage life for each produce.

In addition to research, lectures, seminars, and workshops on the proper method of storage FVRC's to farmers, exporters and other relevant personnel are given.

### Committee

Member of the following:

- (i) Root Crops Committee
- (ii) Jamaica Agro Medical Association (JAMA)
- (iii) Caribbean Food Crops Society (CFCS)

Identification of the problems of post-harvest storage and an awareness of current post-harvest storage techniques and the use in eliminating these problems. Setting up applied research prospects aimed at solving various post-harvest problems and particularly those which result during the export of FVRC's work has also been done on the physiology and pathology of FVRC's and in particular investigation on:-

- (i) the physiological and chemical processes in the harvested fruit and vegetable;
- (ii) curing root crops at different temperatures;
- (iii) post-harvest fungi and their control by chemical physical and biological means;
- (iv) handling of fruits and vegetables after harvesting, by waxing, packaging and cooling.



**WOMEN'S DESK**  
**MINISTRY OF HOME AFFAIRS.**  
**INDUSTRIAL RELATIONS AND HOUSING**

Tel. No. 2401 Ext.

Our Ref.....

Your Ref.....

**ROSEAU,**

**COMMONWEALTH OF DOMINICA,**  
**WEST INDIES.**

**15th October, 1982.....**

The Director,  
 Department of Scientific and  
 Technological Affairs,  
 Organisation of American States,  
 1819 "M" St., N.W.,  
 Washington, D.C. 20006.

Dear Sir,

..... Enclosed are a number of Research project proposals that have  
 been drawn up as a result of intensive discussion.

Most of these are concerned with the reduction of Post-Harvest  
 losses which is one of the main areas of concern in Dominican  
 agriculture.

We hope that our proposals will meet firm support.

Yours sincerely,

.....  
**ISMAEL ROMER (IIR.)**  
 Delegate to the Puerto Rico conference in Agricultural Research  
 Priorities in the Caribbean Basin.

TITLE OF PROJECT: The Dehydration and Packaging of Sorrel Calycos

PRINCIPAL INVESTIGATOR:

NAME : Claudia Ballet (Mrs.)  
TITLE : Produce Chemist  
ADDRESS : Botanic Gardens, Ministry of Agriculture  
TELEPHONE : 2732

EXECUTING INSTITUTION

The Women's Dept., Ministry of Home Affairs, Industrial Relations and Housing.

DURATION OF THE PROJECT : 6 months

TOTAL BUDGET REQUEST: US\$ 16,530.18

CONTRIBUTION OF INSTITUTION OF OR COUNTRY

Technical assistance in the setting up of the plant, and constant supervision. This assistance will come from the Produce Chemist who is employed by the Government.

1. TITLE OF PROJECT: The Dehydration and Packaging of Sorrel Calyces

2. BACKGROUND AND PRESENT STATE OF KNOWLEDGE:

The content of this proposal is based on preliminary work conducted on the drying of sorrel in 1976 and 1977 at the Produce Chemist Laboratory. They are initial efforts aimed at establishing drying parameters that yielded an acceptable dried product, with satisfactory storage characteristics.

Sorrel calyces are primarily used for making a very refreshing drink, popular in the Caribbean.

It also has potential as a natural dye, and has been approved by USDA.

3. BENEFITS TO COUNTRY AND REGION

A number of women's groups, youth groups in addition to the many sorrel growing farmers will benefit from this project. It must be noted that our similar project has been approved and funded by the Organisation of American States. This one project, however, can only service one geographical area of the island. This proposal is being put forward in order to be able to service as wide an area as possible. Much and badly needed foreign exchange is to be expected from this project as well as employment for a large number of persons.

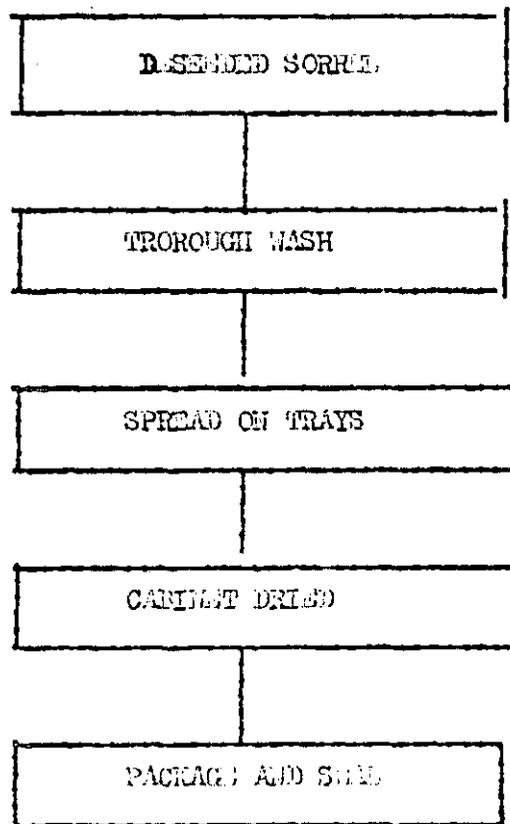
It is to be hoped that the equipment can and will be used in the off-season sorrel period for the following:-

1. The plant could be used to dry the agricultural product (coconut mainly, also coffee and cocoa) of farmers at an agreed on rate.
2. The unit could comprise the first input of the establishment of a "dehydration unit" which could be charged with the responsibility of researching the dehydration of other crops (roots crops, vegetables) as well as the grinding (composite flours, dried herbs). This drying and packaging of spices could also be an area of activity of that unit.

4. PLAN OF WORK

The flow diagram of the process is given below. The deseeded sorrel will be washed thoroughly, spread on trays up to 2 inches high and dried at 50 - 60°C for 6 - 7 hours, in a forced air convection cabinet drier. This operation will reduce the moisture content of the sorrel from 80 - 85 percent to 13 - 17 percent. The dried sorrel will be packed in polythene bags (should be packed in cellophane bags preferable to avoid loss of Flavour and texture for as a result of re-absorption of moisture from the atmosphere) and stored at room temperature.

FLOW DIAGRAM



5. PERSONNEL AND FACILITIES AVAILABLE

The project will be executed as a direct liaison between the Programme Officer and the Produce Chemist.

Mrs. Ismaïe Royer (BSc. Agriculture)

Programme Officer

Women's Desk

Ministry of Home Affairs

Mrs. Claudia Bellot (BSc. Chemistry)

Produce Chemist

Ministry of Agriculture, Lands and Fisheries.

6. BUDGET (Request from USAID/CAS)

a. Salaries and Wages	26,750.00
b. Supplies and Raw materials	1,325.73
c. Equipment :	5,631.82
1 Cabinet dryer	
1 Solar dryer	757.52
1 heat sealer	190.00
d. Cost involved in export of samples to different areas in the Caribbean for market-testing, and also travel for promotional reasons	1,825.00
	<u>26,280.73</u>

7. EXPECTED DURATION : Twelve months

8. GOVERNMENT'S CONTRIBUTION

Salaries - Produce Chemist 26,650.45

Transportation (local)

2 \$151/month for 12 months 2,412.00

28,062.45

Title of Project: Determination of Maturity Indices for Mango  
and Avocado Pears.

Background

Dominica has always been at the Caribbean level, a significant producer of Avocado pears and mangoes. Recently, the British Development Division in the Caribbean funded a tree crops diversification programme in which export production is expected to increase by 1732 tons. This development will increase the amount of fruit available for sale on the regional and extra-regional markets.

However, a great deal of post harvest losses have been experienced with these fruits for two main reasons:-

- a. With traditional varieties of these fruits, experienced farmers and agriculturists have developed indices for maturity and have been able to pick fruits at the right maturity. With the introduction of new varieties, traditional indices are no longer correct, so that in one shipment to the United Kingdom last year, fruits ripened at different times, thus disrupting marketing arrangements.
- b. Dominica because of its topography, is subject to climatic differences in different areas. A major problem arises when fruits from some areas of the island mature at times of the year when the demand for these fruits on overseas markets is low.

The project proposes that a study of the maturity indices of these fruits be made with a view to producing and harvesting top quality fruit at the right time of year.

Benefits.

- a) Inform farmers of correct harvesting times and practices.  
Increased production of harvestable fruits.  
Improved quality of fruits on arrival at overseas markets.  
Reduced post harvest losses.

Plan of Work

Year 1

- a. Observational plots will be selected representative of the various ecological areas where the crops are grown.
- b. These plots will be fenced off to keep out animals and discourage pilfering.
- c. The plots will be monitored monthly till flowering and bi-weekly thereafter to collect the following data:

- i. time and duration of flushing
  - ii. interval from flushing to flowering
  - iii. time and duration and extent of flowering
  - iv. interval from flowering to fruit maturity.
- d. Fruit samples will be taken at various intervals from flowering to maturity and subjected to various tests to determine the following data:
- i. shelf life following various storage regimes
  - ii. ripening uniformity
  - iii. development of Anthracnose disease.
  - iv. optimum harvesting interval.
- e. Fruit samples will be laboratory tested for; soil and sugar content, thickness of skin, consistency of pulp in order to relate these parameters to the optimum harvesting interval.

#### Year II

- f. Trials will be carried out on the observational plots to determine the effect of the following practices on the maturity indices:
- i. fertiliser application
  - ii. pest and disease control
  - iii weed control
  - iv soil and water conservation
  - v different ecological areas
  - vi application of plant hormones

It is recommended that the principal investigator and the Produce Chemist visit Tropical Products Institute in the United Kingdom and the University of Florida, United States of America to observe and become familiar with the methods used in determining ripening indices in these two countries which incidentally, are the two proposed markets for the fruits under study.

#### Personnel and facilities available

Project leader: Urban M. Martin  
 BSc Agricultural Botany, Reading University U.K.  
 BSc Crop Protection

Present Post: Crop Research Officer

Elton Lawrence  
 BSc Food Technology, London University, U.K.

Present Post: Produce Chemist.

Angus Mc. Intyre  
 Diploma in Tropical Agriculture, JSA, Jamaica.

Present Post: Research Assistant

Budget (Request from USAID/OAS)

	<u>Year 1</u>	<u>Year 2</u>	<u>Total</u>
a. Salaries and wages			
Field Assistant	US\$ 1,413.18	US\$1,537.42	US\$3050.60
Casual Labour	376.79	751.58	1128.36
b. Supplies and equipment			
Pesticides	568.18	568.18	1,136.36
Fertilizers		681.81	681.81
Spraying equipment		1,515.15	1,515.15
Miscellaneous tools (forks, spades etc)		303.03	303.03
c. Travel			
Visit to T.P.I. (London)	1,703.03		1,703.03
Visit to University of Florida (USA)	1,075.76		1,075.76
Per diem	1,060.61		1,060.61
	6.2	5.4	US\$11,074.23
			642.41
B. <u>Government contribution</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Total</u>
a. Salaries	8,200.00	9,019.70	17,219.70
b. Transport	1,636.36	3,272.73	4,909.09
			US\$21,973.65

Personnel and laboratory equipment from the Produce Chemist Laboratory will also be used during the course of the Project.

RESEARCH PROPOSAL FOR SUPPORT BY OMS

TITLE OF PROJECT: Banana Raisin Project.

PRINCIPLE INVESTIGATOR.

NAME: Claudia Bellot.

TITLE: Produce Chemist

ADDRESS: Botanic Gardens, Roseau, Dominica.

TELEPHONE: 2732.

\*\*\*\*\*

INSTITUTION (NAME AND ADDRESS)

Pointe Michel Women in Action Group

Pointe Michel

DOMINICA.

DURATION OF PROJECT. 6 months

TOTAL BUDGET REQUEST: US\$3,695.00

CONTRIBUTION OF INSTITUTION OR COUNTRY.

Technical Assistance.

Labour to build furniture.

Title of Project: Off season production of tomatoes by  
'Ring Culture' method.

L.O. ...

### Background

Tomato is a traditionally dry season (January to May) crop in Dominica. This is due mainly to the lower yields obtained during the wet season (June to December) because of increased disease incidence (damp and high humidity) and the physical damage done to the crop by the frequent heavy downpours. The technology is now available to enable the growing of tomato during the wet season in order to take advantage of the much better prices during that period.

However, this technology has never been applied in Dominica because it needs to be adapted to suit our conditions.

### Benefits.

- a. Economic profitability to the farmers through the higher prices.
- b. Import substitutions - one of the key areas of emphasis for our Agricultural Development.
- c. Constructive employment creation especially for the youth and landless as this venture requires very little land space and the necessary skills are quite easily learned.
- d. Improvement in the diet and health and nutrition of the people as presently vegetables do not form a regular part of the diet of a large percentage of the population.

### Plan of Work.

The trial will be set up at the Hillsborough Agricultural Station. A wooden framework supporting a simple pitched roof - a layer of clear plastic sandwiched between two layers of poultry wire, one to support the plastic, the others to anchor it - sloping from a height of seven feet to a height of six feet will be constructed. The size of the shed will be 50ft. by 30ft.

The ring culture system to be tried entails plants cultivated in one foot square, bottomless wooden boxes or tins, filled with sterilised soil or compost and set on a gravel base.

The plants will be tied to wires stretched between supporting posts. The boxes will be placed in double rows, thirteen inches apart, with a walk way of twenty-six inches.

Irrigation will be done to the gravel only and not the soil or compost to which the fertiliser will be applied.

A regular 10 - 14 day spray programme will be followed to control pest and disease outbreaks.

A visit by the Project leader, to Jamaica where similar operations are already in operation, to observe their methods and discuss the problems they faced, would greatly facilitate the successful completion of this research operation.

Personnel and Facilities available.

- Project Leader:
1. Mr. U. Martin - Crop Research Officer  
BSc Agricultural Botany; MSc Crop Protection  
Reading University, U.K.
  2. Mr. A. Guye - Director of Extension
  3. Mr. A. Mc. Intyre - Research Assistant  
Diploma in Tropical Agriculture,  
JSA, Jamaica.

The work involves largely field work. The trial will be set up on a site located within the Government Agricultural Station of Hillsborough in the West Central district of the island.

Budget.

a. Salaries and wages:	1. Construction of Shed	\$378.79
	2. Building of boxes	\$151.52
	3. Casual Labour	\$340.91
b. Supplies and Equipment		\$1,136.37
c. Travel - trip to Jamaica for 1 week - ticket		\$227.27
	per diem US\$90	\$450.00
	per day	

The project will be carried out both in the field and in the laboratory.

The field work will entail setting up observational plots around the island.

The laboratory is sufficiently equipped to perform the various tests required.

Request from USAID/OAS

a.	Salaries and Wages	-	Year 1	US\$871.21
b.	Supplies and equipment	-		81,136.36
c.	Travel	-	1. Jamaica for 17 days	- \$454.55
		-	2. Board/lodge US\$1530 (US\$90/day)	8579.55
			Total	- US\$3,041.67

Government Contribution.

Salaries - Year 1	-	US\$4,100.00
Transport	-	US\$ 818.18
		<hr/>
Total	-	US\$4,918.18
		<hr/>



NAME OF PROJECT

"The Microbial Fermentation of Waste Green Bananas  
and Banana Peel For The Production of Microbial  
Protein to be incorporated into Animal Feeds"

## Introduction

Jamaica, like most developing countries is:

- (a) deficient in protein and
- (b) faces a severe foreign exchange problem

This protein deficiency is seen to be of great significance in the animal feed industry.

In 1981 approximately 234,000 tons of animal feed were consumed. Although all animal feeds are manufactured in Jamaica all the components are imported. The main components being soybean and corn, were imported at a cost of US\$35.4 million.

The ensuing project looks at a potentially simple and inexpensive method of utilizing waste material from Agro-based industry for the production of high protein material comparable in composition to soybean to be used as a partial replacement for soybean and corn.

In 1981 a total of 207,476 tons of bananas were produced. Of this quantity, approximately 88,000 tons were rejected.

Further wastes from bananas are generated by the Banana Chip Industry. It is estimated that some 16,000 tons of banana peel are generated annually. Currently, all the waste peel is dumped.

It is estimated that one can realistically recover annually some 30,000 tons comprising both waste bananas and peel.

## Goals and Objectives

The objectives of the project are:

- (i) to produce microbial protein comparable to soybean by simple and inexpensive non sterile solid substrate fermentation methods
- (ii) to utilize waste bananas and peel for use in animal feed manufacture
- (iii) to establish a small scale industry to produce microbial protein from waste bananas and peel for use in animal feed manufacture having an output capacity of about 50,000 tons annually.

3 The production is aimed at substituting 15 - 20 percent of soybean and corn currently imported for use in animal feed, thus reducing foreign exchange spending.

#### Work Plan

The project is divided into four phases as follows:

- Phase I            Laboratory Experimentation
- (a) Chemical assessment of raw material for suitability
  - (b) Screening of microorganisms to obtain most suitable feed organism and protein yield
- Phase II           Semi-Pilot Plant Scale
- (a) To observe parameters in open trays
- Phase III          Pilot Plant Scale
- (a) To produce microbial protein/output capacity one ton per week
- Phase IV          Feeding Trials - to determine
- (a) Effects on weight gain
  - (b) Toxicity and Carcinogenicity
  - (c) Lack of teratogenicity

#### Benefits to Country

1. Reduction in foreign exchange spending. Foreign exchange savings for twenty percent substitution level would be approximately US\$7 million annually
2. Provide direct employment for approximately ten persons
3. Solving a serious national problem
4. Help to build our technological base.

Cooperative Arrangements

Arrangements have been made with the Ministry of Agriculture, Livestock Division, for conducting feeding trials.

- Personnel
- (i) Mr. McCorkle,  
Director, Ministry of Agriculture  
Livestock Division,  
Bodles, St. Catherine
  - (ii) Mr. C. Gordon  
Ministry of Agriculture  
Livestock Division  
Bodles, St. Catherine

Tentative arrangements have been made with the University of the West Indies, Department of Biochemistry, Mona, for analysing amino acid profile

Biographical Data on Principal Investigator

- Name : Mr. Gaston Foderingham B.Sc. (Hons)
- Title : Microbiologist/Research Scientist
- Education : B.Sc.(Hons), University of Guelph, Canada (1975)
- Experience : Seven years research experience in Food Technology and Microbiology  
Microbial Corrosion of Oil equipment in the Petroleum Industry  
Water and Food Analysis, Quality Control (Dairy)  
Single Cell Protein Production from Cassava  
Production of Baby Food from Local Materials  
Development of Corn and Meat Based Foods.

TASK DESCRIPTION	CALENDER MONTHS AFTER INITIATION OF PROJECT																			
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	
Techno-Economic Survey																				
Laboratory Experimentation																				
Semi-Pilot Scale																				
Pilot Plant Scale																				
Feeding Trials																				
Process Report																				



PROPOSAL TO OAS - SCREENING AND  
EVALUATION OF LOCAL PLANTS FOR USEFUL CHEMICALS

INTRODUCTION

An estimated \$10 million is spent annually on the importation of speciality chemicals - insecticides, fungicides, herbicides. They play a major role in the agricultural sector in planting, growing, and storage of a wide variety of crops. In many industries such as Banana, Coffee, Cocoa, specialised chemicals are indispensable. As a sub-tropical country insecticides are used in almost every household.

Historically there is a number of plants reputed to contain principles of medicinal and insecticidal values. Prominent among these plants are those from the piperaceae family. They are known to contain essential oils, resins, bitter principles and physiologically active compounds. It is reported that three compounds having insecticidal properties have been isolated from black pepper, one of these reported as having a toxicity equivalent to pyrethrum.

The pepper elder (*piperoma pellucida*) a plant growing profusely along the wet slopes of Jamaica has been under investigation for insecticidal properties. It is one of a number of plants slated for such investigations, the choice being influenced by the availability.

Preliminary investigations suggest that the crude solvent extract could be more toxic than a black pepper extract when tested against roaches, ants, grasshoppers, centipedes and moths.

The studies so far undertaken have been joint efforts with the University of the West Indies, Ministry of Agriculture and Storage and Infestation Division (Ministry of Industry and Commerce).

The survival of the agricultural industry depends to a very large extent on the ability to control or eradicate pests. The health of the nation also hinges on insect control. A great strain is placed on the nation's budget since all the chemicals are imported, resulting in scarce foreign exchange expenditure.

GOALS AND OBJECTIVES

The project seeks to achieve:

- a) research of indigenous plants to identify those containing chemicals with insecticidal or other beneficial properties.
- b) the identification and propagation through tissue culture or other means of the most suitable plants for production.

- c) the identification of such localities best suited for cultivation of selected varieties.
- d) the establishment of an industry for producing chemicals from plants for domestic and export markets.

TIME TABLE

See Attachment

BENEFITS TO COUNTRY

- a) A lessening of imports of speciality chemicals
- b) Increased employment, particularly in rural areas, arising from the establishment of such cultivations and their subsequent upkeep.
- c) Potential to increase foreign trade in marketing products accepted internationally.

CO-OPERATIVE ARRANGEMENTS

The SRC will conduct laboratory studies in the separation, identification and formulation.

Organizations and agencies assisting are:

- I Ministry of Agriculture  
Crops and Soils Division  
Plant Protection Division  
Hope, Kingston 6

Mr. N. Singh - Acting Director, Research and Development

Who will undertake the agricultural research in planting, growing, harvesting.

- II Ministry of Industry and Commerce  
Storage and Infestation Division  
Hope Road, Kingston

Mrs. C. Graham - Head of Division

To determine LD<sub>50</sub> and other factors necessary for evaluation of efficacy of extracts and isolated compounds.

- III University of the West Indies  
Entomology Department  
Mona, Kingston 7
- Dr. A. Mansingh, Reader in Entomology
- To assist in entomological studies
- IV Local Manufacturer
- To undertake the production and marketing

BIOGRAPHICAL DATA

Name : John Archibald Wright

Title : Director, Research & Development

University Education : B.Sc. (UWI) 1968  
PhD. (UWI) 1973

Experience : December 1971 - February 1975 Scientific  
Officer, Scientific Research Council  
March 1975 - July 1978 Technical Manager,  
Colgate Palmolive Co. (Ja.) Ltd.  
August 1978 - September 1981 Plant Manager  
Colgate Palmolive Co. (Ja.) Ltd.  
November 1981- December 1981 Consultant,  
Scientific Research Council  
January 1982 - present Director, Research and  
Development, Scientific Research Council

Research Interests : Natural Products  
Industrial Chemistry

Other Activities : Member, Food Packaging Committee , Jamaica  
Bureau of Standards  
Member, Soaps and Detergents Committee, Jamaica  
Bureau of Standards

WORK PLAN

1. Optimisation of extraction methods (one month)
2. Purification of extract. (one month)
3. Plant survey to determine:
  - (a) population density throughout the island
  - (b) climate condition
  - (c) soil type
  - (d) compatability with other crops
4. Isolation of compounds by chromatographic methods. (one month)
5. Identification of compounds by nuclear magnetic resonance, infra-red M.V. spectroscopy and gas chromatography/mass spectroscopy
6. Biological tests to determine the LD<sub>50</sub>, mammalian toxicity, lethal dosage for a variety of insects
7. Extraction and purification will be scaled up to pilot plant level.



PROJECT PROPOSAL

Institution

Scientific Research Council  
P.O. Box 350  
Kingston 6, Jamaica

Principal Investigator

Dr. J.A. Wright  
Director, Research & Development  
Scientific Research Council  
P.O. Box 350  
Kingston 6, Jamaica  
Tel: 927-4471-4

Duration of Project

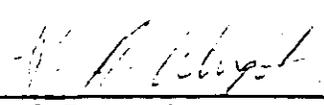
Two Years

<u>Total Budget</u>	US\$158,248	First year	US\$95,513
		Second year	US\$62,735

Contribution of Institution

Staff : To be determined  
: S.R.C. will be responsible for all  
Administrative functions

Equipment : Limited facilities such as extraction  
equipment, infra-red spectrophotometer,  
UV spectrophotometer and an NMR are  
already available

  
\_\_\_\_\_  
Principal Investigator  
J.A. Wright  
Director, Research & Development  
August 10, 1982

\_\_\_\_\_  
Authorising Official  
August 10, 1982  
M.O. Hamilton  
Executive Director  
Scientific Research Council  
P.O. Box 350  
Kingston 6, Jamaica  
Tel: 927-4471-4

## OAS PROPOSAL - ESSENTIAL OILS

### INTRODUCTION

A large number of plants exist in Jamaica from which may be extracted essential oils and other principles used widely in the food, drug, and cosmetics industries. To date, no sustained research has been undertaken to fully commercialize a number of them. Among the plants which are known to grow locally are:

pimento (all spice)  
ginger  
lemon grass  
basil  
pine  
cedar (cedrella odorata)  
eucalyptus

The essential oils of all the above are in good demand internationally. Locally there is a demand for these products along with others, but this demand is not met, either from the unavailability or the cost. Apart from the essential oils from citrus plants (orange, lime, lemon), and pimento oil (leaf and berry) there is no production of essential oils.

On the other hand there is manufacture of drugs, beverages, foods, cosmetics, soaps, disinfectants, perfumes, in which a wide variety of essential oils is used. Most of the essential oils used are therefore either imported as whole oils or as components in perfumes and/or other finished product formulations.

In addition, spices from pimento and ginger which were formerly supplied from Jamaica have not increased in sales but through competition and chemical synthesis have surrendered a sizeable portion of the market.

Investigations in certain aspects of essential oils from local plants have been made by local groups and the SRC has conducted research specifically to determine yields and characterisation of certain oils. Agronomic studies are expected to be undertaken by the Ministry of Agriculture and joint and independent studies in tissue culture and alternate uses for pimento oil are now planned by the SRC and U.W.I.

More recently collaborative studies have been initiated between the Jamaica National Export Corporation and SRC to bring financial relief to distillers of pimento leaf oil; now experiencing difficulty in marketing the oil produced.

## GOALS AND OBJECTIVES

- a) To conduct research and development leading to the production of essential oils to form the basis for establishing industries using these essential oils.
- b) To establish experimental plots for estimation of yields of useful extracts from plants as determined by laboratory and pilot plant studies.
- c) To place the existing essential oils industry on a very sound footing through research in tissue culture technique, and to identify alternate uses of essential oils.
- d) To implement the growing of other plants from which useful essential oils can be obtained.
- e) To recapture, maintain and improve the strong position once enjoyed by traditional essential oils - ginger and pimento.

## BENEFITS TO COUNTRY

The establishment of manufacturing industries utilising indigenous raw materials from which would result the following:

- a) increased employment opportunities in the agricultural sector of rural areas, as well as in the manufacturing sector.
- b) increased land utilization.
- c) increased foreign exchange earnings via exports.
- d) a decrease in imports of chemicals and other raw materials.
- e) utilise more fully the capacity of distillation plants now idle for up to eight months of the year.
- f) create an opportunity for scientists to fully investigate tissue culture techniques applicable to local agriculture.

## CO-OPERATIVE ARRANGEMENTS

Proposals have been made from various scientists outlining details for co-operation in this project. The I.D.R.C. has expressed interest to collaborate in this project

The SRC will be the co-ordinating body with responsibility for laboratory research to determine yields, the assay of extracts and isolation of components as necessary, as well as investigate uses of plant extracts for existing and new products.

Other participants include:

I U.W.I.  
Department of Botany  
Mona, Kingston 7

Dr. K.E. Magnus - Head, Department of Chemistry  
Pro. G. Sidrak - Head, Department of Botany  
Dr. L. Coke - Senior Lecturer, Department of Botany

Who will undertake methods for tissue culture propagation, identification and classification of suitable varieties of plants.

II Ministry of Agriculture  
Crops and Soils Division  
Hope, Kingston 6

Mr. W. Singh - Acting Director, Research and Development

Will undertake the agronomic aspects of the project (variety selection, planting, growing and harvesting techniques).

III Pimento Distillers Association

To make available lands for trial, and equipment for plant distillation studies.

IV JNIP - JNEC

- a) To undertake such promotional work as is necessary to secure markets products
- b) To promote the establishment of industries producing finished goods from contemplated extracts.

Biographical Data on Principal Investigator

Name : John Archibald Wright

Title : Director, Research & Development

University Education : B.Sc. (UWI) 1968  
PhD. (UWI) 1973

Experience : December 1971 - February 1975 Scientific Officer, Scientific Research Council  
March 1975 - July 1978 Technical Manager, Colgate Palmolive Co. (Ja.) Ltd  
August 1978 - September 1981 Plant Manager Colgate Palmolive Co. (Ja.) Ltd.  
November 1981-December 1981 Consultant, Scientific Research Council  
January 1982 - present Director, Research and Development, Scientific Research Council

Research Interest : Natural Products  
Industrial Chemistry

Other Activities : Member, Food Packaging Committee, Jamaica Bureau of Standards  
Member, Soaps and Detergents Committee, Jamaica Bureau of Standards



INSTITUTION

Scientific Research Council  
P.O. Box 350  
Kingston 6  
Jamaica W.I.  
Tel: 92-74471-4

PRINCIPAL INVESTIGATOR

Al Binger, PhD.  
Head, Engineering and Applied Sciences Unit  
Scientific Research Council  
P.O. Box 350  
Kingston 6  
Jamaica W.I.  
Tel: 92-74471-4

DURATION OF PROJECT

Approximately three (3) years

PROJECT TITLE

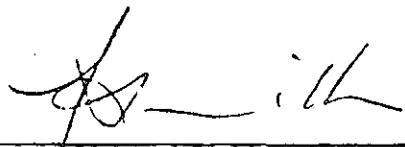
Ethanol production from Agricultural Feedstocks

TOTAL BUDGET  
US\$189,793

FIRST YEAR	US\$39,300
SECOND YEAR	85,000
THIRD YEAR	65,493

  
\_\_\_\_\_  
Al Binger, PhD  
Head, Engineering and  
Applied Sciences Unit

August, 1982

  
\_\_\_\_\_  
M.O. "Pat" Hamilton, PhD.  
Executive Director  
Authorizing Official  
Scientific Research Council  
P.O. Box 350  
Kingston 6  
Jamaica W.I.

August, 1982

## INTRODUCTION

Ethanol has a variety of uses in both the Chemical and Processing Industries. As a Non-toxic Organic Solvent it has application in a number of extraction processes including the extraction of essential oils from heat sensitive organic materials. It is also a major raw material in the production of plastics and can also be used for the production of food preservatives such as Acetic Acid.

With the ever increasing cost of motor fuel, ethanol is now being used as an addition or as substitute for petroleum based fuel. The use of ethanol whether as a fuel additive or substitute is yet to be fully explored and documented. The Brazilian experience varies depending on which side of the story is presented. The Brazilian however, have the largest fuel ethanol production and utilization programme. A programme utilizing Sugar Cane as the feedstock. Because of Contracts under the LOME Convention Jamaica and other English Speaking Caribbean Countries have Contracts to supply significant quantities of Sugar to the European Common Market. As a result Sugar Cane is not a potential feedstock for ethanol in the near future.

Our project proposes to examine the potential of producing ethanol from starch based crops which can be grown on marginal lands, and from seasonal crops such as mangoes and breadfruit, as a significant quantity of these rot during the season. Starch material made available as a result of natural disaster and poor marketing condition are also potential feedstock.

## OBJECTIVES

The first aim of the project is to conduct Laboratory Scale comparative investigations on a number of locally cultivated crops, as to assess which crops have the best potential as being raw material for ethanol production. Examination of the possibilities for using locally available enzymes in fermentation and utilization of by-products will also be examined.

Preliminary economic evaluation studies will then be made for each identified crop to high-light where further emphasis would most likely give fruitful results.

The second aim would be identifying the proper cultural practices for growing the identified crops on pilot scale farms, so as to obtain information for the Economic Evaluation for the commercialization prospects. Similarly the techniques for producing ethanol would have to be stream lined to obtain optimum yield and minimum production cost. From these results the potential for commercialization would be seen.

#### WORK PLAN

A literature survey has been conducted on estimated values of the starch content of some of the locally grown crops. This is currently being supplemented by laboratory investigations with these crops to produce ethanol. This involves fermentation of the raw materials, after preparation, for varying periods, as well as using different hydrolysing agents. The preliminary results are encouraging.

Further work on different crops is required. Subsequently, operating conditions such as temperature, pH, fermentation period and distillation conditions will be varied to determine the effects of such changes on the yield. The results from these investigations would provide a basis for decisions on which crops should be further investigated at a pilot plant level (i.e. agronomic and chemical processing). The emphasis for chemical processing will be to evaluate the economics of the process, as well as optimization of operating and design criteria. The results will also be used for scale-up from pilot plant to commercial scale operations. The pilot agronomic phase will be to generate yield and cost production data.

The information from both the Chemical and Agronomic studies will be used to evaluate the potential for commercialization. The estimated time scale for this project is as summarized below (see also work plan).

Laboratory experimental work	12 months
Agronomic studies (preliminary economic evaluation)	23 months
Purchasing and setting up of pilot plant equipment	3 months
Pilot plant equipment	9 months
Pilot plant investigations	<u>12 months</u>
TOTAL	3 years

NATIONAL AND REGIONAL BENEFITS

Ethanol can be used as primary raw material in a variety of industries. With such a high demand, a economically viable process which uses locally available crops as raw materials would enhance the earning capacity of local farmers who would have a guaranteed market for their products, as well as the foreign exchange earning capacity of Jamaica as a whole.

With an economic process for production of ethanol the feasibility of conversion to fuel, gasohol, and plastics can be investigated. Such diversifications would have both national and regional benefits.

Further carbon dioxide as a major by-product of the process in manufacturing ethanol has numerous uses including soft drinks gasification, these uses would further enhance the economies at both national and regional levels. With some crops, for example, sweet corn, the stillage left after completion of the fermentation process can be used as animal feed.

PERSONNEL

- 1 Senior Research Scientist (Engineer)
- 1 Research Scientist (Chemist)
- 1 Research Scientist (Engineer)
- 1 Research Scientist (Agronomist)
- 1 Technician

BUDGET BREAKDOWN

Raw materials	US\$ 2,000
Laboratory equipment	6,000
Agronomic supplies and Equipment	15,000
Pilot plant equipment-purchased cost	17,000
Installation cost of pilot plant equipment (30% of equipment cost)	5,100
Salaries	131,693
Local travel	5,000
Overseas travel	3,000
Contingencies	<u>5,000</u>
TOTAL	US\$189,793

WORK PLAN

DURATION (MONTHS)

OPERATION	9	12	24	36
1. LABORATORY EXPERIMENTAL WORK	_____			
2. AGRONOMIC STUDIES	_____			
3. PRELIMINARY ECONOMIC EVALUATION	_____			
4. PURCHASING AND SETTING UP OF PILOT PLANT	_____			
5. PILOT PLANT INVESTIGATIONS	_____			

MINISTRY OF AGRICULTURE

KINGSTON - JAMAICA

PROJECT PROPOSAL

PROJECT TITLE: COMMERCIAL PRODUCTION OF CASSAVA FOR JAMAICA

DATE: AUGUST 1982

PREPARED BY: R.J. BAKER

PROJECT PROPOSAL -- MINISTRY OF AGRICULTURE  
KINGSTON - JAMAICA

PROJECT TITLE: COMMERCIAL PRODUCTION OF CASSAVA FOR  
JAMAICA

INTRODUCTION

Much useful work has been done on cassava in Jamaica since 1953, but so far, the programme has not reached a stage for full commercial production. This crop is now grown on a limited scale by small farmers mainly in the dry southern plains of Jamaica - (St. Elizabeth) with an estimated area of 8,000 hectares available for the production of cassava. It has been a "hit-and-run" for cassava on which the follow up for large scale production has been put back for several years.

PROBLEMS

- In 1975 a cassava mill was established in Goshen, St. Elizabeth - Jamaica to produce cassava flour to be used as 20% substitute for wheat flour in the baking industry.
- The mill has a capacity of 100 metric tons of fresh cassava roots per day an equivalent of 50 tons per shift.
- The plant would require 24,000 metric tons on double shift operating at 240 days/year.
- Present estimated yield/cassava which is 5,000 - 8,000 tons is approximately 12.5 metric tons per hectare.
- It is unlikely that the supply of cassava necessary to keep the mill in full production can be met through the productive efforts of the small farmers on 0.5 to 2 hectares.

It is important that a viable cassava industry be developed based on larger farms of 40 to 30 hectares.

Alternative uses for the crop other than flour for the baking industry should be contemplated.

A report by Dr. C.J. Allen<sup>1</sup> indicated that cassava meal may be able to replace grain in livestock ration as follows:-

Dairy Cows	20	-	100%
Pigs	15	-	60%
Poultry	10	-	15%

The leaves of cassava which contains approximately 15% crude protein can also be utilized in animal feeds.

#### PREVIOUS ACTIVITIES

The Ministry of Agriculture<sup>2</sup> conducted several trials in which D.J. Rogers unpublished data compared the HCN content of local varieties of cassava grown on Potassium deficient soils at Bodles in 1953. Further work was carried out by D.C. Webster which included:

- Cassava Variety Trial - 49 cultivars tested 1958-59.
- Time of Maturity Trial- 1960-61
- Eight cultivars from Cuba and 49 of the Rogers' collection set out as a comparison trial at Bodles and tested for starch content 1962-63.

In 1973-74 Weir/Dexter tested 2 varieties M. Coll-22 and Llanera which was introduced from CIAT - Columbia. Yield data when compared with 2 local varieties were not significant. Llanera and M.Coll-22 gave 4.9 & 5.3 Kg/plant respectively.

In 1975-76 ten (10) cultivars were introduced from CIAT - Columbia and two (2) from Costa Rica.

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<sup>1</sup>CONSULTANT - RESEARCH AND DEVELOPMENT DIVISION - JAMAICA

<sup>2</sup>INVESTIGATIONS BULLETIN - MINISTRY OF AGRICULTURE - JAMAICA - 1958-59; 1970-74; 1975; 1976.

Tuber yields of most of the introduced cultivars (1.0 - 11.30 tons/ha) were low when compared with most of the local varieties (8.2 - 21.8 tons/ha).

Other areas of work done on local and introduced cultivars included:

Fertilizer Trials and Herbicide Trials.

The latter was done in collaboration with CARDI/UWI Mona.

#### ON-GOING ACTIVITIES

- Variety Testing - local and introduced - Ministry of Agriculture.
- Intercropping of cassava with peanuts, peas, sorghum and corn - (IICA - Ministry of Agriculture). This programme includes a pruning trial.
- Investigation on the use of cassava for animal feeds - (Ministry of Agriculture Research and Development).

#### OBJECTIVES

- To develop a viable commercial cassava industry.
- To reduce the level of import of ingredients for feed in the livestock industry.
- To utilize marginal land to produce an economic crop.
- To introduce effective methods of cultural practices to reduce cost of production and increase yields.
- To develop and/or introduce simple methods in the utilization of cassava by-products.

#### GOALS

- To develop and maintain a reliable source of raw materials for the manufacturing sector and related industries.

GOALS CONT'D.

- To introduce and test high yielding varieties suitable to Jamaican conditions and to make these varieties available to the farmers at the shortest period of time.
- To produce alternative source of local materials for ingredients in livestock feeds.
- To increase the level of income for small farmers.
- To produce food for human consumption and export possibilities.
- To introduce and utilize "small" machinery for use in the industry.

WORK PLAN

	Year 1	Year 2	Year 3
- Introduction and testing high yielding varieties. )			
- Agronomy and cultural practices )			
pest disease, weed control, post )	XXXXXXXXXX	XXXXXXXXXXXXXXXXXX	XXXXXXXXXXXX
harvest physiology. )			
- Intercropping methods.	XXXXXXXXXX	XXXXXXXXXXXXXX	
- Assessment of products.	XXXXXXXXXX	XXXXXXXXXXXXXX	
- Utilization of products (animal feed, human consumption)		XXXXXXXXXXXXXXXXXXXX	
- Commercial planting (80 ha)		XXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXX
- Marketing investigations	XXXXXXXXXXXX		
- Technical Assistance		XXXXXX	XXXXXXXXXX
- Training - (including visits - two personnel)	XXXXXX		

## BENEFITS

- Saving of Foreign Exchange
- The commercial growing of cassava will act as a stimulant which should revive the traditional small planters.
- Cassava could be grown at any distance from the existing factory since the industry would not be based on the processing of fresh cassava at the mill.
- Solar energy for drying cassava chips could be done on the farms, therefore cutting back on waste and developing on farm programmes.
- Creating job opportunities in the rural areas.
- Small farmers will have a reliable source of income.
- Reliable source of raw materials will be provided for the livestock industry and human consumption.

## CO-OPERATIVE ARRANGEMENTS

- The pilot project should be done on Government owned land near the present mill.
- The Ministry of Agriculture will be the Executing Agency. Research and development of the programme including formulation of rations will be done through the Research and Development Division and the Production and Extension Department.
- The Scientific Research Council - Hope - Kingston 6 - Jamaica will do assessment of the products for toxins.

## OTHER CO-OPERATING AGENTS

### COULD BE

- Jamaica Livestock Association to assist in the utilization of feeds.
- CARDI, IICA, CIAT - To assist in securing materials, machinery and Technical Assistance.

MINISTRY OF AGRICULTURE

KINGSTON - JAMAICA

PROJECT PROPOSAL

PROJECT TITLE: A POTENTIAL FOR THE EXPANSION OF NON-  
TRADITIONAL TREE CROPS IN JAMAICA

DATE: AUGUST 1982

PREPARED BY: R.J. BAKER

MINISTRY OF AGRICULTURE - HOPE GARDENS - KINGSTON 6 - JAMAICA

PRINCIPAL INVESTIGATOR

Name: R.J. BAKER

Title: PRINCIPAL RESEARCH OFFICER - CROPS

Address: AS ABOVE

Telephone: 92-76601; 92-79831-2; 92-79830

Duration of Project: 2 - 3 years

Total Budget Request: US \$ 301,045 First Year: \$ 252,899

Second Year: \$ 48,146

Contribution of Institution or of Country: \$ \_\_\_\_\_

Signatures

\_\_\_\_\_  
Principal Investigator  
(Typed name, title and date)

\_\_\_\_\_  
Authorizing official (date)  
Performing institution  
(typed name, title, address and  
telephone)

PROJECT PROPOSAL - MINISTRY OF AGRICULTURE  
KINGSTON - JAMAICA

PROJECT TITLE: A POTENTIAL FOR THE EXPANSION OF NON-  
TRADITIONAL TREE CROPS IN JAMAICA

INTRODUCTION

<sup>1</sup>"Rural Development is thought of as a process of change which covers four independent aspects: technological, economic, socio-cultural and political. Technologically we can say that new methods and forms of production would allow increase in productivity, greater employment and greater income which allows for the creation of new roles for the members of the community. In the economic aspect, the generation of income and also of employment will in turn generate greater mobility for the affected individuals and may also allow for the movement of some individuals from the primary to the secondary and tertiary sectors of the economy. These changes will have great impact on the socio-cultural aspect because new aspirations can be created, new social organizations may spring up and a change of the social structure can be expected. The political aspect is as always the repository of the normative part of decision making and provides the guidelines that orchestrate the development. In a harmonious development a greater political participation can be expected.

Jamaica being a hilly country (80% hillside) has to develop a technology and a strategy which projects rural development using the most efficient ways to take advantage of the land resource availability.

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<sup>1</sup> R.J. BAKER - DIR. CROPS & SOILS - MINISTRY OF AGRICULTURE  
DR. PERCY AITKEN-SOUX - DIRECTOR IICA/JAMAICA.  
J.R. SUAH - HEAD CARDI/JA. (SEMINAR RESEARCH AND DEVELOPMENT  
OF FRUIT TREES (1980) RESEARCH & DEVELOPMENT DIVISION -  
MINISTRY OF AGRICULTURE - JAMAICA.

The Ministry of Agriculture is at present dedicating resources to the development of hillside agricultural technology. Within this technology fruit tree farming plays a very important role because it potentially allows technologies which serve the purpose of soil conservation and the use of defined soil areas in an economic manner. It creates gainful employment, it produces an income, it supplies the domestic market, it supplies the international market, it produces foreign exchange, it becomes an import substitution activity and it produces raw materials for potential agro-industries. The above effects of fruit tree culture serve the purposes and targets outlined by our Government for the development of the agricultural sector."

#### PROBLEMS

Mabel Tenn<sup>2</sup> (1980) indicated that perhaps too much was said on the fruits which are traditionally being processed. However these fruits are already being marketed not only by Jamaican Food Processors but also by other countries. The traditional fruit juices are already well known in markets in which we wish to export - these markets are already developed.

- The trouble is however that we are not getting our share because we do not have the local production of raw materials.
- Until we plant these orchards, large exports of tropical fruits and juices will remain wishful thinking.

---

<sup>2</sup> A DIRECTOR - GRACE KENNEDY & CO. LTD. - JAMAICA -  
TREE CROPS - COMMENTS ON PROCESSING ASPECTS

PROBLEMS CONT'D.

H. Hamilton<sup>3</sup> (1980) "wished all to seriously review the role of fruit tree production and to take advantage of the lucrative markets that awaits us.

- We have the necessary marketing channels to service efficient and reliable production."

The problems are clearly:

- Wishful thinking (to start the planting of long term crops).
- To initiate pioneer commercial ventures in tree crops.
- Capital outlay.
- Technology based on:
  - (i) efficient land use - "zoning" including high elevations
  - (ii) efficient production and post harvest physiology
  - (iii) efficient use of by-products.
- Identification of sufficient quantities of suitable varieties.
- Meeting of market standards.

Varieties which are:-

- Subject to alternate bearing.
- Subject to pests and diseases.

---

<sup>3</sup> JAMAICA EXPORT TRADING CO. LTD. (JETCO) - FRESH EXPORT MARKET FOR NON-TRADITIONAL FRUIT CROP.

The crops selected for inclusion in this project for expansion are:

- Soursop (Annona muricata)
- Naseberry (Manilkara zapota)
- Mango (Mangifera indica)
- Cashew (Anacardium occidentale)

#### IMPORTANCE OF SOURSOP

Soursop has the potential as an industrial commodity - fresh fruit

- processed for puree, nectar, ice-cream and jelly
- fruit contain fructose, glucocose and pectin that could be important by-products
- tree is easily propagated
- plants will produce fruits in 3 years.

#### NASEBERRY

- fresh and processed fruits for export
- grows well on shallow stony soils in dry areas
- does not compete for arable land
- easily propagated.

#### MANGO

- as a fresh fruit, juices for the local and export market
- varieties suitable for local and export markets have been identified, most of which are in museum plots in Jamaica.  
These include Keit, Parri, Tommy Atkins, Kent.
- Sites for growing this crop without competition with other crops have been identified.

CASHEW

- All portions of the crop can be utilized.
- Processed for jams, juices and roasted nuts.
- Can be considered on a cottage industry basis (as in India, Madagascar).
- Areas for growing this crop are clearly defined.

EXPORT OF FRESH FRUIT - Selected statistics - (Kilograms)

Product	1973-74	1974-75	1975-76	1976-77	1977-78
Soursop	11,861	13,239	15,952	22,678	16,530
Naseberry	2,474	5,442	5,257	3,445	3,019
Mango	123,333	109,965	180,815	195,346	114,927

GOALS AND OBJECTIVES

It is within the current National Development Plans that this project is identified to revitalise the agricultural sector.

OBJECTIVES

- To establish commercial orchards of tree crops capable of taking advantage of lucrative markets available to us.

At present the growing of tree crops is scattered and farmers show little interest to invest into capital programmes where returns on investment is a long term one.

- The ultimate objective is that government should initiate pioneer work in commercial tree crop planting in selected locations.

GOALS

- To identify and to propagate high yielding varieties with export potentials.
- To identify rootstock suitable to the environment.
- To provide planting materials of these varieties in commercial quantities\*
- To provide technology based on efficient production of the crop.
- Establishment of commercial - plantings in suitable environment.
- Assessment of agro-industrial developments on cottage industry in or outside of these areas.

Crop	Quantity*	Spacing	Effective Area to be occupied
Soursop	34,000)	18"x18" (5.5m	100 hectares
Naseberry	34,000)	x 5.5)m	100 hectares
Mango	72,000	30'x12' (9.2x3.7)m	240 hectares
	28,000	30'x30' (9.2x9.2)m	233 hectares
Cashew	100,000	(9.2 x 9.2)m	833 hectares

WORK PLAN

- The programme is to be initiated firstly on Government owned land and secondly on farmers holdings.  
It is envisaged that at least 40% will be initiated on Government land.
- Plants will be established in orchard style where possible followed by plantings in pasture, intervals (especially on sugar cane lands) and at fences.  
(N.B. Cashew is resistant to limited amount of fire).
- The project will therefore lend itself to the effective number of trees planted.

WORK PLAN CONT'D.

- Trees would not be scattered but "zoned" in areas for marketing arrangements and agro-industrial developments.

ACTIVITIES - (Naseberry, Soursop, Cashew, Mango)	Location	Duration		
		Yr.1	Yr.2	Yr.3
- Selection of project staff	Kingston			
- Order of materials/equipment	"	XXXXXXXX		
- Identify and propagate high yield- ing varieties	Land Autho- rities - Rural	XXXXXXXXXXXX		
- Provide planting materials	) Parishes			
- Establishment of commercial planting	Selected Parishes approx. 5 locations		XXXXXXXX	
- Assessment of markets	) Kingston & Rural	XXXXXXXXXXXX		
- Assessment of Agro-industry)	Parishes			
- Technical Assistance	"	XXXXXXXXXX		

BENEFITS

- Fresh fruits, fruit juices and other processed commodities will be available from a reliable source for the export market.
- Securing Foreign Exchange at the earliest possible time as most crops will start to produce 3 - 5 years.
- Creating agro-industry and job opportunities in the rural areas.

CO-OPERATIVE ARRANGEMENTS

- The programme is to be operated as part of the Ministry of Agriculture under the control of the Production and Extension Staff.
- The programme will rely heavily on support and co-ordination from the Research and Development Division.
- Other collaborative efforts would lie in the institutional and organizational framework, in which the projects will establish links with institution wherever and whenever common objectives are envisaged.
- Scientific Research Council (SRC)
- Jamaica Industrial Development Corporation (JIDC)
- Sugar Industry Research Institute (SIRI)
- IICA/CARDI
- Jamaica Export Trading Company (JETCo)
- Ministry of Industry and Commerce (MIC)

INSTITUTION (Name and address)

MINISTRY OF AGRICULTURE - HOPE GARDENS - KINGSTON 6 - JAMAICA

PRINCIPAL INVESTIGATOR

Name: R. J. BAKER

Title: PRINCIPAL RESEARCH OFFICER - CROPS

Address: 92-76601; 92-79831=2; 92-79830

Telephone:

Duration of Project: 2 - 3 years

Total Budget Request: US \$ 790,785 First Year: \$ 494,157  
Second Year: \$ 296,628

Contribution of Institution or of Country: \$                     

Signatures

\_\_\_\_\_  
Principal Investigator  
(Typed name, title and date)

\_\_\_\_\_  
Authorizing official (date)  
Performing institution  
(typed name, title, address and  
telephone)



Certain types of "kraft papers", such as paper bags, are low in lignin content, contain large amounts of potentially digestible cell wall constituents, and show large digestion rate constants in vitro; others, such as unwaxed corrugated, are intermediate in these criteria (Belyea et al., 1979).<sup>a</sup> Some of these materials contain sufficient potentially digestible fiber to be useful in ruminant diets.

Millett et al. (1973)<sup>b</sup> made in vivo digestibility estimates of fibrous residues from pulping operations when these were blended with other ingredients and pelleted. Residues from a southern pine kraft mill and bleached fines from a mixed hardwood kraft mill were estimated to be 47 and 78% digestible, respectively. The same authors found that a ration containing 50% of unbleached southern pine kraft pulp supported an average daily gain of .54 kg in a trial with steers.

On the other hand, little information is available concerning the extent to which "kraft paper" can replace traditional forages as a fiber source for lactating dairy cows. High levels of intake are essential in this class of animal and steam pelleting provides a means by which molasses can be incorporated uniformly throughout the paper, thus enhancing its palatability. The present experiment will provide data relevant to this question.

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<sup>a</sup>Belyea, R. L., B. K. Darcy and K. S. Jones, 1979. Rate and extent of digestion and potentially digestible cell wall of waste papers. J. Anim. Sci. 49:887.

<sup>b</sup>Millett, M. A., A. J. Baker, L. D. Satter, J. N. McGovern and D. A. Dinius. 1973. Pulp and papermaking residues as feedstuffs for ruminants. J. Anim. Sci. 37:599.

Puerto Rico and its Caribbean neighbors face many difficult obstacles in developing their livestock industries. They all depend heavily on imported concentrate feeds. Every year millions of dollars of foreign exchange leave the islands in payment for feed ingredients. The livestock producers meanwhile reluctantly absorb the added costs of ocean shipping and complain bitterly about price controls and high feed costs.

Why the availability of few other local feed resources besides pasture?

First, little organized by-product industry exists. Most of the potential local resources lack development. Relatively few slaughter house, brewery, distillery or citrus by-products are available to the commercial feed manufacturers and still less to the individual livestock producers.

Second, the traditional feedstuffs resulting as by-products from the processing of cotton, corn and other grains are limited to a few of the islands, when imported raw materials are processed. So, the Caribbean continues to be a basic importer of feedstuffs.

Third, intense dry seasons turn previously lush green pastures into brown wastelands. "What can I feed during the dry season?" is a question frequently asked. Supplementation with hay or silage would seem a logical alternative, but neither of these has been traditionally used by the local farmers. In some areas non-existent irrigation would be needed for adequate hay production. Imported hay is a luxury.

One resource overlooked is digestible cellulose in the form of corrugated boxes and waste "kraft" papers. These materials represent treated cellulose from which most of the indigestible lignin has been removed. Supplies of waste corrugated boxes

are abundant. On some islands waste boxes are burnt as a refuse problem. A definite way to reduce the cost of animal feeding is through the use of such a local resource.

#### 4. PLAN OF WORK

##### Animals and Housing Arrangement

Twenty-four Holstein cows from the Lajas Substation herd, which reach a production of at least 15 kg of milk daily during the first 15 days of lactation, will be used in this experiment. They will commence the experiment individually on day 16 of lactation and continue therein for 90 days, until day 106 of lactation. Successively available animals will be assigned to quartets based on date of calving and one cow from each quartet assigned at random to each treatment, until completing 8 groups of 3 cows each, 2 groups per treatment.

Each group will be maintained in one of 8 sections of a concrete-paved, saran-shaded yard, equipped with a feed bunk and watering trough in each section. The floor of the yard will be washed daily with a high-pressure hose. Cows will be removed from their respective pens only during the two daily milkings.

##### Rations

Four isonitrogenous, equicaloric, all-in-one rations of the approximate formulae presented in the Table 1 will constitute the experimental treatments. Cut and pelleted kraft paper and cardboard will be supplied by Cartofibra, Inc., of Bayamón, Puerto Rico. Hay made from well-fertilized swards of 50-60 day old stargrass will be field cured and baled, then ground in a hammermill and pelleted at the Lajas Substation.

Table 1 - Tentative Ingredient Composition and Calculated Net Energy for Lactation and Crude Protein Contents of the Four Rations -

<u>Ingredient</u>	<u>Ration</u>			
	1	2	3	4
Pelleted kraft paper	45.0	30.0	15.0	0
Pelleted stargrass hay	0	15.0	30.0	45.0
Ground shelled corn	25.4	28.4	28.8	33.9
Soybean meal	17.6	13.8	12.0	6.3
Cane molasses	9.0	9.0	9.0	9.0
Animal fat	0	.8	2.2	2.8
Urea	1.0	1.0	1.0	1.0
Salt	1.0	1.0	1.0	1.0
Vitamin-mineral premix	<u>1.0</u>	<u>1.0</u>	<u>1.0</u>	<u>1.0</u>
	100.0	100.0	100.0	100.0
<u>Expected content</u> <sup>a/</sup>				
Net energy (NE <sub>2</sub> ) Mcal/kg	1.693	1.687	1.698	1.692
Crude protein (%)	13.96	13.96	13.96	13.96

<sup>a/</sup> Dry basis

The remainder of the ingredients will be purchased from commercial sources and used in the rations without being pelleted.

Feeding will be ad libitum, providing a sufficient daily allowance to obtain approximately 5% feed refusal. Samples of feed offered and refused will be taken daily and composited for determination of dry matter content weekly, of crude protein biweekly and of fibrous fractions and major minerals monthly, using standard analytical procedures.

#### Data Recording

Milk production will be recorded at each milking and milk samples from each cow taken at 15-day intervals for analysis of fat and total solids contents.

Daily feed consumption will be recorded and converted to a dry matter basis.

The cows will be weighed on a platform scale immediately after calving, on day 16 of lactation (upon commencing the experiment) and thereafter at 30-day intervals on three subsequent dates.

Estrus periods and any other relevant observations on the health and behavior of the animals will also be recorded.

#### Statistical Analysis

Analysis of variance of this experiment, which employs a nested sampling design, will be based on 23 total degrees of freedom, subdivided as follows: 3 for treatments, 4 for groups within treatments, and 16 for error. The 3 d.f. for treatments will be used to make orthogonal comparisons applicable to a 4 treatment-design with levels of one variable (fiber source) equally spaced. The response criteria analyzed will include feed intake, milk yield and composition, liveweight

changes and gross feed efficiency for milk production, during each of the individual 30-day periods and for the whole 90-day experiment.

An economic evaluation of the results will include the calculation of feed costs and monetary return above feed costs, expressed both per cow per day and per unit of milk produced, for each treatment.

The results from this experiment will be incorporated into a manuscript for publication in a scientific journal and will also be written up in the form of a non-technical article for circulation in the Carribbean area.

## 5. PERSONNEL AND FACILITIES AVAILABLE

### Investigators

Paul F. Randel (project leader) - Ph.D Louisiana State Univ. in Dairy Cattle Nutrition (1963); 20 years experience in research and approximately 40 scientific papers published.

George D. Wesoloski - Ph.D University of Illinois in Animal Nutrition (1970); 8 years experience as Nutricionist with Central Soya Corp., Decatur, Indiana; now part owner and administrator of Cartofibra, Inc., a company producing processed paper for use as animal feed.

John Fernández VanCleve - M. S. Texas Agricultural and Mechanical University in Dairy Cattle Nutrition (1980); Administrator of two dairy herds operated by Univ. of P. R. and active in research.

One or possibly two graduate students (candidates for the M. S. degree) to be assigned to work on this project either for thesis research or for credit in Special Problems courses.

### Support Personnel

Santos Noel Caraballo - Research assistant with 15 years experience assigned to the conduct of experiments.

Two experienced laborers of the Lajas Substation dairy to dedicate part of their time to work involved in this project.

One experienced laborer and helper to operate the feed mixing unit of the Lajas Substation.

### Laboratory Services

Central Analytical Laboratory of the Agricultural Experiment Station at Río Piedras will analyze feed samples for content of minerals by flame spectrophotometry.

### Veterinary Services

Regular visits for examination and treatment of animals by a D. V. M. on the staff of the Department of Animal Science.

### Livestock and Physical Facilities

#### A. Lajas Substation

1. 24 Holstein cows in appropriate stage of lactation obtained from the 90-100 cow herd.
2. Paved yard with pens, milking parlor, hay making machinery, and buildings for storage of hay and mixed rations at the substation dairy.
3. Feed mixing unit equipped with Kelley-Duplex hammer-mill and California Pellet Mill, plus accessory equipment, including bins for bulk storage of ingredients.
4. Nutrition laboratory adjacent to the substation dairy equipped with Wiley Mill, drying ovens, macro-Kjeldahl apparatus and facilities for analysis of fibrous fractions of feeds and milk samples.
5. Fields adjacent to the substation dairy with nearly pure stands of stargrass to be used for hay production.

#### B. Cartofibra, Inc.

Commercial scale facilities for processing and pelleting kraft paper for use in animal feeds.

6. BUDGET

Explanatory Note

Aside from all the above-mentioned facilities and services to be provided by the University of Puerto Rico and Cartofibra, Inc., the operating budget for this project will rely on OAS funds only.

a. Salaries and wages

Care of experimental animals	\$ 8,000.00
Ration preparation	3,000.00
Field work	2,000.00
Miscellaneous	<u>500.00</u>
Subtotal	\$13,500.00

b. Supplies and equipment

Ration ingredients	9,000.00
Laboratory glassware and reagents	1,000.00
Machinery maintenance and spare parts	<u>1,000.00</u>
Subtotal	\$12,000.00

c. Travel (transportation of supplies)

500.00

Total \$25,000.00

7. EXPECTED DURATION: Six months

1

2

3

4

