PROCEEDINGS

OF THE

CARIBBEAN FOOD CROPS SOCIETY

SECOND ANNUAL MEETING

BRIDGETOWN, BARBADOS

OCTOBER 19-23, 1964

VOLUME II

OFFICERS

1964

President : A. deK FRAMPTON
Chief Agricultural Officer
Ministry of Agriculture
Bridgetown, Barbados

Vice President : HUGH C. MILLER
Caribbean Organization
Hato Rey, Puerto Rico

Secretary/Treasurer : ARNOLD KROCHMAL
Virgin Islands Agricultural Program
United States Department of Agriculture
Kingshill, St. Croix
U. S. Virgin Islands

Directors :

H. AZZAM
Agricultural Experiment Station
University of Puerto Rico
Rio Piedras, Puerto Rico

F. APONTE APONTE
Agricultural Extension Service
University of Puerto Rico
Rio Piedras, Puerto Rico

R. OSBORNE
Banana Board
Kingston
Jamaica, W. L.

JOHN PHILLIPS
Director of Agriculture
Department of Agriculture
Plymouth, Montserrat

CLAUDE PY
Agriculturist - I.F.A.C.
Fort-de-France
Martinique

CHARLES HORTH
Chairman
St. Croix Growers' Association
Kingshill, St. Croix
U. S. Virgin Islands

CHAIRMAN OF COMMITTEES

1964

Finance : C. Horth

Plant Introduction: H. Azzam

Plant Pests : G. Stell

Economics and Sociology: P. Ruopp

Technical Assistance : A. Krochmal

Publicity : H. C. Miller

Programme : A. deK Frampton

CARIBBEAN FOOD CROPS SOCIETY
Second Annual Meeting
Barbados October 19-23
Business Session October 23

MINUTES

The Business Session of the Second Annual Meeting of the Caribbean Food Crop Society was held at the Aquatic Club - Barbados commencing at 10:30 a.m.

Opening

The meeting was called to order by Mr. H. Miller, Vice President in the absence of Mr. A. de K. Frampton, President.

Quorum

There were 32 members in attendence when the meeting was called to order and a quorum was formally declared.

Minutes of Previous Meeting

The minutes of the previous meeting were confirmed on a motion by C. Samuels seconded by R. Foreman.

The meeting decided to request the Board of Directors to ensure that in the future minutes of annual meetings be distributed to members at the same time as notices of the next annual meeting.

Secretary's Report

The Secretary's report was approved and accepted for incorporation in the minutes.

Treasurer's Report

The Treasurer presented a Financial Statement as of September 30, 1964. The Report showed a bank balance of $1,303.17 at credit of the Society after deducting expenditure shown under sub-heads and totalling $5,390.97 from total receipts shown as $6,694.14.

The meeting requested that in future the item "Receipts" should be broken down to show active membership fees collected, sustaining membership fees and individual donations, and that an audited Financial Statement be presented.

Report of Plant Quarantine Working Committee

The meeting noted the circulation of a Report by G. Still, Chairman of the committee and referred it for the attention of the Board of Directors and appropriate follow-up action.

Resolution arising from Discussion Session on "Land Tenure and Agricultural Production"

The meeting noted that discussion had brought to light a serious condition existing in several countries of the area in which expansion of agricultural production is being hampered by:

1- Inflated land values arising out of the uncontrolled development of tourist resorts, the lack of development zoning and inadequacy of legal and other regulating provisions.

2- Sub-division of land into units of a size inadequate to provide full-time occupation or a reasonable annual income for rural families.

3- Use of valuable agricultural land for the establishment of large-scale housing settlements.

4- Insecure agricultural tenancy arrangements.

The meeting accordingly accepted the following resolution, which it directed the Secretary to transmit to Ministers of agriculture in the various countries which have shown interest in the activities of the Society.

"The Caribbean Food Crops Society at its Second Annual Meeting held in Barbados October 19-23, 1964

a) Invites special attention by Governments and, in particular, by Ministers responsible for agriculture in the Caribbean area, to the serious threat to agricultural productivity posed by the developments noted above.

b) Recommends the undertaking, where necessary, of surveys of national land resources with a view to the definition of areas which should be permanently conserved for agricultural production and

c) Requests their co-operation in supplying to the Secretary of the Caribbean Food Crop Society copies of all laws and publications dealing with land tenure and land use in their countries in order that the Society may undertake a comprehensive study of these problems on a Caribbean wide basis.

Site of Third Annual Meeting

The meeting was assured of a strong desire on the part of the Puerto Rican members of the Society that the Third Annual Meeting should be held in Puerto Rico, and of the willingness of several agricultural agencies to offer support to ensure a useful programme of agricultural activities.

Subject to the approval of the State Department of the Government of the Commonwealth of Puerto Rico, it was accordingly agreed that the next annual meeting of the Society will be held in that country in July 1965.

Election of President

Dr. Hassan Azzam of the University of Puerto Rico was unanimously elected President of the Society as from October 23, 1964 to the date of the Business Session of the next annual general meeting, or until a successor shall have been duly appointed in his stead.

Election of Vice-President

Mr. R. A. Foreman of Jamaica was unanimously elected Vice-President.

Election of Board of Directors

The Secretary read a letter from C. Horth, a member of the Board of Directors, sending his resignation in view of pressure of business matters in the U. S. This was accepted.

The chairman pointed out that in addition there would be one vacancy for replacement of Dr. Azzam who had been elected President and that Messrs. J. Phillips and C. Py were retiring by rotation, but were eligible for re-election. Thus there was a need to elect four persons to serve on the Board of Directors for 1964-65.

The meeting unanimously elected the following:

H. Miller - Caribbean Organization
V. Royes - U. W. I. - Trinidad
J. Phillips - Montserrat
R. Bond - U.S.V.I.

and the Board of Directors was requested to determine the period for which each member should serve before retiring, in conformity with the rules of the Society.

Balloting for Prize Awards

Ballots were opened and closed for the following awards:

a) The Cornelli award of $100 by the Cornelli Seed Company for the best paper on Vegetables.

b) The Harvey award by Harvey Aluminum, Inc. for the paper which offers the most valuable contribution to problems of food production in the Caribbean area.

The ballots after examination indicated majority decisions as follows:

For the Cornelli award - Dr. Hassan Azzam
For the Harvey award - Paper by N. Davies and A. J. Vlitos on "Coconut fiber waste as a basic medium for the production of Vegetables in Trinidad".

Election of Honorary Members

The meeting unanimously elected to Honorary Membership in the Society the underlisted persons who were considered to have made an outstanding contribution to food production in the Caribbean area.

Mr. Leo Harvey - Harvey Aluminum, St. Croix, U.S.V.I.
Mr. Arturo Roque - Former director of Agricultural Experiment Station U.P.R., Río Piedras, P. R.
Mr. Roberto Huyke - Director of Agricultural Extension Services of the U.P.R., Río Piedras, P. R.

Any Other Business

Mr. D. Basil Williams of the U.W.I., Trinidad, informed the meeting that early in 1965 the Government of St. Vincent would be celebrating the second centenary of the establishment of the Botanic Gardens in that country and suggested that the Caribbean Food Crop Society should be officially represented on that occasion. It was agreed that the Board of Directors be requested to arrange for appropriate representation of the Society at these historic celebrations.

RESOLUTION

WHEREAS the Barbados Government through the kindness and generosity of the Premier, the Hon. Errol Barrow, made available to the Caribbean Food Crops Society free secretarial and transport services for the holding of the Society's second meeting in Barbados, during the period 18th to 23rd October, 1964, without which it would have been extremely difficult for the Society's meeting to be held;

BE IT RESOLVED that the Caribbean Food Crops Society in session at its second annual general meeting held at the Aquatic Club, Bridgetown, Barbados, on the 23rd October, 1964, record its sincere and grateful appreciation for the many courtesies and kindnesses as well as assistance afforded the Society by the Barbados Government during the meeting of members of the Society which began on the 18th October and ended on the 23rd October, 1964:

BE IT FURTHER RESOLVED that a letter be sent to the Honourable Errol Barrow, Premier of Barbados, expressing the Society's appreciation as herein stated.

Adjournment

The meeting adjourned at 12:45 a.m.

PROPOSED ESTABLISHMENT OF A CARIBBEAN REGIONAL PLANT PROTECTION ORGANIZATION

BACKGROUND:

1- All of the Caribbean countries depend very largely on agriculture for sustenance, for export trade or for both.

2- The already extensive travel, and trade in agricultural products between the Caribbean countries is constantly increasing.

3- There exist throughout the world numerous pests and diseases of plants that have not reached the Caribbean region, and others that occur in some, but not all of the Caribbean countries. Spread of these pests and diseases into and within the region would have a serious and in some cases a disastrous effect upon agriculture in the Caribbean countries. This is particularly true in those countries in which diversification of crops is being stressed.

4- Few of the Caribbean countries have adequate and up-to-date plant quarantine legislation. Still fewer have adequate staff and facilities to enforce such laws as they have.

5- In other parts of the world there exist Regional Plant Protection Organizations, embracing countries with common problems and engaged in agricultural trade with each other. An outstanding example is OIRSA (Organismo Internacional de Sanidad Agropecuaria) in Central America and Mexico, which has been instrumental in assisting in developing plant protection and plant quarantine programs on an international level, and has clearly demonstrated the success that can be achieved by an organization of this type.

6- International Organizations, especially the Food and Agricultural Organization of the United Nations, have regularly provided assistance in the establishment of Regional Plant Protection Organizations, and have provided technical assistance once the Organization has been established.

THEREFORE, BE IT RESOLVED:

1- That the Caribbean Food Crops Society request the assistance of the Food and Agricultural Organization of the United Nations in the formation and establishment of a Regional Plant Protection Organization for the Caribbean Region, and in the preparation of a Convention, which shall serve as the basis for the establishment of said Organization.

2- That the Caribbean Food Crops Society, in collaboration with the college of the Virgin Islands, sponsor a meeting to be held on St. Thomas, V. I.

during the period 21st to 25th March, 1965, at which time the Ministers of Agriculture of the Governments of the Caribbean Region (or their duly accredited representatives) will study a model of the Convention prepared by FAO for the establishment of a Caribbean Regional Plant Protection Organization, in order that this Convention may be approved during the course of the meeting.

3- That a detailed background paper, clearly justifying the need for a Caribbean Regional Plant Protection Organization, on the basis of existing plant protection problems in this area, be prepared by one of the officers of the Caribbean Food Crops Society, for presentation at the meeting to be convened in March, 1965.

4- That the Caribbean Food Crops Society respectfully ask the Ministers of the Governments within the Caribbean Region to request the Food and Agricultural Organization of the United Nations for its co-operation in the preparation of the Plant Protection Convention previously mentioned and in the establishment of a Caribbean Regional Plant Protection Organization.

This report was prepared by the Working Committee on Plant Quarantine:

R. M. Bond, U. S. Virgin Islands

F. del Prado, Surinam

A. G. Naylor, Jamaica

Harold Bowman, Puerto Rico (USDA)

George Berg, San Salvador (FAO)

No. A.G. 11/T.2.

IN REPLYING THE ABOVE NUMBER AND DATE OF THIS LETTER SHOULD BE QUOTED.

Ministry of Agriculture, ~~Lands~~ & Fisheries,
Crumpton Street,
Barbados.

23rd October, 1964.

Sir,

I am directed to refer to the report on Plant Protection in the Caribbean Region which was referred to this Government on 22nd October, 1964 for consideration, and to inform you that the Government has agreed that it would -

(a) support the proposals for the establishment of a Caribbean Regional Plant Protection Organisation;

(b) agree to send a representative to the proposed meeting to be held in St. Thomas, Virgin Islands from 21st to 25th March, 1965 to study a model of the Convention which it is proposed to request the Food and Agricultural Organization to prepare for the establishment of a Caribbean Regional Plant Protection Organization; and

(c) support an application of the Governments within the Caribbean Region to the Food and Agricultural Organization of the United Nations for its Corporation in the preparation of the Plant Protection Convention mentioned above and in the establishment of a Caribbean Regional Plant Protection Organization;

2. It is assumed that you will keep this Government informed of developments.

I am,
Sir,
Your obedient servant.

Austin
for Permanent Secretary. ag.

The Secretary,
Caribbean Food Crops Society,
Aquatic Club,
ST. MICHAEL.

CARIBBEAN FOOD CROPS SOCIETY

SECOND ANNUAL MEETING

Opening Remarks
by
Vice President - H. C. Miller

The Hon. Errol Barrow, Premier of Barbados
Hon. Capt. George Ferguson, Minister of Agriculture and Fisheries
Other Hon. Ministers of Government
Mr. Speaker of the House of Assembly
The Hon. President of the Senate
Other Distinguished Visitors
Officers and Members of the Caribbean Food Crops Society

I have the honour this morning to deputise for our President Mr. A. Dek. Frampton, one of the Co-founders of the Society, whose abseence today is unavoidable and greatly regretted, and to call to order this Opening Session of the Second Annual Meeting of the Caribbean Food Crops Society.

It is also my pleasant duty on this occasion to extend a warm welcome to our members who have, at great personal difficulty, travelled from countries all over the Caribbean and from as far away as Canada, to attend this meeting and, in particular, those who have made it possible to contribute papers or who have agreed to take a leading role in our panel discussions, contributions which will provide the basis of our proceedings at this meeting.

On behalf of the Society, I must also convey to the Hon. Errol Barrow our profound appreciation of the active interest he has shown in our Society, our heartfelt thanks for his kind invitation which made it possible for us to be here and for the considerable assistance rendered by him personally, as well as by the Hon. Capt. Ferguson and members of their staffs, in the completion of the many and varied preliminary arrangements without which our meeting here would have been severely handicapped. Indeed, Barbados, its Government and its people have extended to us in full measure that welcome and hospitality for which this island is so famous, and the presence here this morning of so many distinguished representatives of all sectors of the community is ample evidence of this friendliness and interest which I am sure we shall all long remember.

On behalf of our Society, Sir, I ask you to accept our warmest thanks to you and to Barbados.

Since our last Annual Meeting, the Society has successfully carried out a number of practical measures which we are sure will make an important contribution to Caribbean agriculture. These include advisory visits made to several countries by qualified specialists, a study of the needs of certain countries of the Caribbean as regards quarantine restriction and the fuller exchange of material throughout the area, and the organisation of a training course in Chemical Pest Control for Caribbean personnel. This course was completed last Friday and from all accounts it was an outstanding success and will greatly promote the efficiency of vegetable production in the area. The Society is indebted to the Vice-Chancellor of the University of the West Indies at the College of Agriculture in Trinidad and to Dr. Kasasian and Mr. Patrick Haynes, members of this Society, who were responsible for organising and conducting the course. We are looking forward to a year of increased activity following this meeting.

I now have the honour to call on Dr. R. Bond, First President of our Society and Chairman of our Board of Directors, to introduce the Hon. Errol Barrow who will later address us.

Welcome Address by His Excellency the Governor at the Second Annual Meeting of the Caribbean Food Crops Society

Honourable Ministers, Distinguished guest, ladies and gentlemen, first of all I would like to extend a very warm welcome to those delegates who have come from abroad. We have various delegates here from Surinam, Puerto Rico, Jamaica and Trinidad, San Salvador and the Virgin Islands and we are very delighted to see them. We did extend the invitation to the Governor of the U. S. Virgin Islands, Mr. Paiewonski and his lady, but unfortunately they are in the States on other business and it has not been possible for them to attend, but I am sure that they would have liked to be here if it had been possible for them to do so.

Now the choice of Barbados as the venue of the second annual meeting of the Caribbean Food Crops Society is a matter of more than passing significance and one which we in Barbados accept and appreciate as an honour. While it must be recognised that statistics taken in isolation can often be misleading, Barbados by virtue of its size and population constitutes a subject for special study when viewed in the context of self-sufficiency in food production. Adequacy of land and its complementary endowments are usually considered as an indication of the potential resources of a country; and one which boasts of over 1,400 people to the square mile will not easily escape attention in the world at large or in this particular area.

How many times casual visitors to Barbados have said to me with little knowledge of the implications and difficulties - "Why don't you grow more food crops?" "You should not depend on sugar entirely." So right. Here we have a problem which deserves further study. The problem of feeding the world's millions has come most prominently into focus in the 1960's with the declaration of the period by the United Nations as "the development decade" and in assessing the social and economic levels of countries, conclusions have been drawn testifying to the prerequisite of adequacy in food supply, both as regards quantity and quality, for orderly development. It is in support of this widely accepted view that the Freedom from Hunger Campaign has been launched in recent years and which has led the Economic and Social Council of the United Nations to promote its World Food Program as one of the prescriptions for economic mal-adjustments from which millions the world over still continue to suffer.

The emphasis which has been placed on global food production in the post-war era is amply reflected in the existence of the Food and Agriculture Organization which can boast of being one of the oldest members of the United Nations family of Organizations as presently constituted. Initial action taken in 1943 led to its formal constitution in 1945, and I think it would be appropriate on an occasion such as this to reflect on certain principles of its policy as laid down in the preamble to its constitution.

Member nations accepting the constitution of the Food and Agriculture Organization agreed to promote their common welfare by furthering separate and collective action on their part for the purpose of contributing towards and expanding world economy. This objective was to be achieved firstly by raising the levels of nutrition and standards of living of the peoples under their separate jurisdictions; secondly - by securing improvements in the efficiency of the production and distribution of all food and agricultural products; and thirdly - by bettering the conditions of rural populations.

It has been estimated that the total world population is about 300 billion and that more than half of this number is either under-nourished or malnourished. We are told that one child out of every three born has no chance of living a normal life, and the situation is getting worse because population is increasing rapidly and food production is not keeping pace with it. These are terrifying thoughts which must jolt us out of our complacency. However, it is considered that there are means at hand to meet this challenge if properly used, and that the possibility of a world free from the miseries of hunger is attainable. From studies and projections made, it is believed that world food supplies must be trebled by the turn of the century if the world population which is expected to double itself by then, is to have enough to eat.

The gravity of the problem has been stated in no uncertain terms by the Food and Agriculture Organization in one of its publications in which the prevalence of hunger in the world is high-lighted and at the same time condemned. Its enormity and consequent evils which it inflicts upon society are incorporated in this description of a hungry man -

"A hungry man is a social liability. He cannot work effectively on a hungry stomach; he cannot study and learn as he should to improve his conditions of life; he cannot think beyond his immediate needs, of which food is dominate - in short, because he can be counted in millions, he retards not only the economic and social development of his country, but also the prosperity of the world."

The same publication defines hunger. This, it states, connotes either undernutrition or mal-nutrition implying that insufficiency of food or inadequacy in the balance of diet is in either case a threat to life and social and economic progress. It is against the background of the world problem on which I have so far dwelt that I wish to bring your society with its regional commitments, into perspective.

It is known that the objectives of the Society are to advance Caribbean food production and distribution in all their aspects to the end of improving levels of nutrition and standards of living in the Caribbean. This would seem to indicate that there exist special common factors hindering the achievement of this goal in individual territories, and it is heartening to think that countries in the area will benefit from the collective experience and expertise of persons who have made such problems their study. The territories have in the past concentrated on the development of certain specialised crops for which there was a great export demand. While this is understandable from the point of view of developing trade, the opinion is now widely held that in the face of ever-growing population pressures over the world in general, a country's self-sufficiency in basic agricultural products is essential if development is to proceed at a reasonable and increasing pace. The establishment of your Society signifies that there is need to intensify efforts for the region in satisfaction of its special needs. But we can view this as promoting efforts which should redound not exclusively to the benefit of the countries of the Caribbean but as contributing to the solution of a world problem.

Your society is still in its infancy, and your interest in promoting food production, processing and marketing in the area will, I hope, be rewarding. The strenght of any organization springs from its members and I hope that you will be able to attract to your list a greater number of active as well as sustaining members. The Caribbean Food Crops Society was born out of enthusiasm and if this enthusiasm is sustained and leads to definite action in the stimulation of food crops in the area, I have no doubt that the Society will grow from strength to strength. It is at annual meetings such as this that you will find scope for stock-taking and making plans for the future, and what is most important, exchanging information on research.

I have therefore much pleasure in extending to you all a very warm welcome to Barbados, and hope that on your departure you will take with you memories of an enjoyable stay. I wish you fruitful deliberations and every success in the conduct of the business of your meeting, and I have much pleasure in declaring this Second Annual Meeting of the Caribbean Food Crops Society now open.

Address by the Honourable Minister of Agriculture & Fisheries at the Second Annual Meeting of the Caribbean Food Crops Society

The agricultural policy of the Government of Barbados is aimed at increasing productivity, diversifying agricultural production, and improving the system of marketing local produce with a view to a more efficient use of the island's land resources in order to meet the needs of its rapidly growing population. This involves a modification of the established pattern whereby most of the arable land has been geared to the production of sugar cane. In speaking to you on the "Government's policy in reference to food crops expansion", I will necessarily have to confine myself to the field of vegetables and root crop production; but I may mention in passing that the promotion of livestock and fisheries is considered a complementary essential in catering to the island's food needs, and that steps are being taken simultaneously in this direction in support of efforts to expand food crops.

The arable acreage in Barbados is about 68,000 acres, and it has been a policy established during the days of the last war, to require that all estates over 10 acres should plant a certain percentage of this acreage in food crops. The present percentage is 12 per cent, except in the cases of estates in the area known as the Scotland District which are required to plant 7 per cent. These estates have more grasslands than the average estates, hence the difference. In compensation, however, the estates having the mandatory food crop cultivation of 7 percent are required to increase their livestock production. The purpose of the stipulation of a food crop cultivation percentage was to ensure a minimum supply of vegetables and root crops in the face of war time shortages and the relatively good prices obtaining in the sugar industry. The mandatory requirement, while ensuring a minimum supply of food crops locally, could not be expected to bring about self-sufficiency in this field, which is the Government's ultimate goal. It was not intended to do so. Consequently, large quantities of vegetables and ground provisions which can be produced locally have been imported yearly.

It has been found that with improved technology in the sugar industry, greater emphasis can be placed on food crops production without impairing the returns from the sugar industry and the island's economy. This view is strengthened by the fact that food crops production yields a higher net revenue and offers more constant employment than sugar cane. In the light of this therefore, our policy in promoting the expansion of food crops has been stated in the current Development Programme as follows:

Firstly: A reduction in the dependence of the economy on a single export crop which is supported by a guaranteed market and a guaranteed price, and an increase in the quantity of locally produced foodstuffs to help feed the rapidly growing population and the tourists.

Secondly: The replacement, as far as is practicable, of the imports of those vegetables and food crops which the island can produce as economically as abroad, and the development of an export trade in vegetables.

Thirdly: Provision of jobs in agriculture or in enterprsies based on agriculture, in order to help relieve the unemployment situation in Barbados.

Fourthly: Encouragement and promotion of efficient management of soil in order to preserve and raise its productivity; and

Fifthly: Conservation and protection of existing land resources by arresting the process of soil erosion in certain parts of the island.

In seeking to promote increased food production in the private sector, Government has taken a number of positive steps. We feel that peasant farming should be given every encouragement. With this in view, Government has for some years had in operation an Agricultural Credit Bank which provides loans at nominal rates of interest to enable small land-holders to effect improvements and finance cultivation. In addition, free grants are made to small-holders in cases where they are desirous of introducing irrigation systems. The Government wishes to encourage greater use of this facility than has so far been made, and so the minimum grant under the scheme has recently been increased in order to induce a greater number of small-holders to take advantage of the scheme.

It is realised that the greatest problem facing the small-holder is lack of capital and so in addition to offering the facilities just mentioned, the Government has introduced a tractor scheme under which plots are ploughed at relatively low charges. The tractors are owned and operated by Government, and in effect the scheme is a means of subsidising the production of the small farmer. By these methods it is hoped to stimulate food crops production among small farmers in place of traditional sugar cane cultivation which is a less tedious method of land utilization.

Because of the factor to which I have just referred, Government realises that more is needed than the provision of capital. Traditional methods die hard, and if change is to be brought about, demonstration must play an important role in effecting it. For this reason, the Government continues to provide agricultural extension services over the island by which new crops cultivation and techniques are brought to attention.

We are aware that small farmers also face certain disadvantages in economies because of the samll size of their operations, and we are attempting to overcome this difficulty by means of producer co-operatives. The Government is therefore actively engaged in promoting and supporting the functioning of co-operative societies as a means of shielding the small farmer from extreme risks.

It is realised however, that sole reliance on the efforts of small farmers will not go far towards the attainment of self-sufficiency in food crops. If the island is to satisfy its present needs and cater to its growing population, increased cultivation of food crops on a large scale will be essential. It is considered that there is much marginal sugar cane lands which could be profitably diverted to food crop production, and so to this end Government intends to demonstrate the feasibility of mixed farming and crop cultivation on a large scale. A number of estates has been acquired by Government for operation on a large scale basis, and plans are afoot for the establishment of an Agricultural Development Corporation for the management of all Government-owned lands. The functions of this corporation will be two-fold; firstly, to stimulate food production among privately owned large estates by demonstration and avoid the possibility of fragmentation; and secondly, to augment the island's total supply of food crops.

It is hoped that a further step towards food crops expansion in Barbados will follow from soil conservation work now being undertaken in the area known as the Scotland District in the north-east of the island. For centuries the Scotland District which comprises one seventh of the island's land area has been undergoing a process of severe erosion. Much valuable surface soil has been washed into the sea, thereby ruining the land, destroying agriculture, and leading inevitably to the decay of several communities in the area. The object of this work is to check further erosion by reclaiming and rehabilitating the land to enable it to make its contribution towards increasing the productivity of the island, and so to improve the social and economic conditions of the people who live in the area. Preliminary research indicates that land in this area is marginal for sugar cane and would be more suitable for food crops. The scheme involves rehabilitation of private as well as Government-owned lands, and this affords opportunities for demonstration and research.

It is realized that any attempt to encourage increased production and diversification of agriculture must take into account the need of the producer for favourable price and easy outlet for his produce. And so, in endeavouring to cope with this problem, the Government established within the last two years a Marketing Corporation with a view to providing price support and a guaranteed market for producers' food crops. It is expected, therefore, that the Corporation which is provided with modern facilities for the cold storage of vegetables and fruit, will afford the necessary stimulus for increased production and improved quality.

Research to discover new cash crops which are technically and commercially feasible in the island, and ways and means of reducing loss caused by plant disease and pests, is basic to any programme of Agricultural expansion. Although research into these problems is only on a comparatively small scale at present, there are plans for expansion in this vital area in the near future. In this field we welcome the aims and objects of the Caribbean Food Crops Society, and realize the benefits likely to accrue from its work.

Barbados is a territory which has tremendous respect for the results of agricultural research, as the maintenance of the efficiency of its sugar industry can be attributed to intensive and sustained research over three-quarters of centry. The fact that the island is densely populated and that there are pressures on the limitted land available for agricultural cultivation, demands that production must be intensive rather than extensive. If we are to reach our goals of adequate and cheap supply of locally grown food, production must be as efficient as modern technology affords.

Message to
The President, Officers and Members
of the
Caribbean Food Crops Society
at their
Second Annual Meeting - Barbados
by
C. G. Beauregard, Secretary-General of the Caribbean Organization

Dear Friends of the Caribbean Food Crops Society,

I greatly regret that pressure of urgent business makes it impossible for me to attend in person this Second Annual Meeting of your Society which is being held in the beautiful island of Barbados.

Barbados is well known for its natural attractions and for the warm friendliness of its people. These I have myself enjoyed on previous visits, and I am sorry that I shall not be able, on this occasion, to share this privilege with you.

I am happy that it has been possible to arrange that Mr. Hugh Miller, your Vice-President and our Development Officer for Natural Resources, will be able to represent our Organization on this important occasion. The Caribbean Organization recognizes in your Society a tremendous potential for improving the economic well-being of the peoples of the Caribbean area.

No problem looms more menacingly on the Caribbean horizon than the rapid increase of population and unemployment on the one hand and regularly recurring unfavourable balances of trade on the other.

At the present time, there are still too many countries in this area which devote their resources almost exclusively to the production of one or two traditional crops for markets outside the area. As you know only too well, the area has little or no say in the prices it receives for these crops. At the same time, most of these same countries are importing an increasing volume of their food requirements from countries outside the area - again at prices over which they have no influence. This subjects the economies of countries of the area to factors beyond their own control, and this is far from being an ideal situation.

Development of production of fruits and vegetables and other food crops for intra-Caribbean trade, as well as for extra-Caribbean markets, can provide the means to improve this situation and can secure changes in resource utilization which will enhance agriculture's contribution to the current problems of unemployment, low nation income and unfavourable trade balances.

The countries served by the Caribbean Organization spent in 1963 over U. S. $180 million to purchase from non-Caribbean sources fruits, vegetables and animal products, the bulk of which can be produced within the area. This sum is 50% greater than the total deficits in the trading balances of the 12 countries of the area, including Barbados which depend primarily upon agriculture for their national income.

Clearly the task to which your Society has dedicated itself is a worthy one, deserving of the vigorous support of all Governments and all those interested in the economic emancipation of the area.

he Caribbean Organization was happy to share with you sponsorship of the short course held last week in Trinidad with the cooperation of the Agricultural College of the University of the West Indies and under direction of two of your active and competent members; your several projects which are laying a sound foundation for the expansion of production and marketing will continue to have our full support and cooperation, and, on behalf of the Organization and its Secretariat, I extend to you on this occasion our warm congratulations on the results already achieved and our best wishes for the continued success of your Society in its future work.

CARIBBEAN FOOD CROPS SOCIETY

Countries of residence of members

1964

Countries	Active	Sustaining
Antigua	3	0
Barbados	17	0
British Guiana	1	0
British Virgin Island	1	0
Canada	1	0
Dominica	2	0
Dominican Republic	2	0
Guadaloupe	1	0
Haiti	2	0
Jamaica	16	3
Martinique	1	0
Mexico	1	0
Montserrat	2	0
Puerto Rico	40	6
St. Lucía	1	0
St. Kitts	2	0
San Salvador	1	0
Surinam	3	0
Trinidad	11	3
U.S.A.	8	2
U.S. Virgin Islands	18	3
Venezuela	1	0
	135	17

CARIBBEAN FOOD CROPS SOCIETY

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1964

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BRIDGETOWN, BARBADOS

October 18, 1964

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49-	Roy Woodbury	Agricultural Experiment Station University of Puerto Rico Río Piedras, PUERTO RICO

CONTENTS

THE SURINAM AGRICULTURAL EXPERIMENT STATION STORY

by

F. A. del Prado[1]

On December 3, 1963 the Surinam Agricultural Experiment Station celebrated its sixty years existence. The first director was Dr. Van Hall, who was followed by Dr. Cramer, Dr. Huizinga, Dr. Stahel, Dr. Ostendorf and Ir. J. Van Emden. The present director is Ir J. A. Samson.

Besides the Experiment Station grounds there are several experimental fields where field experiments in control of diseases and pests, and breeding of better varieties take place; better harvest methods are also studied, as well as new methods of cultivation.

Experimental field Oryza is one example shown in this movie. Certified seed rice is grown here and stored for sale to farmers.

Mole drainage is being tried in an experiment as a new method on our heavy soils, instead of open drains.

There are several laboratories at the Experiment Station. Instruments are shown that are used to determine the composition of the soil in relation to clay, sand, water, air and nutrients. Diseases and pests are also studied and the damage they cause. The study of nematodes is one of the new projects at the Station.

Microclimatologic studies are made, especially in regard to the influence of shade, in order to find out the best growing conditions for our crops.

The Experiment Station is also in charge of propagation of plants: citrus, cacao, fruit trees etc. Citrus is very important.

New methods of propagation are employed now, which reduced the price of an orange tree from $0.45 to BWI $0.22.

Fruit culture is also important. Passion fruit and papaya are shown. Jams, jellies, fruit, juices etc. are made at the Techonology Division.

Plant Quarantine has to prevent the introduction of new pests and diseases, so a rigorous inspection takes place of all imported plants and parts of plants. The poster is self explanatory.

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[1]Plant pathologist and Head of the Plant Protection Service, Agricultural Experiment Station, Surinam

There is a close cooperation between the sections of the Experiment Station. There are frequent Staff meetings, where H. E. the Minister of Agriculture and the Director of Agriculture may be present. The film starts and ends with such a staff meeting.

FOOD PLANTS WHICH MAY ALSO SERVE AS ORNAMENTALS

by

Roy Woodbury[1]

As the earth is for man's pleasures, it is natural that he is desirous of making available to him many of its wonders, to select an adapt and to even modify to his liking.

Plants inhabited the earth generations before man and will continue to exist after he is gone. Man, in fact, is just beginning to learn all the many kinds and their utilization. In the use of these numerous species, man does not have to exercise restraint but has the opportunity to partake.

In the utilization of these plants, whether it be for a large public garden or a small home garden, one must select those species which he thinks to be the most useful for his special purpose. It then becomes a necessity for the small home gardener to select ornamental plants which may also bear fruit, often of better quality than can be obtained in the local markets. Why not choose more of them to grace the garden picture and augments its delight? This dual purpose is especially important where the garden is confined or is of limited space.

Let's note some of the advantages of using some food bearing plants as ornamentals. A well placed, good quality fruit tree, in time, will provide just as good a shade as most ornamental shade trees. They may be placed in almost all the positions in which non-food plants are artistically or appropriately placed. Moreover, when varieties of high quality are grown, the home garden can provide his table, or please his friends, with better plant foods than can ordinarily be purchased. Obtaining maximum results for one's efforts may be secured by the proper selections of species and varieties. They could extend the harvest season to several times the normal.

It soon becomes evident that it is not enough to plant and then to harvest the benefits of our efforts, but to find out how we can improve upon our techniques so that we may obtain the utmost in beauty and production. To grow a plant to perfect maturity is a triumph which deepens our enthusiasm and stimulates us to even greater interest in our garden. It will gradually become a part of the home and family. The children will begin to realize, and to learn about nature's wonderful offerings. The home garden provides a haven of diversion and occupation not only for us but may contribute to the joys of the community as well.

In respect to the above, may I present you with a few slides for illustration.

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[1] Taxonomist, Agricultural Experiment Station, University of Puerto Rico.

Agricultural Applications of the Puerto Rico Nuclear Center Co^{60} Gamma Irradiation Facility

J. Cuevas-Ruiz and D. B. Linden[1]

The Co^{60} Gamma Irradiation Facility for the Puerto Rico Nuclear Center has been in use since May 1963. It is housed in a laboratory room in the Nuclear Center Building at Mayaguez. It is operated by the Agricultural Bio-Sciences Division. The facilities have met the requirements of the biologists and agricultural experimenters.

Description of Source:

The Co^{60} gamma irradiation facility consists of a pool nine feet by eight feet that is fourteen feet deep. The facility uses water as the shielding material.

A portable steel bridge goes across the top of the pool and serves as the base for the operator conducting the irradiations.

A platform three feet by eight feet is located ten feet below the water surface. This platform holds the variable geometry irradiator. All irradiations are performed on this platform. The ten feet depth is sufficient to reduce the radiation level at the surface to less than 0.2 mr/hr. It allows observation of all operations in the pool without difficulty.

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[1]Research Assistant II and Associate Scientist II
Agricultural Bio-Sciences Division, Puerto Rico Nuclear Center
College of Agriculture and Mechanic Arts
Mayaguez, Puerto Rico

The Co^{60} is contained in twelve pencil type capsules each containing approximately 200 curies. The capsules are held in a hollow cylinder variable geometry irradiator. This variable geometry irradiator can be adjusted to simulate a radiation chamber from three centimeters to twenty centimeters in radius formed with the capsules. A symetrical field can be obtained by using three, six or twelve capsules.

Irradiations have been conducted using all possible geometries (3, 5, 10, 15, 20 cm). Any dose can be obtained by changing the geometry of the holder or by using three, six or twelve capsules. The ten centimeters position with a dose rate of 2,000 r per minute is the most useful for biologists.

Most of the samples to be irradiated are placed in an aluminum container which is weighted to overcome floatation. This container has a screw top and a solid aluminum rod attached to the top for underwater handling. The top of the container also has two hose connections either for air, or for oxygen or nitrogen, allowing irradiations to be conducted in different atmospheres.

Other biological samples are placed in plastic bags and weighted, then are lowered in the radiation field by means of a cord.

Following is a brief account of some of the experiments conducted so far in the field of biology and agriculture using the facilities. A big group of the experiments conducted are from different agencies using the cooperative irradiation service from the Puerto Rico Nuclear Center.

Insect sterilization studies are in progress now by irradiating the insect in different stages of the life cycle. The studies are with the sugar cane borer, Diatraea saccharalis. The primary objective of this experiment is to determine if D. saccharalis can be rendered sterile by subjecting it to gamma radiation from a Co^{60} source. The preliminary work indicates that the larval stage and the early pupal period cannot be used for gamma irradiation since mortality dosage and sterility dosage are practically equal at these stages. Irradiations of newly emerged adults shows some promise and the dosage for sterility appear to be in excess of 8,000 roentgens. According to the preliminary works seems to be easier to irradiate the females and release them than the males.

Unripe banana fruit of Johnson and Monte Cristo variety has been exposed to gamma radiation and stored at room temperature. The objective of this experiment was to study the radiation effects on the ripening of the fruit. The fruits are placed on sealed plastic bags and are lowered down in the radiation field. Ordinarily such fruit ripen in six to ten days. At doses of 25 Kr. the ripening of both varieties was retarded by ten days or more with little, if any, effect on flavor. Higher doses caused more rapid ripening and early blackening of the skin.

Rice seeds (Oriza sativa) have been treated with gamma radiation and with 5 BUDR to see if this chemical can modify the gamma radiation effects on seedling height. The purpose is to establish a mutant stock and induce backmutation in the somatic tissue. Seedling pigment defficiency mutants have been observed at 8,000 r and at 12,000 r.

Mutation studies have been conducted by irradiating maize tassels and maize seeds. The tassels have been exposed to a wide dose range (varies from 0 to 20,000 r). A suitable dose range has been obtained for the full development of kernels in the cob. Also radiation effects on the germination ability of the seeds and the germination rate have been observed.

Corn seeds have been exposed to gamma radiation to study the radiation effects on the absorption of calcium and strontium on corn plants.

Bacterial cultures have also been irradiated to study radiosensitivity, threshold dose, and to obtain a dose-response curve. This irradiation was done as a cooperative service for the radiobiology courses given by the Biology Department in the CAAM. Also backmutation studies are conducted in the present by exposing bacterial cultures to gamma radiation.

Vegetative cuttings of bananas and guava have been exposed to gamma radiation to study the growth of these cuttings after treatment. The guava also includes rooted cuttings from several varieties. After exposure they are transplanted to a nursery plot. Radiation effects have been observed in the growth of these cuttings.

Seedlings from ornamental trees have been exposed to gamma radiation and grown in a nursery plot. Muntigia calabura seedlings (Panamá berry) were used for this experiment. The objective was to cause partial or complete sterility to the tree. 600 seedlings were treated with a dose ranging from 0 - 100 Kr. Only 90 seedling reached maturity. No survivals were obtained over 60 Kr. From the observations, it appears that this material was very sensitive in the vegetative state, to gamma rays. Radiation failed to cause sterility in this material. Also seeds from the same ornamental trees were exposed to ionizing radiation. Radiation effects on the germination ability of the seeds was observed.

The effects of gamma radiation upon the phenol level in the leaves has also been studied. Velvet bean plants, Stizolobium deeringranum, four weeks old were used for the experiment. The leaves were irradiated with five dosages of gamma rays ranging from 15 to 100 Kr. Extraction and assay of phenolic compound using the Folin-Denis calorimetric procedures were done following each irradiation. The data obtained indicated that the most significant change in phenolic content of irradiated leaves occured at about 15 Kr.

Indigophera cuttings have also been irradiated trying to get toxin-free mutants from this plant. The cuttings after being exposed to gamma radiation are planted in the greenhouse. No survivals have been obtained over a 3,000 r exposure.

Mangoes from several varieties including the native have been exposed to gamma radiation. The fruits are selected green, almost ripe, and ripe and are exposed to the same dose range. Radiation effects and post-irradiation treatments have been observed for the varieties.

The field of induced mutations has received considerable interest, and some high school science teachers and their students have asked for information and for irradiation services. Material which has been irradiated for them include: small plants, seeds, and chicken embryos.

Visitors from foreign countries have shown great interest in the design and the diverse uses of the Puerto Rico Nuclear Center Co^{60} gamma irradiation facilities.

The facility has been successfully used by researchers from various fields of science. The accuracy of the dose delivered, the visual observations of the material during the irradiations and the safety in conducting the irradiations has made the Co^{60} gamma irradiation facility a great tool for researchers.

The supervisor of the facilities is able to give all possible help in the irradiation services to all experimenters interested in using the facilities. All services given are free, and valuable information is given to those who ask for it.

Recommendations such as: dose range to be used, dose rate, suitable geometry, number of capsules to use, and safety precautions involved in conducting the irradiation are given by the supervisor prior to any irradiation process.

The Puerto Rico Nuclear Center also has a research reactor which operates at 1000 kilowatts. The combustible elements contains Uranium oxide enriched at 20°/o in Uranium-235.

It is a pool type reactor. The pool is 49 feet long, 23 feet wide by 32 feet deep. At 1000 kilowatts, a flux of 5×10^{12} neutrons per squre centimeter per second is obtained.

Biological material which have been exposed to neutron irradiation include: pieces of sugar cane variety PR980, and seeds.

FURTHER EVIDENCE ON THE NEED OF MAGNESIUM FOR PINEAPPLE IN LATOSOLS

by

Ernesto Hernández[1]

ABSTRACT

The information presented in this paper clearly demonstrates once more the outstandingly beneficial effect of magnesium on yields of pineapples when grown on the acid latosols, soils typical of the pineapple growing region of Puerto Rico.

Pineapple plants supplied with magnesium produced the average 2.75 tons more fruits per acre than plants not supplied with this nutrient. This was equivalent to a 20 percent increase in yields.

Foliar analyses revealed that highest fruit yields were associated with the highest leaf magnesium contents.

Neither the use of lime alone or in combination with magnesium were effective in increasing significantly pineapple yields.

From the results presented herein it may be concluded that magnesium should be incorporated in the fertilizer mix or applied in foliar sprays, as may be more advantageous in a particular situation so as greatly to increase economical pineapple production.

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1 Horticulturist, Agricultural Experiment Station, Río Piedras, Puerto Rico

TABLE 1.--Mean yield per acre of pineapple as affected by fertilizer treatments on Bayamón sandy clay 1/

Treatment No.	Description of treatments	Leaf Mg	Mean weight of fruit	Mean yield of fruits per acre	Outyielded at .01
		Percent	Pounds	Tons	
1	$MgSO_4$, 300 lbs. per acre	0.18	4.14	18.25	11, 12
2	MgO, 300 lbs. per acre	.22	4.24	18.69	11, 12
3	$MgSO_4$, 600 lbs. per acre	.20	3. 93	17.32	11, 12
4	MgO, 600 lbs. per acre	.33	4.39	19.35	11, 12
5	$MgSO_4$, 1000 lbs. per acre	.19	4.13	18.21	11, 12
6	MgO, 1000 lbs. per acre	.35	4.25	18.73	11, 12
7	$MgSO_4$, 600 lbs. per acre + $CACO_3$	.28	4.36	19.22	11, 12
8	MgO, 600 lbs. per acre + $CACO_3$	.32	4.10	18.07	11, 12
9	McChelate, 100 lbs. per acre	.16	3.85	16.97	11, 12
10	$MgSO_4$ spray, 15 lbs. per 100 gals 2/	.18	4.33	19.09	11, 12
11	$CACO_3$, 1 ton per acre	.14	3.49	15.38	--
12	Check - NPK only	.14	3,38	14.90	--

1/ NPK was supplied in all treatments in a 13-3-12 fertilizer at the rate of 20 cwt. per acre distributed in 3 applications.

2/ Plants received 3 magnesium sprays.

TABLE 2.--Mean yield per acre of pineapples as affected by fertilizer treatments on Bayamón sandy clay at two locations 1/

	Treatment ($MgSO_4$ per acre)	Experiment No. 2: Mean Weight of fruit	Experiment No. 2: Mean yield of fruit per acre	Experiment No. 2: Outyielded at .05	Experiment No. 2: Outyielded at .01	Experiment No. 3: Mean Weight of fruit	Experiment No. 3: Mean yield of fruit per acre	Experiment No. 3: Outyielded at 05	Experiment No. 3: Outyielded at .01
	Pounds	Pounds	Tons			Pounds	Tons		
1	600	3.97	17.10	1,2,5,6,8	1, 8	4.20	18.09	8	8
2	300	3.90	16.80	1,2,5,6,8	1, 8	4.35	18.74	1, 8	8
3	Mg chelate (100 lbs./acre)	3.67	15.81	8	8	--	--		
4	1200	3.65	15.72	8	8	3.89	16.76	8	
5	150	3.61	15.55	8	8	3.87	16.67	8	
6	75	3.41	14.91	8	8	3.80	16.37	8	
7	$MgSO_4$ sprays (3) (15 lbs. /100 gals. each)	--	--	--	--	4.15	17.88	8	8
8	Check - NPK only	3.18	13.70	--	--	3.41	14.69		

1/ NPK was supplied in all treatments in a 13-3-12 fertilizer at the rate of 20 cwt. per acre distributed in 3 applications.

THE COMPULSORY PLANTING OF FOOD CROPS ON SUGAR ESTATES IN BARBADOS

by

J. M Cave[1]

Introduction

The growing of food crops, mainly sweet potatoes and yams on sugar estates in Barbados is traditional.

During World War II the Government, to produce more food locally, save shipping and keep the cost of living down, took advantage of this tradition and inaugurated a compulsory planting scheme. This Scheme has continued with modifications up to the present day.

Food Crop Cultivation

The growing of sugar cane is the basis of agriculture in Barbados and what food crops are grown must fit in with, and not hamper, the production of cane. Food crops are thus grown on land not at the moment under growing canes. There is therefore no special cultivation for these food crops.

There are two main periods for food crop planting, i.e. "Preparation Land" and "Thrown out" land, as these are know locally, and refer to the cultural methods employed in cane production.

Methods of Harvest

These vary from crop to crop and are governed by traditional practices. The most common of these is for the purchaser to provide the labour for "digging" and to look after transport and marketing.

The requirements under the law

From the very first crop year of the Second World War (1940-41) estates were required to plant not less than 10% of their "arable" land in food crops.

Due to the necessities of wartime conditions this percentage rose to 35% in 1942-43 and remained so till 1944-45. From 1945-46 onwards these percentages have declined gradually to the present 12%

Prices have been controlled at a very low level. The last revision was in 1952. There has never been any guaranteed market for these crops.

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1 Acting Chief Agricultural Officer, Ministry of Agriculture and Fisheries, Barbados.

How it has worked

At the start, it was considered as the cane producers "war effort" and worked extremely well. Even after the war, the cooperation of planters has been remarkable. This can be seen from the fact that there have been very few prosecutions under the law and the average food crop planting is 15%-20% in excess of the requirements. This is surprising as prices are very low, no market is provided while wages have increased 86% since 1952.

Cumpulsory planting, however, under peace time conditions does not encourage efficient production. There has so far been a reluctance to incorporate modern cultural techniques in the production of these food crops, for their own sake, there being not enough incentive to stimulate the use of these methods.

PLANTAIN AND BANAN MOSAIC IN PUERTO RICO

Julio Bird, Frederick L. Wellman and Francisco Aponte[1/]

In 1946, Alvarez (1) observed cases of mosaic on plantains growing close to a cucumber plant field in the municipality of Corozal, Puerto Rico. Spread of the mosaic was reduced when the cucumber plants as well as the weeds in the vicinity of the affected plantain field were eradicated. Recently, work was undertaken on this disease after the occurrence of several outbreaks in different municipalities of the Island.

The leaves of acutely infected plants are characterized by the presence of golden yellow streaks of various lengths running parallel to the veins. In many cases the streaks coalesce with neighboring ones; in extreme cases the leaves become almost totally chlorotic but for a few islands of green tissue. Almost invariably the first noticeable symptoms are one, two, or a series of golden yellow lenticular spots. These lenticular spots were later found to be primary lesions since they always developed around the feeding sites of viruliferous insects. These lesions have been observed to appear in some cases 48 hours after inoculation via aphids. Other symptoms such as heart rot and splitting of the pseudostem were also observed in the field and later on plants inoculated by means of aphids in the greenhouse. Affected plants practically always give rise to diseased shoots. A few instances where diseased plants gave rise to healthy shoots were observed in the field and greenhouse. However, this was true only in the case of shoots which had arisen from the base of plants with apical necrosis.

Cucumber seedlings of the variety Black Diamond failed to contract disease when inoculated by mechanical means with saps extracted from young and old leaves of mosaic affected plantains and bananas. However in parallel tests seedling cucumber plants were successfully inoculated when similarly treated with saps extracted from the inner white pseudostem tissues of affected plants.

Cucumber virus isolates obtained locally from plantain, banana, _Commelina_, and cucumber plants were compared from the standpoint of their host range. They were also compared on the basis of their effect on two indicator plants: _Luffa acutangula_ (L.) Roxb. and black cowpea. The virus isolates had the same host range and also produced similar local lesions on the leaves of the indicator plants.

The results of the host-range and indicator-plant studies were believed to be good evidence that the Puerto Rican _Musa_ virus was closely related to the cucumber virus that Wellman (3) found was so severe on celery and that also infected banana plants in Florida. Also the virus from _Musa_ in Puerto Rico

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1/ Phytopathologist, Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P. R.; Visiting Professor, N. C. State of the University of North Carolian, Raleigh, N. C.; and Horticulturist, Agricultural Extension Service, University of Puerto Rico, Río Piedras, P. R.

was believed to be similar to the banana virus described by Megee (2) in Australia.

Preliminary surveys were made to determine the geographical distribution and pattern of field occurrence of the virus disease among the musaceous crops of the Island. The malady was detected, scattered in nearly all of the fields visited where these crops are grown in Puerto Rico. No aphids, other than the common Pentalonia migronervosa Coquerel so widely seen on bananas, were found in the plantain or banana fields. Though abundant, these aphids did not seem to be specially associated with Musa virus disease.

The results of a survey made in 1963 clearly demonstrated that the mosaic disease is well distributed throughout Puerto Rico and that it is particularly destructive on plantains and bananas in the central mountainous area. Incidence is extremely high on plantains in the municipalities of Orocovis, Barranquitas, Naranjito and Corozal.

On account of the fact that it is the only aphid species normally found breeding and feeding on Musa plants in Puerto Rico, Pentalonia nigronervosa was believed by some to be the vector of the virus under our conditions. This aphid species was repeatedly employed by us in attempts to transmit the Musa virus. In all cases it failed to transmit the virus from Musa sapientum L. to M. paradisiaca L., or from Musa to cucumber plants and viceversa.

Instances were seen in which few acute cases of infection occurred on Musa plants of different species near pure stands of Vinca rosea L. covering the ground. These periwinkle plants were generally infested with aphids and most often exhibited were found on apprently mosaic-free periwinkle, and were multiplied on known virus-free Vinca seedlings. As these remained free of virus symptoms the stock cultures of the aphid were presumed to be virus-free. Specimens from the stock culture were forwarded to Clyde Smith at the University of North Carolina, who identified them as Aphis correopsidis Thomas. When tested under controlled conditions, this aphid was found capable of spreading the Musa virus from Musa to Musa and from Musa to cucumber. However, on the whole it was not a very efficient vector. This aphid is believed to be a vector of little importance under natural conditions in Puerto Rico. The tobacco aphid Myzus persicae was found to be incapable of transmitting the virus under our conditions.

Another aphid tried was Aphis gossypii Glover, because it has a wide host range, it is abundant on its hosts in the Island, and it is well known as an efficient vector of the cucumber virus (the Musa virus is a strain of this virus). Extensive transmission studies were carried on with A. gossypii under carefully managed greenhouse conditions. This aphid proved to be an excellent vector of the virus from cucumber plants to Musa. The aphid spread the virus within plants belonging to the genus Musa, and also transmitted it successfully from Musa to various weed and cultivated plant hosts.

Plantains become affected and often die as a result of acute infection. In other less common instances plantains enter a mosaic stage after acute infection. Many times complete recovery occurs after acute infection and the causal agent cannot be isolated from the plant tissues. In other cases after acute infection no outward symptoms of disease are evident on the plants but the causal agent can be isolated from the inner tissues. On some of these plants the disease may flare up again, the plant entering the mosaic stage. Not infrequently symptomless plants produce deformed fruits with signs of internal necrosis.

In a series of susceptibility tests effected in the greenhouse using Aphis gossypii as vector, all of the common varieties of plantains and bananas that are known to be grown in Puerto Rico, were successfully inoculated with the Musa virus. In addition, two species allied to the bananas and plantains, namely Musa rosacea Jacq. and Canna cocinea Mill. also developed severe symptoms of mosaic.

Parallel inoculations of cucumber plants, through the rubbing technique, were carried out employing what we consider a mild strain of virus from M. paradisiaca, a severe strain from M. sapientum, and known strains of the Puerto Rican Commelina and cucumber viruses. These 4 strains induced different symptoms on Black Diamond cucumber. No symptom other than a characteristic mild mottling developed on cucumber plants diseased with the so-called mild strain of the Musa virus. Somewhat more severe effects resulted from infections induced on cucumber by what we called the severe strain of Musa virus, and the typical Puerto Rican Cucumber virus. Extremely severe mottling accompanied by ringspotting, as well as extensive necrosis resulted form inoculations with the Commelina virus.

The cucumber seedlings diseased with these 4 strains of virus were kept in different insect cages and colonized with aviruliferous Aphis gossypii. In each case, after an acquisition feeding period of 4 days about 100 aphids were transferred from the diseased cucumber plants to healthy separately grown plantain shoots of the variety Maricongo. All of the shoots thus infested with virus-containing aphids, developed very similar symptoms of mosaic.

The disease can be successfully controlled. Farmers should eliminate affected plantain and banana stock as soon as symptoms of mosaic become evident. Seemingly healthy shoots arising from the base of affected plants should not be used for propagation. Plantain and banana fields should be kept free of solanaceous, cucurbitaceous and commelinaceous plants. Many species within these families often harbor the casual agent and/or the agent that spreads the malady.

LITERATURE CITED

(1) Alvarez, L. A. - Unpublished data. 1946.

(2) Magee, C. J. P. - Transmission of infectious chlorosis or heart rot of the banana and its relationship to cucumber mosaic, Australian Instit. Agric. Sci. 6 44-47. 1940.

(3) Wellman, F. L. - A disease of banana, markedly similar to bunchy top produced by celery virus 1 in U.S.A., Phytopath. 24 1032-1034. 1935.

WHITE RUST A NEW DISEASE IN SURINAM

F. A. del Prado[1]

In May 1963, several plants of chinese cabbage were received from farmers by the Plant Protection Service showing as symptoms white blisterlike postules.

A survey during the next six months showed the disease to be present mostly in the vegetable areas on shell ridges around the capital city of Paramaribo. This being a new disease, we were not content with our initial diagnosis, but material sent up to the Plant Protection Service at Wageningen, Holland, confirmed the disease as being caused by the white rust fungus, Albugo candida (Pers. ex Chev) Cystopus candidus (Pers. Rous).

Symptoms of this disease which is new for Surinam are yellow spots on the leaves. Furthermore on the lower surface of the leaves are found the pronounced white chalky sporemasses. There is no indication of any disease present until light coloured areas begin to appear under the epidermis on the lower surface of the leaves. These areas enlarge, become lighter in colour and produce a raised area before they finally cause the epidermis to rupture and at this stage the conidia are released. The edges of the ruptured epidermis dry and shrivel, exposing more and more of the white spore mass. The spots enlarge, producing single, more or less circular postules, or the epidermis is ruptured in several places often resulting in more or less circular rows of small postules or sori surrounding the original one. The leaf tissue of the upper surface directly above the postules becomes yellow, dies and turns brown. Eventually dark brown necrotic spots are visible.

According to publications by J. C. Walker, R. H. Larson, A. L. Taylor, George F. Weber, and others, white rust is found on many wild and cultivated crucifers and is worldwide in its distribution. However in Surinam white rust was found only recently on chinese cabbage namely on the varieties amchoi, pakchoi, and kaichoi. On the latter, the disease incidence was the least while on the former, sometimes the under surfaces of the leaves were for a large part covered by the white postules, which render this vegetable unsalable. Distortions, which were mentioned also by Walker and others, were not observed in Surinam. Only an attack of the leaves was found, while in other countries, stalks, flower petals, stamens and ovaries were found hypertropied and many times their normal size.

In Europe white rust Albugo candida which grows between the cells and feeds by means of haustoria, does not kill the tissues right away, but frequently it is the cause of morbid growth, which develops after normal cell division and the formation of giant cells. In the cells where morbid growth takes place, oogonia and antheridia, the organs of reproduction of the fungus are formed. After copulation the oogonium becomes a oospore, a thickwalled resting spore. The oospores are capable to carry the fungus through unfavourable periods. However if the conditions are favourable 100 or more zoospores or swimming spores can be produced form an oospore.

[1] Plant Pathologist, Head of the Plant Protection Service, Agricultural Experiment Station, Surinam

Usually cool weather and soaking in water for a few hours cause the oospores to germinate and form zoospores. The oospores are formed between the cells of the plants and they are carried over in plant debris or soil. Usually after one year "overwintering" they germinate and form zoospores which the cause of the primary infection the next year. Shortly after the primary infection the above mentioned white spore masses may develop; it is the the so-called asexual form, which is the source of distribution of the disease during the growth period of the crop. These spore masses are formed form the intercellular mycelium under the epidermis in groups of conidiophores or sporangiophores. Afterwards small chains of round sporangia develop and these are visible with a lens as small granules after rupture of the epidermis.

In each sporangium 4 to 8 zoospores are formed, which appear to be the same as the previously mentioned sexually formed zoospores. The development of these asexual zoospores takes place only when the sporangium has lost about 30% of its moisture content. On the leaves this loss of moisture is determined by the rate of water loss of the tissue of the host plant. When plants have a shortage of water due to long periods of warm or dry weather, low water level or high rate of evapotranspiration, these asexual zoospores develop rapidly. The asexual zoospores cause the spread of the disease. In Surinam especially these conditions are found frequently, and it is for this reason that after primary infection a rapid spread of the disease takes place.

Since the disease is not of major importance, in many countries, no control measures are undertaken. In some publications it is even mentioned that no effective control measures are known against Albugo candida. However in Holland the Plant Protection Service at Wageningen advises spraying of the plants with zineb (zinc aethylene bisdithiocarbamate) at a rate of 350 grammes per 100 liters of water, TMTD, tetramethylthiuramdisulfide at a rate of 250 grammes or copperoxychloride at a rate of 500 grammes per 100 liters of water.

In Surinam it is a regular practice to grow seed from some plants left over for that purpose and replant on the same beds. A high incidence of infection with Albugo candida spores is the result. We advise the farmers not to follow this practice.

Since this disease is of major importance in Surinam we plan to run some control experiments the next season. Concerning the introduction of this disease in Surinam nothing is known but we suspect that it was imported on plants that were not inspected by our Plant Protection Service. It would be of interest to find out in which countries in the Caribbean region this disease is present.

PINEAPPLE MEALYBUG CONTROL IN PUERTO RICO

by

Mario E. Pérez Escolar[1]

The pineapple mealybug, Pseudococcus brevipes, is the proven vector of wilt disease caused by a virus. It has been reported from practically all pineapple regions of the world. The Smooth Cayenne, the most important commercial variety, is one of the most susceptible. Control depends to a great extent, on the use of clean planting material and prevention of ants attending the mealybug colonies. The latter may not be 100 percent efficient especially in areas of intensive rainfall or high temperatures as the insecticide (usually Aldrin) is washed mechanically from the surface of the lethal level reduced.

The use of a systemic insecticide has been tested in Hawaii with partial success. Such materials as dimethoate and systox were found to be ineffective and the reason was experimentally demonstrated to be poor absorption by the pineapple plant. However Disyston, a related compound, was found to be readily absorbed throughout the entire plant especially by the root system and the older leaves. As little as 25 lbs. of the 10% granular material applied as a broadcast or to the soil at the time of planting is recommended by Chemagro Chemical Company but for Hawaii only.

The effectiveness of Disyston granular applications to control mealybug wilt is being investigated under Puerto Rican conditions. One application only of 25 or 50 lbs., three months after planting was found to be superior to the check at the 1% level of significance. No differences could be detected between the two dosages tested. Leaf sampling to determine translocation by anti-cholinesterase methods showed good results. Fruit sampling for residues studies have been made by Chemagro Chemical Company.

Recent greenhouse tests to determine best site of application (using the anticholinesterase technique) have shown inconsistent results.

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[1] Entomologist, Agricultural Experiment Station, Río Piedras, Puerto Rico.

YIELD COMPONENTS IN PIGEON PEAS (Cajanus cajan)

by

Vernon Royes[1]

The main purpose of this paper is to present for critical examination the use of selection for various components of yield as a means of improving the quality and quantity of the crop in Pigeon peas. It is also to be used as a vehicle for the presentation of the results of some preliminary experiments on the subject.

A number of workers in the past have attacked the problem of yield through yield components. Harland (1920) working on cotton, broke lint yield into its components and investigated their inter-relationships and correlation with yield. He concluded that the yield of Sea Island cotton could be increased by selection for certain combinations of morphological characters. Woodworth (1932) and Weatherspoon, and Wentz (1934) investigated the components of soy bean yields. The latter authors found that an increase in one component was often accompanied by a decrease in another. They concluded that there was a strong physiological relationship between the components which was imposed by the existence of a physiological limit to yield.

Frankel (1942) cites an instance where two New Zealand wheat varieties were produced which gave superior yields, although they showed no improvement in any of the "limiting components" of the first group. Boyce, Copp, and Frankel (1947) found that selection for yield components in wheat was no more successful than selection for yield itself.

Powers (1945) and Griffing (1953) investigated yield components in the tomato. The former found that the interrelation of yield per plant, number of ripe fruit and size of fruit is such that it should be possible materially to increase yields by recombining greater number of fruit that ripen with larger size. He also found that the recombination of the components, number of locules and weight per locule should lend to an increase in the size of the fruit. Griffing, however, suggested that "selection for larger fruit size" will generally result in fewer numbers of fruit per cluster, fewer numbers of clusters, and therefore, fewer numbers of fruit per plant. He concluded that one set of plieotropic genes may exist which control the balance between a "growth force" tending to increase the number of reproductive parts and a similar force tending to increase the size of such parts. He thus refuted the earlier work of Powers and dismissed selection for increased yield through selection for yield components as difficult and tedious.

Thus some inconsistency exists in the findings of various workers on the usefulness of approaching the problem of yield through yield components. It often seems to be the case that an increase in one component results in decrease in one or more of the others. However, Grafius (1956) has linked the yield of wheat and oats to the volume of a box, the dimensions of which

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were the yield components. He suggests that the right combination of components must be found in order to obtain the highest possible yield.

The results presented here were obtained by preliminary recordings designed primarily to show how best the components of yield may be recorded. They do, however, allow a few tentative conclusions to be drawn.

MATERIALS AND METHODS

Materials

The recording made on fresh peas and pods was carried out on four lines, GC 12/2, GI 17/1, CH 11, 33, 34, and 03/59. The first three of these are derived from crosses made at St. Augustine, the progeny of which has been selfed for three generations. The last is an original selection which has been selfed for the same three generations. The recording made on dry peas was carried out on 57 varieties collected at St. Augustine from the Caribbean Area, India, Ceylan and East Africa.

Methods

The recordings on fresh peas and pods were carried out on the four lines which represented part of randomised blocks in a trial containing 15 lines in all.

Weekly records were taken from the commencement of cropping in October 1963 on the number of pods per tree. The number of peas per pod and the number of abortive ovules per pod were also recorded weekly on a sample of 30 pods from each line. Individual pea weights and mean pod weights were taken once for each line. Recordings were made on the first crop only.

For the dry peas the smallest dimension and the weight were recorded for individual peas.

RESULTS

Table I

Table I gives the components of yield and other data recorded for the four lines. A few points of explanation should be raised at this point.

For the number of pods per tree the variation between replications was no greater than could be accounted for by variation within replications. The lack of statistically significant differences between means, even at the 5% level may be due to the small size of the sample and/or the large coefficients of variation. The expanded trials now being recorded have 168 trees per line.

For number of peas per pod there was no statistically significant variation between weeks except in 03/59 which was significant at the 5% level. Inpection of the detailed results suggested that heteorogenetity between trees as opposed to within trees may have been the cause. The differences between lines were significant at the 0.1% level.

For weight of pea the sample size was between 50 and 70. The lines fell into two groups, GC 12/2, and GI 17/1 in the first and the others in the second. There were no significant differences within groups but the differences between each line and any line in the other group were significant at the 0.1% level.

For the number of abortive ovules per pod there were no differences between weeks except in GC 12/2. What appears to be a very high coefficient of variation is only 20-30% higher than would be expected if the abortion of ovules follows a Poisson distribution.

The regression of any yield component upon another failed to produce coefficients significant at the 5% level. Thus a full consideration of these will not be undertaken. It will, however, be pointed out that with three degrees of freedom many were significant at the 10% level. They suggest that the further investigation now in progress may show that this crop may not yet be limited physiologically and that it may be possible to improve the yield in quantity and quality by selection for yield components.

Figure I

Figure I shows the mean smallest dimension which is called the width and mean weight of samples of twenty dry peas of 57 varieties. Ten times the natural log of the parameters are plotted since it facilitates the interpretation o the exponential relationship between width and weight.

The slope of the best straight line through these points is 1.83: 1. For objects of the same density and the same shape a similar graph would give a line with a slope of 3. Thus for this sample of pigeon pea varieties, either a given increase in weight is accompanied by a disproportionally large increase in width or an increase in linear dimensions is accompanied by a decrease in density.

Both of these possible interpretations have important quality considerations. A decrease in density with increasing size would greatly hamper the canning of large seeded high yielding varieties of peas, since less food and weight could be packed in a given space. However, if a change in shape towards a more rounded pea accompanied an increase in weight, it would simplify the task of selecting for both yield and a round full pea. Preliminary measurements on three dimensions of the peas suggest that there is a considerable change in shape with weight. However, it is not yet possible to exclude the possibility of density changes.

DISCUSSION

Bearing in mind the inadequate nature of the data and the consequent reservations which must be made on their significance, a mainly theoretical discussion will be undertaken.

There are three main benefits which may accrue form the study and use of the components of yield. Firstly, there is an increase in yield, secondly, an increase in quality and thirdly, an increase in the knowledge of the biology of the crop.

On yield, Weatherspoon and Wentz working on soy beans, Frankel et al. working on wheat and Griffing working on tomatoes did not hold out much hope of increasing yield by way of selection for yield components. The opinion was that yield was limited by the physiological limit of production for the crop. It should be pointed out, however, that soy beans, wheat and tomatoes are "old" crops, that is they have been subjected to intensive breeding programmes and selection for long periods. Thus these crops may now have attained the physiological maximum of production and this would result in a close inter-dependence between yield components. On the other hand, the situation may be different in a "new" crop. Harland, working in 1920 on cotton, a tropical crop that was only at the beginning of a period of rapid improvement, stated that selection for components was a probable means of gaining increases in the quantity and quality of the crop.

The pigeon peas is now at the stage that cotton was at in 1920. Although work started as early as 1933 on pigeon peas in Trinidad, it was mainly directed towards the selection of a good deal or dry seed. The present programme was started in 1957 by H. J. Gooding, and it is still in its early stages.

Thus it may be argued that the findings for other crops, particularly "old" temperate crops may not be applicable to pigeon peas, and quantitative improvements may still be possible through selection for yield components.

On the question of the improvement of the quality of the crop, there seem to be fewer difficulties. All the authors cited have found that variation exists in the distribution of yield into its components. In pigeon peas, all the components studied show significant differences between lines except the number of pods per tree. This component is closely correlated with yield and differences in yield have been demonstrated on larger samples of trees.

Thus there is variation in pigeon peas in the apportioning of yield into its components. It is therefore probable that by applying selection directly to yield components it may be possible to rearrange the distribution in a more favourable manner. It is unfortunate that the state of knowledge of this crop is such that no clear indications exist on the subject of what would be a desirable form of crop to produce.

Thirdly, the increase in the knowledge of the biology of the crop. The necessity for this need hardly be stressed and a number of important questions which should be answered come to mind.

The cost of reaping pigeon peas by hand is one of the major problems of the crop. Higher picking rates would result in varieties with longer pods with more peas per pod, if all other factors remain constant. However, it is uncertain whether this proviso will hold. It may be that an increase in the number of abortive ovules. Experiments are currently in progress to determine if this is the case, and if it is, to estimate the optimum number of peas per pod for maximum yield.

The matter of the relationships of pea width, weight and density is another question which should be answered.

The question of the pea to pod ratio is not without complication. At present the pod "shells" have only a nuisance value to the manufacturer and consumer. An increase in the proportion of pea to "shell" would benefit both in Trinidad, since pigeon peas are sold in the pod or "unshelled" there. However, selection for an increase in the pea to "shell" ratio would result in thinner "shells" which may in turn lead to greater attack by pod borers. Insecticide protection would have to be increased and eventually a point of maximum return would have to be ascertained.

It is my opinion that the shape and form of the pigeon pea crop must be changed radically if it is to make an important contribution to the Caribbean and the general protein deficiency in the region. These changes will be most easily effected through selection and breeding in which the study and use of the components of yield and the shape and form of the tree and cropping season will play a very important part.

EXTENDING SHELF LIFE OF MANGOES WITH IRRADIATION

by

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Puerto Rico Nuclear Center[2]

(ABSTRACT)

Each year hundreds of thousands of mangoes are not used in Puerto Rico while in New York City the Puerto Rican population are missing this fruit. Unfortunately mature mangoes have too short a shelf life before becoming spoiled to be shipped from Puerto Rico to the United States. Experiments using gamma irradiation to extend the period before the fruit becomes unsuitable for consumption were conducted.

Green mangoes, almost ripe mangoes and mature mangoes of the native variety were used. Post irradiation temperature control at 50°F and 70°F was studied. Fruit in open containers and fruit in sealed plastic bags were compared. Varietal difference in response to dose and to length of time before spoiling were obtained. Combinations of cool (50°F) storage conditions and radiation levels were observed. The results of these experiments will be presented. Their significance and recommendations for future work and application will be discussed.

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[2] Operated by the University of Puerto Rico for the U. S. Atomic Energy Commission under Contract AT-(40-1)-1833.

TOMATO BREEDING FOR THE TROPICS

H. Azzam [1/]

Introduction

The tomato is a very important vegetable in the tropics. Production is low in general, due to the lack of a suitable commercial variety. The commercial varieties grown have been developed for either temperate or subtropical conditions. The subtropical varieties may do rather well, but still are not considered perfect. Therefore, there is a great need for commercial tomato varieties developed for the tropics.

Tomato problems in the tropics are in many ways similar to the temperate zones, yet, it still has some peculiar problems of its own. These are entomological, horticultural and pathological problems. For instance, breeding for resistance to insects is not being carried out in the tropics, and thus the available commercial varieties lack the resistance to several important tropical insects. Therefore the control of all insects must be done by the use of insecticides.

Fruit Set

Fruit-set is considered among the most important horticultural problems. High night temperature contributes to poor fruit setting. In general tomato requires a night temperature of 65°F - 70°F for optimum set. The high temperature causes what is known as heat sterility. Pollen tube germination is best at about 70°F. Temperature above 90°F may produce pollen sterility. Heavy rains may wash the pollen grains before fertilization or even prevent the opening of anthers. This will result in little or no pollination, and as a consequences no fruit set. Excessive soil moisture, such as tomato grown in poorly drained soil, could cause flower drop. Diseases and insects, especially those that can attack and damage tomato flowers, can cause poor set. The tropics are in need of tomato varieties that may overcome some of these difficulties.

Yield

Tomato yield could be devided into two major components (2): the total number of fruits depends on the number of clusters per plant and the number of fruits per cluster. The average fruit weight depends on the average number of locules

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and the weight per locule. The environment no doubt plays an important role on each of the components mentioned. Since there are several genes affecting yield (3) and to obtain maximums yield, there should be no limiting factors in any component. A desirable variety should posses all the desirable genes affecting each yield component.

Quality

The quality of tomato produced in the tropics is considered generally poor. However, some are produced with excellent quality. Tomato fruit quality depends on its external and internal features. The external features are: fruit shape, size, the scar at the blossom end, skin blemishes and cracking. The internal features are: the number of locules, flesh color, number of seeds, firmness and fleshiness. It is often noted that tomato fruits produced in the tropics are soft, cracked, with cat-face, of small size, and does not color well especially when picked mature-green. Any variety that is being developed for the tropics should have resistance to as many as possible of the above mentioned quality problems.

Mechanization

The gradual increase in labor man power in the tropics will in the future necessitate the development of a tomato variety adapted to mechanical harvesting. In addition, the increased interest in tomato processing will also demand the development of a tropical tomato variety suitable for that purpose.

Diseases

Tomato diseases in the tropics could be grouped into physiological and pathological diseases. Among the physiological disorders are: fruit cracking, blossom end rot, cat face, sun burn, softness and puffiness. The pathological diseases are those caused by bacteria, fungi, nematodes and viruses

Among the diseases caused by bacteria is the bacterial wilt caused by *Pseudomonas solanacearum*. The lack of a good resistant germ plasm materials is considered a handicap for breeding to its resistance. However few breeding lines were obtained that show some degree of resistance but their fruit quality are not commercially accepted.

Among the high costly items in tomato production is the frequent spraying with fungicides for the control of leaf and fruit fungi. Breeding for resistance to these fungi should help in cutting down the cost of production.

Nematodes are found everywhere in the topics. The root knot type is the most common one found on tomato roots. Varieties that were developed elsewhere for resistance to these nematodes were found not to be fully resistant in the tropics. This could be due to the differences in "races" or other reasons.

Among the most common tomato viruses that are widely noted are the tobacco mosaic and the cucumber mosaic. Commercial varieties that may have some resistance to either virus do not produce well in the tropics.

Tomato species other than Lycopersicon esculentum often carry genes for disease resistance. The following are some diseases and the corresponding species in which resistance could be found:

L. pimpinellifolium: bacterial canker, bacterial wilt, fusarium wilt, stemphylium, cladosporium, verticillium wilt and spotted wilt virus.

L. hirsutum: Septoria and Tobacco mosaic virus.

L. peruvianum: Root know nematodes, Alternaria, leaf mold, Curly top virus, spotted wilt virus, Tobacco mosaic virus and bacterial spot.

L. chilense: Curly top virus.

Resistance to other diseases are found now and then in the above mentioned species as well as others.

The interspecific hybrids has their own problems. These are in most cases Genetical and Cytogenetical aspects including incompatibility, sterility and linkages.

The inheritance mechanism of certain plant characters and the inheritance to some diseases, should be studied, if they are yet unknown. This will contribute to a better understanding of the characters that are being bred.

It is sometimes a problem for a breeder to determine the most suitable method of selection. Could he select for one trait at a time, or use a total score method in which to select for all traits simultaneously or set a certain level for each trait and eliminate any plants that falls below that level?

Selection methods will depend on the condition of each case, the breeding objectives and the characters that are being selected for or against.

Natural Cross-Pollination "NCP" is rather high under certain conditions. In Puerto Rico (1) it varies between 3 and 32% depending on insect activities and distances between breeding plots. The solitary bee, Exomalopis glubosa F, which is common in Puerto Rico and other minor insects were found to be the pollinating agents. NCP could be studied with the use of simple gene characters such as the potato leaf, pigment and some male sterile lines. The determination of the isolating distances needed to minimize the effect of NCP, is vital, not only to the breeding project, but also for future seed production of the varieties that will be developed. There have been cases in other self-pollinated crops that newly developed varieties lost some of its important characters within few years. NCP during seed multiplication is possibly among the reasons that contributed that loss.

In a tomato breeding program with the previously mentioned objectives, shor. cut methods should be used, as much as possible, in order to achieve most of the objectives in the least time possible. Some of these short cut methods could be: to screen for disease resistance to the most virulent isolates in the seedling stages, correlating seedling characters with mature plants, prediction of fruit shape by observing the ovary shape of the first flowers to develop and the selection for some plant characters in the young stage. In addition and due to the fact of freedom from frost in the tropics, several generations could be obtained in one year. These methods will undoubtedly help in the rapid release of new varieties.

The final goal in a breeding project for a tropical tomato variety should be to combine the resistances to as many diseases as possible and in the mean time to maintain good horticultural characters.

The search for new germ plasms, the exchange of information and materials among tomato breeders in the tropic as well others, the cooperation of a Plant Pathoiogsit and Entomologist, and above all the work as a team, are of extreme importance to the success or failure of any breeding project.

SUMMARY

Tomato problems in the tropics in as much as they are similar to the temperate zones, still has some problems. Heat sterility; internal and external qualities of fruits; yield; diseases; insects and others, represent a great challenge in breeding for tropical varieties. Natural cross-pollination, in relation to seed production should be investigated. Discussion involves, breeding systems, methods, materials used, and emphasis is given to combined disease resistance.

LITERATURE CITED

1- Azzam, H., "Natural Cross Pollination of Tomato in Puerto Rico", Proceeding A. S. H. S. (Caribbean Region) 4:85-86, 1960.

2- Guffing, B., "An analysis of tomato yield components in terms of genotypic and environmental effects", Iowa State Agric. Exp. St. Research Bul. 397:324-380, 1953.

3- Powers, L. et al, "Partioning method of genetic analysis applied to quantitative characters of tomato crosses. U.S.D.A. Tech. Bul. 998: pp. 56, 1950.

PROMISING WEEDICIDES FOR USE IN FOOD CROPS

by

L. Kasasian[1] and A. Doheland

At the first Annual General Meeting of the Caribbean Food Crops Society held in 1963, Mr. L. Kasasian presented a paper entitled Chemical Weed Control in Tropical Food Crops. In that pape. reports were made on the performance of forty one weedkillers. Of this number about a dozen have proven to be especially useful.

The present paper seeks to define some of the characteristics and conditions of use of these currently recommended weedkillers. This is because results obtained may vary according to three ma n factors. Factor (a) the soil type may be first mentioned since any variable behaviour induced by this factor may be dealt with in usage recommendations (a scale of dosages is given to suit different contents of clay and organic matter). Factor (b) the climate (especially rainfall), and (c) the stage of plant growth (both of crop and weeds) have been analysed for their relevance to local practice in experiments conducted by the Herbicide Research Unit in Trinidad.

Table 1 charts the weedkillers against certain food crops in which they may be used.

Some information on each chemical is given below, together with a guide to usage.

Amiben

Chemical name - 3-amino-2, 5, dichlorobenzoic acid
Available as liquid and granules.
Properties - Amiben is active mainly on germinating weed seeds, and must therefore be used pre-weed emergence. It is effective on annual broadleaf and grass weeds to a lesser extent. Persistence in the soil is short, usually 3 - 6 weeks. The chemical is tolerated by a wide range of horticultural crops.
Uses - The granular formulation is somewhat more persistent than the spray and is particularly useful for post-transplanting use e.g. in tomatoes whereas the spray is used before crop emergence. Application rates are about 1 - 2 lb/ac. of the active ingredient.
Toxicity - Mammalian toxicity is low.

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[1] Herbicide Research Unit, University of the West Indies, Trinidad

Table 1

WEEDICIDES	CROPS											
	Maize	Rice	Pigeon Peas	Dwarf Beans	Bodi-Beans	Sweet pota-to	Yams	Tannia & Dash-een	Cas-sava	Tomato	Cabbage	Carrots
Mainly pre-emergence use												
Amiben			x	x	x	x		x		x	x	x
Atrazine	x						x		x			
Diphenamid				x		x				x	x	
Diuron							x		x			
Prometryne			x					x				x
TCA						x	x	x	x			
Mainly post-emergence use												
Paraquat			x	x	x	x	x	x		x		
2,4-D	x	x										
Dalapon								x				
Stam F-34		x										
Kerosene												x

Atrazine (Gesaprim, Primatol)

Chemical name - 2-chloro-4-ethylamino-6-isopropylamino-1, 3, 5-triazine.

Prometryne

Chemical name - 2-methylmercapto-4, 6-bis (isopropylamino) 1, 3, 5-triazine Both compounds are available as wettable powders; atrazine available also as granules.

Properties - Atrazine and prometryne are persistant herbicides which are active mainly as pre-emergency sprays on many annual grasses and broadleaf weeds; at higher rates they may be also effective on perennials. These compounds tend to be less active, less persistent but more selective than diuron. Atrazine and prometryne lack post-emergence activity and where it is desired to kill emerged weeds they should be mixed with paraquat. Both compounds act mainly through the roots and therefore they are in general most active, least selective and least persistent in soils in which leaching occurs readily and where rainfall is high. In the absence of precipitation to carry the compounds into the soil, intense sun-light for 1 or 2 weeks after application causes considerable breakdown resulting in their losing much of their activity. They are very much more effective if application periodical agitation of the spray liquid is necessary. Symptoms usually show as interveinal chlorosis, chlorotic blotches and necrosis.

Uses - Atrazine is less selective and more persistent than prometryne. Rates of application are 1 - 3 lb/ac of the active ingredient of both compounds dependent upon the tolerance of the crop, environmental conditions and the period of control required. At selective rates they will give up to 8 weeks control.

Toxicity - Both compounds are non-corrosive and of low mammalian toxicity.

Diphenamid (Dymid)

Chemical name - NN-dimethyl-2, 2-diphenylacetamide.

Properties & Uses - Diphenamid has short soil persistence usually 4 - 8 weeks. The compound is effective on weed seeds of grasses and of broadleaf plants to a lesser extent. Normal rates of application are about 4 - 8 lb/ac of the active ingredient.

Toxicity - It is of low mammalian toxicity.

TCA

Chemical name - Trichloroacetic acid.

Dalapon

Chemical name - 2, 2-dichloropropionic acid.
Both compounds are available as water soluble formulation. TCA also available as pellets.

Properties - Both compounds are active primarily against grasses. Dalapon is absorbed both by leaves and roots, while TCA is thought to be absorbed mainly by the roots. When absorbed through the leaves dalapon is much more active than TCA; when absorbed through the roots there is much less difference in activity. Dalapon is a translocated herbicide and gives best results on actively growing plants, application to regrowth 1 - 2 ft. tall can be expected to give the best results. Where pre-swoing applications are made soil persistence is unlikely to be much of a problem; in the wet season it should be safe to plant a treated area about 2 - 4 weeks after treatment.

Symptoms - include browning and chlorotic blotching of foliage and distortion and cessation of growth. Both, particularly TCA, are slightly corrosive to metals.

Uses - Selective rates of application are 2 - 5 lb/ac dalapon and 5 - 10 lb/ac TCA dependent upon soil type, rainfall, the risk being greatest under conditions of high leaching.

Toxicity - Mammalian toxicity of both herbicides is low. Dalapon may cause slight skin irritation while TCA is highly corrosive to the skin. Occasional individuals suffer respiratory irritation from dalapon.

Paraquat (Gramoxone)

Chemical name - 1, 1'-dimethyl-4, 4'-bipyridylium-2A.

Properties - The compound is highly effective for top-killing herbaceous perennials and annuals; weeds with poorly developed root systems may fail to recover. It has no residual effect and is inactivated when it comes in contact with the soil. Entry into the plant is very rapid indeed and thus rain soon after application five minutes or so should have little or no effect. Paraquat may successfully be applied in 5 - 30 gallons per acre depending upon the density of the vegetation.

Uses - Selectivity seems to depend solely on soft growth escaping the spray. The compound is usefull as a pre-crop emergency spray if the weeds emerge before the crop. Paraquat may be added to atrazine and prometryne to kill emerged weeds. Rate of application is about 1/2 lb/ac active ingredient, equivalent to two pints per acre of Gramoxone. Agral 90, a wetting agent, should be added at a rate equal to 0.1% of the total spray volume.

Toxicity - The compound is considered to be of low mammalian toxicity.

<u>2,4-D</u>

Chemical name - 2,4-dichlorophenoxyacetic acid.

Available as iquid, granules and pellets.

Properties & Uses - 2,4-D is used primarily as a translocated foliage spray, and is active against broadleaf weeds. Care should be taken to avoid spray drift and use of the non volatile amine salt is recommended. Selective rates are 1 - 2 lb/ac of the active ingredient. The early injury symptoms are distortion of leaves and stems. 2,4-D contaminates spray equipment which should therefore carefully be washed with detergent.

<u>Stam F-34</u> (Propanil)

Chemical name - N-(3, 4-dichlorophenyl) propanamide.

Available as emulsifiable concentrate.

Properties - Stam is a post-emergence herbicide mainly active on seedling weeds.

Uses - The compound is used selectively as an overall application in rice fields when the rice is in the 3 - 4 leaf stage. Normal rates of application are about 3 lb/ac of the active ingredient.

Toxicity - Mammalian toxicity is low.

<u>Kerosene</u>

Properties - This oil will give a top kill of annual and perennial broadleaf weeds and grasses. It may eradicate seedling weeds.

Uses - Carrots will tolerate overall kerosene sprays. Rate of application is 20 gallons per acre and above. Kerosene has been found to be a more effective weedkiller when applied soon after sunrise (when the dew is still on the leaves and light intensity is low).

Toxicity - not a problem in normal usage.

THE SWEET POTATO IN CARIBBEAN AGRICULTURE

Some Aspects of its Improvement by Breeding

by
D. Basil Williams[1]

ABSTRACT

The sweet potato has been in cultivation in the caribbean and Tropical American region probably since prehistoric times. Today it is still widely grown and utilised in these parts and together with other local food crops, it makes an important contribution to the economies of individual West Indian territories.

Directed efforts toward improving the crop, particularly by breeding and selection, have been - with a few notable exceptions - few, intermittent and largely superficial. Since 1956, when the Food Crops Department of the present University of the West Indies was established, a breeding programme on sweet potatoes has been in progress.

Up to the present time, seedling improvement has been made by practising selection on: a) open-pollinated seedlings, b) seedlings derived from polycross plots of selected parental cultivars and to a limited extent, c) seedlings obtained from controlled crosses.

The procedure of practising selection from open-pollination derived populations permits fairly rapid initial progress without the need for extensive preliminary evaluation of parental stocks. From a total of some 1,500 seedlings raised to date, at least ten of exceptional merit yielding in excess of eight tons of tubers per acre, have been selected. This method, however, has the serious limitation that it yields inadequate information on the parentage os superior seedlings and for the same reason, prevents the critical study of the inheritance of possibly important economic traits of the crop.

It would be much more desirable if the breeder could practise selection on populations derived from controlled hybridizations of tested parental stocks. In the pursuit of this method, however, some serious problems are encountered. The most important are those deriving from the wide-spread self and cross-incompatibility which occurs in the crop and from the irregular flowering of clones.

In an attempt to solve these problems and to learn some more about the nature of their operation, a number of studies has been initiated at the University of the West Indies. The specific areas of emphasis are as follows:

1) The establishment of cross-compatible groups among the cultivars making up our basic breeding stock.

2) The search for self-fertile clones and clones possessing the character of prolific and sustained flowering.

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3) Studies on the control of flowering in the sweet potato.

4) Investigations into the nature and mode of operation of self- and cross-incompatibility and on means of overcoming or, at least, of circumventing them.

5) Inheritance studies which, hopefully, may throw some light on the still clouded question of the nature or origin of the crop.

We trust that the information which these studies may supply in time, would put us in a position to make a more effective assault on sweet potato improvement in the interest of Caribbean agriculture.

MINERAL-DEFICIENCY SYMPTOMS OF BANANAS

George Samuels and Héctor Cibes-Viadé[1]

INTRODUCTION

Little published information appears to be available on the mineral nutrition of the banana. Murray (5) in Trinidad produced deficiency symptoms of nitrogen, phosphorus, potassium, calcium, and magnesium using a sand culture technique. He did not give any information on sulfur, iron, manganese, and boron; nor did he cite any chemical analyses of the plant tissues under this deficiency study. Martin-Prevel and Charpentier (6) working on the Ivory Coast in Africa produced deficiency symptoms on the "Poyo" or Robusta variety for nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. They showed that the "blew" of bananas found in the Ivory Coast area could be produced by a magnesium deficiency.

Chemical analyses of the various parts of the banana plant growing under normal conditions has been well done by Baillon et al. (1), however, their study does not include manganese and boron. C. W. Hewitt (4) in Jamaica showed the possibility of using plant analysis as an indicator of the nutritional status (N-P-K) of the banana. Bhangoo et al. (2) used Hewitt's technique in their study of Giant Cavendish banana nutrition in Honduras.

In Puerto Rico there appears to be no published information concerning the mineral nutrition of the banana. Recent efforts by the Puerto Rican Department of Agriculture has been directed to the promotion of larger acreages of bananas in mountainous areas formerly in coffee or sugarcane. It is the purpose of this paper to provide accurate pictures and written descriptions of the deficiency symptoms of bananas (Dwarf Cavendish) for use by farmers and agricultural technicians in determining these deficiencies under actual field conditions. Also presented are chemical analyses of various parts of the banana plant under deficiency and complete nutrient treatments for the benefit of the agronomist and research worker.

PROCEDURE

All deficiencies were developed on plants grown in sand culture. The fine quartz sand used was obtained from the Tortuguero area and is classified as a St. Lucie fine sand. It was placed in concrete pits 3 feet on each side and 1 1/2 feet deep each pit had an individual hole for draining out the excess nutrient solution.

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There were 10 treatments, each replicated 2 times. The composition of the different nutrient solutions used in this experiment are shown in table 1. Applications were made once a week at the rate of 2 1/2 gallons per pit. Once in a while the pits were flushed with distilled water only to wash out excess salts or to prevent salt accumulations.

RESULTS

VISUAL DEFICIENCY SYMPTOMS

The deficiency symptoms described herein for bananas were developed under experimental greenhouse conditions. It is to be expected, therefore, that differences in intensity of the symptoms will be found under field conditions. However, the pattern of the deficiency development will be the same, and thus the descriptions given should serve as a useful guide in identifying nutrient deficiencies in bananas.

Nitrogen

The effects of nitrogen deficiency were the first to appear. The leaves became lighter green in color in the earlier stages of the deficiency. The growth of the plant was stunted as a result of a reduction both in the rate of leaf production and in the size of leaf developed. The new leaves were progressively smaller and paler green in color, and there was also a gradual loss in color of the older leaves as nitrogen was translocated from them to the young leaves. All leaves became a pale yellow green and older leaves developed a necrosis along the margin of the leaves.

Phosphorus

A deficiency of phosphorus began on older leaves. The symptoms first appeared on the margin of the leaf as a necrosis which began at the tip and extended about two thirds of the way to the base. In the pale areas, purplish spots or flecks appeared which coalesced and work towards the midrib. The necrosis extended rapidly soon leaving premature senescent older leaves. Growth was reduced and the banana bunch was small with few hands.

Potassium

For a potassium deficiency, reduction in growth was noted before any marked leaf symptoms appear. The interval between the production of new leaves became longer and the leaves were progressively smaller. The production of a bunch was delayed as well as the maturing of the hands.

Leaf symptoms, when they developed, were seen on the older leaves, the younger leaves remaining green. The old leaves lost their color from the margin inwards and from the tip towards the base. The chlorosis and yellowing was followed by a marginal necrosis. The chlorosis spreads very rapidly so that in a few days the whole leaf became yellow; it then dried up and the petiole broke.

TABLE I

A Comparison of the Various Parts of Nutrient-Deficient

Banana Plants on a Dry-Weight Basis

Part of plant	Nutrient Content								
	N	P	K	Ca	Mg	S	Fe	Mn	B
	%	%	%	%	%	%	ppm	ppm	ppm
Main plant leaves									
deficiency	0.90	.01	.52	2.02	.31	.14	253	52	16
complete	2.04	.26	2.20	3.78	.84	.15	299	77	22
Main plant stem									
deficiency	1.21	.01	.22	--	.84	.33	200	55	--
complete	2.48	.37	3.21	4.77	2.12	.29	208	52	34
Sucker plant leaves									
deficiency	1.30	.02	1.14	1.31	.44	.25	149	19	20
Complete	1.34	.26	2.09	3.23	.57	.30	211	34	17

Calcium

A calcium deficiency was slow in appearing; and when it did, it began on the younger leaves. The leaf became yellow at the tip and along the leaf margin extending back from the tip. The yellowing became intense followed by a marginal necrosis. The necrosis tended to remain marginal until the leaf turned yellow and becames senescent.

Magnesium

Deficiency symptoms for magnesium developed on the older leaves along the entire margin of the leaf as a chlorosis. This yellow banding of the leaf margin was quite distinctive. Following the chlorosis, was a marginal necrosis. Necrotic spots also developed in the internal part of the leaf.

Manganese

The leaf symptom began as an interveinal chlorosis alternating green vein tissue with yellow intervein tissue. As the deficiency progressed, the yellow chlorotic portion became severely necrotic leaving large black areas. The symptoms developed primarily on leaves about five or six back from the spear.

The fruit produced under a manganese deficiency had a yellow peel as if ripe, but the pulp was hard and not mature. Some fingers tended to become dry and black.

Iron

As for manganese, the iron deficiency begans as an interveinal chlorosis. However, for the iron deficiency, young leaves developed the chlorosis first. In severe stages of the deficiency on very young plants, the entire plant became almost a light green to white color. This symptom has been noted in the field on very acid soils (below pH 4).

Sulfur

Sulfur deficiency was slow in appearing. The leaves tended to turn yellow with a drying of the leaf beginning at the tip and progressing toward the base.

Boron

No especial deficiency symptoms were noted in the leaves which could said to be distinctive. However, fruit produced under a boron deficiency show a blackening of the center part of the pulp. This "black heart" of the banana fruit appears to be similar to that produced by boron deficiency in other fruits and vegetables.

PLANT ANALYSES

The results of the chemical analyses of the banana plant grown under various deficiency symptoms are given in table 1.

The level of the various elements under the deficiency treatments were all lower than those under the complete treatment for the leaves of the main banana plant (table 1). Thus it appears that most of the plants were under deficiency stresses. Some plants showed greater deficiency-level stress than others. The ranking of the intensity of the deficiency from severe to almost none are as follows:

PK, Mg N·Ca Mn B Fe S Complete

Phosphorus, potassium, magnesium, and nitrogen levels under deficiency were all less than 50 percent of the complete treatment; whereas, sulfur had only 8 percent and iron 16 percent less under deficiency as compared to complete. It appears that the iron and sulfur deficiency symptoms produced were not too severe.

When we consider the main stem of the plant, we find that under the complete treatment there were higher values for all stem than in the main leaves. Phosphorus levels were extremely low under phosphorus deficiency for both leaves and stem.

The leaves of the banana suckers showed lower nutrient content under a complete treatment than did the stem or leaves of the main plant except for sulfur and phosphorus.

It is interesting to note that for the more mobile elements nitrogen, phosphorus, potassium, and magnesium, the leaves of the sucker plant under deficiency had a higher level them did the leaves of the main plant under similar treatment. Whereas, calcium and iron which are not considered mobile, physiologically speaking, had lower values in the sucker leaves than in the main plant (table 1).

SUMMARY

1- Bananas have been grown in sand culture in absence of nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, manganese, iron, and boron.

2- The deficiency symptoms produced were described and illustrated.

3- Chemical analyses of the various parts of the banana plant grown under deficiency symptoms were related to the level of the nutrient in the deficient treatment as compared to the complete.

LITERATURE CITED

1- Baillon, A. F., Homes, E., and Lewis, A. H., The composition of, and nutrient uptake by the banana plant, with special reference to the canaries, Trop. Agr. 10 (6) 139-144, 1933.

2- Bhango, M. S., Altman, F. G., and Karon, M. L., Investigations on the Grant Cavendish banana-I, Trop. Agr. 39 (3) 189-201, 1962.

3- Cibes-Viadé, H. and Samuels, G., Mineral deficiency symptoms displayed by _Dracaena_ _Godseffiana_ and _Dracaena_ _Sanderiana_ grown under controlled conditions, Tech. Paper 29, _Agr_. _Exp_. _Sta_. _Univ_. P. R., Río Piedras, 1960.

4- Hewitt, C. W., Leaf analysis as a guide to the nutrition of bananas, _Emp_. _J_. _Exp_. _Agr_. 23 (89) 11-16.

5- Murray, D. B., Deficiency symptoms of the major elements in the banana, _Trop. Agr_. 36 (2) 100-107, 1959.

6- Martin-Prevel, P. and Charpentier, J. M., Symptomes de carences en six éléments minéraux chez le bananier, _Fruits_, 18 (5) 221-247, 1963.

EXPERIMENTAL PRODUCTION OF SEVERAL NEW SWEET CORN VARIETIES FOR CANNING, AND FOR FRESH MARKET USE, IN TRINIDAD

by

A. J. Vlitos[1/] and W. N. L. Davies[2/]

INTRODUCTION

The establishment of a modern, well-equipped food processing plant* in Trinidad has stimulated a more intensive cultivation of food crops by peasant farmers. Pigeon peas (Cajanus cajan) were the first crop to have been produced, marketed, and processed successfully. Growers have been encouraged to extend their acreages of this crop, but have been asked to consider growing other crops as well.

One of the problems facing the processing plant is the seasonal characteristics of the pigeon pea crop. The peas mature in mid-December, and once these are harvested and processed, the canning plant may lay idle for the rest of the year. Thus in cooperation with the Tate and Lyle Central Agricultural Research Station several crops have been studied for their suitability to Trinidad environments and for their potential as processed, canned foods. One of the most promising of these is sweet corn.

Several varieties of sweet corn were imported and evaluated at the Research Station over a two-year period. A pilot scheme was set up in 1964 which enabled trials to be carried from field through to processing and canning. The present paper reviews these studies.

1/ Director of Research, Tate & Lyle C.A.R.S., Trinidad and
2/ Agronomist
* International Foods, Ltd.

EXPERIMENTAL

Experiment 1

Seed of the sweet corn variety PR 30 (developed by the Agricultural Experiment Station in Puerto Rico) was imported into Trinidad in 1963. A fertilizer trial was laid down on Waterloo loam and clay soil at the Tate and Lyle C.A.R.S. on 5th April 1963. Prior to planting the experimental area was treated with ground limestone to adjust the pH to approximately 6.5.

The trial consisted of 5 x 4 randomized blocks. Plot sizes were approximately 1/400th acre each. Four seeds were planted in hills at one foot intervals along rows spaced four feet apart. Overhead irrigation with "Wright Rain" irrigation equipment was used as required.

The fertilizer treatments were as follows:-

1. N P K: Calcium ammonium nitrate at 2 cwt./acre + Triple super phosphate at 2 cwt./acre + Muriate of Potash at 2 cwt./acre.
2. P K: Triple super phosphate at 2 cwt./acre + Muriate of Potash at 2 cwt./acre.
3. N K: Calcium ammonium nitrate at 2 cwt./acre + Muriate of potash at 2 cwt./acre.
4. N P: Calcium ammonium nitrate at 2 cwt./acre + Triple super phosphate at 2 cwt./acre.
5. Control: No fertilizer

The fertilizers were applied on 16th April 1963. The experimental area was hard-weeded on 25th April 1963 and treated with Simazine at 2.5 lbs. active/acre.

Experiment 2.

It had been observed that the varieties Spancross and Illinichief tasselled at a very early stage in their vegetative growth when grown under our conditions. A trial was laid down to compare the tasselling of the two varieties with that of PR 50 and with a local variety of field corn. Also effect of early tasselling on yields was evaluated.

The trial consisted of plots 1/400th of an acre, laid down as a 4 x 4 Latin Square. It was located on Waterloo loam and clay at Tate and Lyle C.A.R.S. and planted on 12th September 1963 under very wet conditions. Three to four corn seeds were sown at intervals of one and a half feet, along rows spaced four feet apart.

Two weeks after planting the following fertilizers were applied to the plots:

a) Calcium ammonium nitrate at 2 cwt./acre

b) Triple super phosphate at 2 cwt./acre, and

c) Muriate of potash at 2 cwt./acre.

Experiment 3.

In 1964, it was decided to plant the PR 50 variety of sweet corn on a pilot scale. An area of approximately 1¾ acre was available. Filter press mud was applied at the rate of about 50 tons/acre. This was buldosed over the area and then ploughed in. Ridges were formed five feet apart and good drainage was ensured by an adequate system of field drains.

Four seeds of the IR 50 variety of sweet corn were planted at intervals two feet along the tops of ridges. Planting was carried out between 6th and 8th April 1964. Irrigation wat was applied by means of Wright Rain irrigation equipment, as required.

Weed control was maintained initially by means of a pre-emergence application of Atrazine (2 lbs. active/acre). Two weeks after planting the seedlings were thinned to two per hill. Insect control, subsequent to germination, was obtained by dusting newly emerged plants lightly with 10% Sevin.

Fertilization of the corn was carried out at the following rates:-

21st April 1964:	Sulphate of ammonia at 1 cwt./acre Triple super phosphate at 2 cwt./acre
11th May 1964:	Sulphate of ammonia at 1 cwt./acre
21st May 1964:	Muriate of potash at 2 cwt./acre

When the ears emerged control of the larvae of the corn ear worm *Heliothis armigera* was attempted by weekly sprayings of all ears with 85% Sevin sprayable in water.

Experiment 4.

Seed of four varieties of sweet corn was made available to Tate and Lyle C.A.R.S. by Seed Research Specialists Inc., of Iowa. The four varieties were:-

Aristogold Bantam Evergreen

Floribelle

Goldengrain, and

Valleygold

It was known that Valleygold had performed well in North Dakota and also in South Texas. Floribelle is a high-yielding sweet corn both in Ontario, Canada and Southern Florida. Goldengrain is the most widely-used variety for canning and processing work in Texas(2). It was, therefore, of considerable interest to evaluate these varieties under tropical conditions.

Limited quantities of seed were made available initially, and a small trial was planted in which the performance of the new varieties was compared with FR 50. The trial, planted on 9th April 1964, was laid down as a 5 x 5 Latin Square. Each plot consisted of one row ten feet long with a five foot space between rows and a four foot space between plots along each row. Three seeds were planted on the tops of the ridges, spaced at 2 ft. intervals. The seedlings were subsequently thinned out to one plant per hole.

Germination counts and growth measurements were recorded periodically. Records were kept of the number of ears obtained at harvest from each plot and the weights of these ears.

5. The Canning Process

At the present time the canning factory has no mechanical means of preparing whole kernel sweet corn for the canning process. When there is a readily available supply of sweet corn to meet the needs of a market then the necessary machinery will be installed. The pigeon peas and sweet corn go through similar canning processes, therefore the existing canning machinery is being used for sweet corn.

Briefly, the details of the process (from the time the sweet corn arrives at the canning factory, to canning) is as follows:-

The corn is first weighed, complete with husks. The husks are removed by hand and weighed. The kernels are removed from the cobs, and separate weights are recorded for kernels and cobs. The husks, kernels and cob are then each expressed as a percentage of the weight of the original ear.

The kernels are then placed on the processing line and are washed with clean cold water before entering a chamber in which they undergo blanching. Blanching consists of passing the kernels through steam at 180°F. for 6 minutes after which they are again washed with clean cold water. The kernels are then inspected, on a processing line for imperfect grains, husks etc. before being passed into the hopper.

The cans are sterilized by steam issuing from a jet before being positioned under the hopper. Approximately 10 oz. of sweet corn are placed into each can, and is filled with the preserving fluid. This consists of a solution of 1% common salt and 2% sucrose in water and is at a temperature of 212°F. After filling, each can is inspected prior to capping and sealing.

The sealed cans are placed in the retorts where the contents are cooked under pressure. Each retort accommodates three baskets. Each basket holds approximately 450 1 lb. cans. The cooking process lasts for 45 minutes and is carried out under steam pressure at

240 lb./sq. in. The cans are cooled in water. The canning process is now complete. The cans of corn are then labelled and crated.

RESULTS

Experiment 1.

The crop was harvested between the 19th and 26th June 1963 (71 days after planting). Results are presented in Table 1.

Table 1.

Treatment	Total No. of Ears	Total Wt. of Ears (lbs.)	No. of Ears per plot	Wt. of Ears per plot (lbs.)
N P K	71	29	17.75	7.25
N K	52	22	13.00	5.50
N P	69	29	17.25	7.25
P K	49	18	12.25	4.50
Control	46	16	11.50	4.00

There was a response, in terms of weight of sweet corn produced, to applications of nitrogenous fertilizers. The response was greatest when applications of nitrogen were combined with applications of phosphate. There was an insignificant response to the applications of nitrogen and potassium in the absence of phosphate(3).

Experiment 2.

In this variety trial very little growth was observed in all four varieties. This was thought to be due to the very wet conditions under which the trial was laid down and also to poor drainage.

Experiment 3.

The sweet corn in the pilot plot grew very well and harvesting of the ears began on 16th June 1964, 71 days after planting. Ears were harvested at intervals between that date and July 10th when harvesting operations were completed.

The crop were inspected for insect damage and then delivered to the canning factory for processing.

The area yielded 3,447 lb. of sweet corn, representing a yield of some 1,970 lb./acre.

Difficulty was experienced in controlling the larvae of the corn earworm Heliothis armigera. This insect is a serious pest of corn and is a source of trouble to all commercial canners(1). All ears were therefore cleaned of any damaged areas prior to being despatched to the canning plant. In subsequent trials, very effective control of H. armigera has been obtained by injecting 1% Sevin in Risella oil into the earliest visible silks.

Experiment 4.

The results of this experiment are presented in Tables 2 and 3.

<u>Table 2.</u>

Variety	Germination %	Growth Measurements (in cm.)			
		26 days	29 days	33 days	41 days
Aristogold Bantam Evergreen	92	46.9	55.9	64.8	100.1
Valleygold	92	39.7	49.1	60.0	93.1
Floribelle	80	37.8	44.8	51.6	79.2
Goldengrain	100	50.9	60.4	69.5	104.5
PR 50	100	41.4	48.4	60.8	90.0

With the exception of <u>Floribelle</u> the varieties germinated fairly well. <u>Goldengrain</u> grew vigorously and maintained a rapid growth rate. <u>Floribelle</u> did not exhibit vigour.

On June 24th (76 days after planting), the first mature ears were harvested. Subsequent pickings were made at intervals up to July 8th 1964. The results, in terms of numbers of ears per plant and mean weight per ear are presented in Table 3.

Table 3.

Variety	Yield Data	
	No. of Ears per plant	Mean Wt./Ear (oz.)
Aristogold Bantam Evergreen	2.6	5.5
Valleygold	3.0	5.3
Floribelle	3.2	4.1
Goldengrain	1.8	5.7
FR 50	3.0	6.4

Floribelle yielded slightly more ears per plant than any of the other varieties and though the ears contained kernels of exeellent quality they were lighter in weight than those of the other varieties.

Goldengrain produced few ears per plant but they were heavier than the ears of all the other varieties with the exception of FR 50. However the ears of Goldengrain were unsatisfactory because the kernels were very few and very scattered on the receptacles.

Aristogold Bantam Evergreen produced relatively few ears of reasonable weight, but as with Goldengrain the kernels tended to be sparse and scattered on the receptacles.

Valleygold produced kernels of excellent quality in good formation on the receptacles.

PR 50 produced the heaviest ears and the kernels were of good quality and were in regular formation on the receptacles.

5. The Results of the Canning Process

A considerable quantity of PR 50 was processed. In view of the rather small plot sizes comparatively few ears of the other four varieties were processed. Nevertheless samples of the canned products were forwarded to the Company's associates in the United States for a Grading Report. Extracts from this report are presented in Table 4.

Table 4.

Extract from Canned Food Grading Report

Details	Puerto Rico 50	Valleygold	Aristogold Bantam Evergreen	Floribelle	Goldengrain	Possible Score	Additional Comment
Date of Canning	2.7.64	30.6.64	30.6.64	30.6.64	30.6.64		
Style Pack	whole	whole	whole	whole	whole		
Kernel Size	small	large	large	large	large		
Color	9	8	7	6	6	10-9	
Cut	9	8	7	7	6	10-9	Cut not uniform
Tenderness and Maturity	30*	26*	23*	20*	16*	14-36	
Presence of Defects	17	17	16	15	14	20-18	Workmanship could be improved
Flavor	15	14	12	10	10	20-18	Typical of over-mature corn
Grade	C*	D*	D*	D*	D*		
Remarks	Best flavor and overall corn, but defects not too good	Somewhat hard and tough	Quite tough and hard	Very tough hard, unflavorful corn	Very tough hard, unflavorful corn		

The grading report (Table 4) indicates that PR 50 is the most acceptable sweet corn variety of the five which were tested. Though its final grading was only C* it gave the best flavour and was superior, in other ways, to the other varieties. Undoubtedly, as with the other varieties, one of the contributing factors to the rather low general grading, was the fact that the crop were somewhat overmature at harvest.

It was to be expected that the kernels would not be uniform because they are presently being cut by hand. With machine processing this defect, most likely, will be eliminated. Also, the comment that workmanship in the canning process could be improved is understandable, as this was the first attempt to process sweet corn in Trinidad.

DISCUSSION

Sweet corn production in Trinidad appears to be feasible, judging from the preliminary results. Not only does the crop provide a need for year-round processing, and canning, but it is also of potential value for the fresh market during both the rainy and dry seasons.

One important point emerging from the experiments is that not all varieties of sweet corn are capable of yielding well in Trinidad at all times of the year. PR 50, for example, when planted in early April yields well in June and July, but when planted in late July and harvested in September and October, does not perform as well.

On the other hand, Valleygold and Floribelle do not do as well when planted in April as when planted in July. It is quite feasible therefore to produce high-quality sweet corn in Trinidad by planting at least these three varieties at the time of year best suited to each. Further experiments along this direction are underway.

Goldengrain and Aristogold Bantam Evergreen do not appear to be suited to Trinidad conditions either during the rainy or dry season. Although both varieties made good vegetative growth, and did not tassel prematurely, yields of grain were poor. There was also a high incidence of scattered grains in both varieties. Spancross is also not adaptable to Trinidad conditions, as it tassels precociously.

Present indications are that, with more experience and by use of machines to prepare whole kernels for canning, the processing will improve. The timing of harvests shall also have to be improved to reduce the incidence of hardness and loss of flavour.

SUMMARY

A number of field trials evaluating several varieties of sweet corn indicated that PR 50, Valleygold, and Floribelle are suited for cultivation in Trinidad. PR 50 was found to be suitable for planting in April and harvest in June/July while Valleygold and Floribelle are better suited for planting in June/July and Harvest in September/October. The results of processing and canning experiments with these varieties are presented and discussed.

ACKNOWLEDGEMENTS

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Our thanks are due also to Dr. S.N. Smith of Seed Research Specialists, Inc. for suggesting some of the varieties for trial and for supplying samples of seed.

We are also indebted to Mr. K. Hakim for his valuable technical assistance in the field.

REFERENCES

1. Metcalf, C.L., and W.P. Flint (1928). "Destructive and Useful Insects. Their Habits and Control". 4th Edit. Revised by R.L. Metcalf 1962. McGraw-Hill Book Co. Inc.

2. Smith, S.N. (1964). Private communication.

3. Tate & Lyle C.A.R.S. (1963). C.A.R.S. Annual Report 1963.

MORPHOLOGICAL DIFFERENCES BETWEEN GUAVA CLONES

by

W. Pennock[1]

Summary

A. A proposed outline for describing guava clonal varieties is submitted.

B. Particular importance is given to some leaf and internode characteristics which make it possible to distinguish many clones in the field. Some degree of correlation was shown to exist between these characteristics and such tree characters as branching habit and tree height to trunk diameter ratios.

C. Fruit characteristics are quite numerous and constant and permit positive identification of clones even in extensive collections.

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PROPOSED OUTLINE FOR DESCRIBING GUAVA CLONAL VARIETIES

I- Name:

II- Origin:

III- Former designation:

IV- Tree and stem characteristics (based preferably on 3 year old tree)

a) vigor (high, low or medium)

b) shape (tall or short; wide or narrow)

c) branching habit (dense or open) (many or few verticals)

d) length of internodes

V- Leaf characteristics:

a) color of new inmature foliage
b) leaf size (lenghth and width measurements in inches)
c) Length to width ratio
d) Degree of midrib curvature
e) Angle of leaf fold at mid-section
f) Leaf margins (wavy or not)

VI- Fruit characteristics:

a) size

1. diameter
2. length
3. thickness of sidewalls
4. diameter of seed cavity
5. fresh weight

b) form
c) size of Calyx scar (diameter in inches)
d) ripe skin color
e) surface texture (smooth; rugose; creased with lines originating at point of stem attachment)
f) seedines (no. per fruit; no. per oz. pulp)
g) flesh color (pink, white, yellow pink, etc.)
h) flesh texture (firm or puffy)
i) taste (sour or sweet; pH)
j) odor (mild or strong; pleasant or Musky-offensive)
k) bearing season (normal, early, late)
l) productivity (high, medium, low)

VII- Others (disease or insect resistance, etc.)

A NEW DISEASE OF PAPAYA IN ST. CROIX

by

Julio Bird and

Arnold Krochmal [1]

In 1955 a seemingly new disease was observed affecting several varieties of papaya at the Federal Agricultural Station in St. Croix, U. S. Virgin Islands.

The upper parts of the stems of affected plants first develop "grease spots". This led some to denominate the disease "greasy spot". The mysterious nature of the malady led others to call it "X disease". As of late, and in view of the fact that most of the damage is suffered by the canopy we have been referring to the disease as "leaf scorch".

In Hawaii, Bembower (2) observed water soaked spots on the stems of papayas and determined that they were caused by <u>Phytophthora parasitica</u>. Water-soaked spots or "greasy spots" also develop on the upper parts of the stems of plants affected by bunchy top and southern coast mosaic, two virus diseases that occur in Puerto Rico.

In 1961 a review of the symptoms found on St. Croix was made and compared again with the Hawaiian description. In Hawaii the fruits were attacked also, and showed a whitish deposit. Later the fruits shriveled and dropped to the ground. Such symptoms on fruit were never found on diseased plants in St. Croix.

Samples of roots taken from 'solo' papaya plants displaying the stem lesions were sent by air to the University of California on several occasions but no <u>Phytophthora</u> organisms were isolated. The disease was one of the major causes of loss of bearing trees during three years' field work in St. Croix (6).

In the spring of 1963 a report (10) was received that there was a leaf spot disease on these 'Solo' plants and that it probably was caused by a <u>Cercospora</u>. The stem symptoms were also present, however, and thus the symptoms in the Virgin Islands did not agree with a description of <u>Cercospora</u> in Hawaii (1). The authors noted the following <u>symptoms of the disease</u> in 1963.

The foliage of affected plants appears scant, rigid and generally chlorotic. Diseased plants develop an umbrella-like shape which resembles that associated with papaya bunchy top (3, 4), but close observation shows that this disease is not related to bunchy top since:

1- Latex issues from the tissues of plants affected by the St. Croix disease.

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2- The leafhopper vector of bunchy top, Empoasca papayae was not found in the papaya fields of St. Croix. (Though in 1946 Martorell and Adsuar (7) collected an apparently new species of Empoasca breeding on papaya in St. Croix.)

3- Symptoms of the two diseases differ in many other respects.

In the field the lower leaves of affected plants were dotted with yellow spots were generally necrotic. Leaves of affected plants were often found dried up and hanging alongside the stem. In some instances, if the petiole was detached from the stem, water-soaked cankerous lesions were found. This suggested that the leaf spotting agent was gaining access to and infecting stem tissue.

Many of the plants with "soaked" lesions, had bumpy areas on the lower part of their stems. We refer to this condition as "bumpy stem". Bumpy sections were not found on the stems of all the plants that showed a reduced canopy and other symptoms of the disease.

Slight ringspotting, as well as curling of the leaves, was observed in several plantations. None of these symptoms could be associated with those of any of the virus diseases that occur in the Caribbean area.

Some of the native (cruzan) papaya plants were found to be relatively free of leafspots, although in some individual cases the malady was severe. The native papayas also showed the bumpy stem condition but seemed in general not to be greatly injured by it.

Isolation and inoculation studies

Specimens from lesioned areas of the stems and from leafspot-affected, curled, and ringspotted leaves were collected from various fields in St. Croix, washed with tap water and placed in polyethylene bags. The material was divided, and part was plated on acidified PDA after surface desinfection with "Clorox" (1/20). Another batch was used for isolation of bacterial and a third batch (curled and ringspotted leaves) ground in order to secure sap for mechanical inoculation of various plant hosts. No bacteria could be isolated from affected stem or foliage tissues. A series of test plants belonging to several families and including such species as: Carica papaya ('Solo', 'Cruzan', and Puerto Rican varieties), Nicotiana tabacum, Nicotiana glutinosa, Phytolacca decandra, Chenopodium amaranticolor, Capsicum Annuum, and Cucumis sativus were dusted with carborundum and mechanically inoculated with the sap expressed from curled and ringspotted leaves. Ten plants of each of the above mentioned species and varieties were inoculated in each of two treatments and observed daily for a period of three months. None of these plants developed symptoms of disease, thus indicating that no mechanically transmissible virus is associated with this disease of papaya in St. Croix.

The lesioned tissues from the upper parts of the stem as well as spotted areas from the leaves yielded several fungi on acidified (pH 5) potato dextrose agar. This included species of Fusarium which were discarded as contaminants since they represented a very minor percentage of the isolates in contrast with a fungus that arose from about 90% of the plated tissue bits. This last fungus was characterized by a cottony, gray mycellial growth, which changed the color of the substratum from light caramel to dark brown and even to jet black. Microscopic examination of bits of affected upper stem, leaf, and petiolar tissue frequently disclosed slende., cylindrical conidia suggestive of Cercospora, or occasionally of a Helminthosporium. Subcultures of the gray fungus from the plated tissues formed conidia, always of the same type, and very similar to those detected on the affected papaya tissues.

Cultures of this fungus were forwarded to Dr. B. Ellis, Commonwealth Mycological Institute, Kew, Surrey, Great Britain, and to Dr. Charles Chupp, Cornell University, Ithaca, New York, for identification. Chupp stated that the fungus did not belong in the genus Cercospora. Ellis identified the fungus as Corynespora cassiicola (Berk. & Curt.) Wei.

In 1950 Wei (9) stated that Cercospora melonis and C. vignola (or Helminthosporium vignae) were species of Corynespora. He found that sixteen collections on 11 hosts from the tropics, previously identified as Helminthosporium cassiicola also belonged to Corynespora. Wei (9) believes Corynespora to be a valid genus, probably most closely related to Helminthosporium which has the same type of conidial structure. The writers agree, although they have observed that the shape and length of conidia of Corynespora cassiicola is variable to some extent. Conidia formed on papaya plants are generally large, slender and light olive in color, at times almost hyaline. Those produced on acidified PDA by the same fungus are generally cylindrical and thicker, their color ranging from light brown to dark brown. In the first case the conidia look rather like those of Cercospora while in the second they are more suggestive of the Helminthosporium. There is no question, however, as to the validity of Ellis' identification of our cultures. Descriptions of the fungus are given by Wei (9) and Ellis (5).

Inoculation studies

Mycelial mats of cultures, from the same isolate that was forwarded to Ellis, were suspended in sterile distilled water. This material was homogenized in a sterile Waring Blendor and the supernatant was transferred to a sterile Erlenmeyer flask (250cc.) for inoculation.

Six flats each containing 50 healthy 1-foot high papaya test plants of the 'Solo' variety were kept in a moist chamber at 90-100 percent relative humidity. Two flats each containing 50 healthy control plants were kept in a contiguous chamber at the same relative humidity and temperature (+83°F.) For inoculation the supernatant was stirred and transferred to a DeVilbiss No. 151 atomizer. The suspension was impelled by air at 20 pounds p.s.i. and directed from a distance of approximately one foot to the foliage and stems of the test plants. The control plants were sprayed with sterile distilled water, and both the test and control plants were kept in the moist chambers.

At the end of about four days the leaves of most of the inoculated plants developed small, round, yellowish water soaked areas. These spots were about one-eight inch in diameter and their centers were slightly grayish in color suggesting tissue breakdown. The succulent green parts of the upper stems developed grease-like spots in places. These more or less lenticular spots were of the same general size as the leaf spots. Their centers were of the same general size as the leaf spots. Their centers were visibly breaking down also. After a week the leaf lesions on the inoculated plants were visibly larger and in some cases coalescene of lesions had resulted in the breakdown of entire leaves. Tissue breakdown and necrosis was evident on the petioles and lower part of the stem of some inoculated plants. The older upper-stem lesions were gummy and many of them were eroded at this time. The control plants remained healthy throughout this test.

At the end of eight days the control and test plants were taken out the moist chambers and into the greenhouse. Dropping of infected leaves was common. At times these hung along the stem without becoming fully abscissed. Leafspots and "grease" spots of the stem were like those encountered in the field. At the end of about one month most of the inoculated plants had lost their lower leaves with only the four or five youngest remaining. A number was completely defoliated, and apical necrosis resulted in several instances.

As time passed (two months) conditions in the greenhouse became extremely dry and a number of plants showed improved vigor and some remission of symptoms, but these plants were only among those that had retained a good leaf canopy. Corynespora was recovered from the artificially inoculated plants (one week, two weeks, three weeks and one and one-half months after inoculation) from stem leaves and petiolar lesions. Cultures thus obtained were found to be identical to the original isolates.

At the end of three months some of the "recovered" plants were found to be vigorous and healthy, but others showed little or no progress. Many of the plants with lesions on their lower stems developed sizeable bumps at this level.

It appears to us that many of the symptoms of the decline disease of the 'Solo' papaya in St. Croix were reproduced under controlled conditions in Puerto Rico by inoculation with Corynespora cassiicola. Similar results were obtained on a second test using subcultures from the original isolates.

Since Olive, et al. (8) reported that race I of Helminthosporium vignae (=Corynespora cassiicola) lost its pathogenicity after three or four transfers, we repeated the test described above, using the same isolates after four transfers on acidified PDA. Not a single papaya plant developed symptoms of disease; this beyond doubt shows that virulence was lost on transferring this organism in the medium used.

Corynespora cassiicola is a highly pathogenic organism although it loses its virulence after series transfers through artificial media. In St. Croix it can severely affect papaya orchards receiving poor care, though apparently manzate D gives satisfactory control if applied every week or ten days.

LITERATURE CITED

1) Akisumi, Tom. Test shipments of papayas, Hawaii Agricultural Exp. Station Technical Bulletin. Jan. 29, 1965.

2) Bembower, Wm. Papaya Culture, Hawaii Extensión Circular 234. April 1952.

3) Bird, J. and J. Adsuar. On the viral nature of papaya bunchy top. Phytopath. (Abstr.) 42(3) 1952.

4) Bird, J. and J. Adsuar. Viral nature of papaya bunchy top. J. Agric. Univ. P. R. 36(1) 5-11, 1952.

5) Ellis, M. B. Some species of Corynespora, Mycological Papers No. 65, The Commonwealth Mycological Institute, Kew, Surrey, Jan. 1957.

6) Krochmal, Arnold and A. L. Frederiksen. Yield Comparisons of Interim and Border Plants in Papaya Grove. Proceedings of the Caribbean Region, A. S. H. S. Vol. 6. Dec. 1962.

7) Martorell, Luis F. and J. Adsuar. Insects associated with papaya virus diseases in the Antilles and Florida, J. Agric. Univ. P. R. 36(4) 319-329. Oct. 1952.

8) Olive, L. S., Bain, D. C., and Lefebvre, C. L. A leafspot of cowpea and soybean caused by an undescribed species of Helminthosporium, Phytopath. 35 822-831. 1945.

9) Wei, C. T. Notes on Corynespora, Mycological Papers No. 34, The Commonwealth Mycological Institute, Kew, Surrey, Aug. 1950.

10) Wellman, F. L. Disease problems of papaya in St. Croix, (Unpublished Report) 1963.

COCONUT FIBRE WASTE AS A BASIC MEDIUM FOR THE PRODUCTION OF VEGETABLE CROPS

by

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INTRODUCTION

The cultivation of high-quality food crops in tropical areas such as Trinidad and Tobago is beset by a number of adverse environmental factors. These include impeded drainage and poor structural conditions in relatively heavy clay soils, the prevalence of soil-borne plant pathogens, heavy downpours during the rainy season and the incidence of destructive insects. As a result large quantities of food crops are imported annually in order to satisfy the local demand.

It has been known for some time that coconut fibre waste, the by-product obtained after the removal of the fibre from coconut husks, can be used as a soil conditioner in composts. Use has been made of such composts in Trinidad and Tobago to root cocoa seedlings prior to transplanting in the field.

Experiments have been conducted over the past two years at the Tate and Lyle Central Agricultural Research Station in which coconut fibre waste has been compounded directly with essential nutrients to provide a medium which will support the growth of temperate zone food crops. Various combinations of coconut fibre waste and the essential nutrients have been evaluated. It is desirable that a substantial part of the nitrogen source in the medium should be of the slow-release type so that not too much nitrogen is immediately available to the plant or is leached out of the medium during heavy rainfall.

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The medium not only provides excellent drainage conditions but is also sufficiently hygroscopic not to require the recirculation of water and nutrient solutions as is necessary in conventional hydroponics systems. Coconut fibre waste is of relatively low weight and can readily be moved about. In addition, many of the plant pathogens normally encountered in the heavier tropical soils are eliminated. It is hoped that this simple system of producing food crops, particularly during the unfavourable rainy season, will stimulate sugar workers and others to produce some of their own vegetables at home.

Experimental

The experiments were carried out during 1963 and 1964 in a variety of different containers. The methods are detailed below . The experiments are grouped together according to the crop being studied.

Tomato (*Lycopersicon esculentum*, Mill.)

Experiment 1.

Coconut fibre waste (CFW) was placed in four 12" clay pots and in large plastic drums. MagAmp (Magnesium ammonium phosphate 8:40:0 NPK + 24% MgO) was incorporated, in granular form, into the coconut fibre waste (CFW) at the rate of 2½% (by weight of CFW). The medium was watered thoroughly. In a second series of four containers, CFW was employed as the growth medium, without adding MagAmp, while in the third series NPK (15:15:15) at 2.5% (by weight of CFW) and 2.5% MagAmp were incorporated into the CFW. Each of the three different media was watered until run-off was visible at the drainage holes provided at the base of each container. Four tomato seedlings (var. Anahu) were planted in each of the three media. Simultaneously, four seedlings were planted in a Waterloo loam and clay soil, adjacent to the area where the containers were kept. The soil was treated with amounts of MagAmp and NPK, equivalent to those which had been added to the CFW. The tomato seedlings averaged 10.5 cm. in height at the time of planting and were chosen for uniformity prior to planting.

Records were kept of the height of the seedlings two weeks after planting, of the number of floral buds visible on the plants at four and six weeks after planting, the number of plants with visible fruit at eight weeks after planting and the average yield in lbs. of fruit per plant. Results are tabulated in Table 1.

Table 1.

Comparisons of Tomato var. Anahu Grown in Four Different Media

Growth Medium	Average height of 4 Tomato plants at 2 weeks after planting (in cm.)	Visible Floral Buds (+ = Visible buds) (- = No Buds visible)		Number of plants with visible fruit at 8 weeks	Average yield in lbs. tomato fruit per plant
		At 4 weeks	At 6 weeks		
CFW (no fertilizer)	11.1	-	-	0	0.5
CFW + 2.5% MagAmp	15.2	+	+	4	2.7
CFW + 2.5% MagAmp + 2.5% NPK	22.6	+	+	4	4.5
Soil + 2.5% MagAmp + 2.5% NPK	12.2	-	+	0	1.7

Growth of tomato plants was most rapid in the CFW + 2.5% MagAmp + 2.5% NPK. The absence of NPK fertilizer from this mixture resulted in a large depression in the height of the plants.

After four weeks floral buds had been developed on plants grown in CFW + MagAmp, and in CFW + MagAmp + NPK, but not on plants grown in soil + NPK + MagAmp, or in CFW lacking fertilizers. After six weeks floral buds were lacking only in those plants which were grown on CFW without fertilizer.

Those plants grown in CFW + fertilizer combinations bore fruit at eight weeks after planting. Although plants grown in soil had developed small floral buds at six weeks these did not develop into fruit at eight weeks. Plants grown in CFW (no fertilizer) also lacked visible fruit after eight weeks.

The greatest yield of fruit at twelve weeks was obtained from plants grown in CFW + 2.5% MagAmp + 2.5% NPK, while the lowest yield was recorded from plants grown in CFW (no fertiliser). The yields in soil, 1.7 lb. per plant, were somewhat above the average for Trinidad (i.e. average yields on Trinidad soils are approximately 1.0 lb. per plant.)[(1)]

Experiment 2.

A "trough" 60' long by 4' wide by 1' deep was excavated in the soil. The sides were lined with polythene plastic sheeting and coarse gravel overlaid with fine gravel formed the base of the "trough". Drainage was ensured by the base sloping to one end. CFW was placed in the "trough" to a depth of 10". MagAmp at 2.5% and NPK (15:15:15) at 2.5% (by weight of CFW) were incorporated into the CFW.

Seedlings of the following tomato varieties were planted in the "trough".

10th May 1963 — 4 plants of var. Beefsteak

10th May 1963 — 4 plants of var. Manalucie

10th May 1963 — 4 plants of var. Burpee Hybrid

13th June 1963 — 4 plants of var. H. 56

13th June 1963 — 3 plants of var. H. 5

At harvest records were kept of the weight of fruit obtained from each variety. Results are given in Table 2.

Table 2.

Yields of Five Tomato Varieties Grown in One Medium

Variety	Date Planted	Date Harvested	Number of Plants	Total Weight of Fruit (lbs.)	Average Weight per Plant (lbs.)
Manalucie	10.5.63	9.7.63 19.7.63 2.8.63	4	4.68	1.17
Beefsteak	10.5.63	9.7.63 19.7.63 2.8.63	4	4.04	1.01
Burpee Hybrid	10.5.63	9.7.63 19.7.63	4	1.59	0.40
H. 5	13.6.63	29.8.63 6.9.63	3	3.00	1.00
H. 56	13.6.63	29.8.63 6.9.63	3	3.33	1.11

Yields in this experiment were rather poor. The best yield was given by the variety Manalucie while the Burpee Hybrid variety gave the lowest yield(4).

Experiment 3.

On 27th December 1963 seedlings of three tomato varieties were planted in the "trough" described in Experiment 2. The CFW in the "trough" had been weathered for some time and contained additional organic matter in the form of the roots of a previous crop. Ground limestone at 5%, MagAmp at 2.5% and NPK (15:15:15) at 2.5% had previously been incorporated into the mixture.

The following varieties were planted in the medium.

20 plants of var. Heinz Special

18 plants of var. Grosse Lisse 717

and 10 plants of var. College Challenger

Growth was excellent in this experiment and yields were good. The fruits were harvested between 17th February and 16th March 1964, and the results are presented in Table 3.

Table 3.

Yields of Three Tomato Varieties Grown in One Medium

Variety	Number of Plants	Total Weight of Fruit (lb.)	Number of Fruit	Average Weight of Fruit (oz.)	Average Yield per Plant (lb.)
Grosse Lisse 717	18	90	339	4.2	5.0
Heinz Special	20	137	488	4.7	6.9
College Challenger	10	42.6	138	4.9	4.3

The Heinz Special variety gave excellent yields of tomatoes. Some individual plants yielded up to 11 lb. of fruit and the average yield of 6.9 lb. per plant is very good under Trinidad conditions. Both Grosse Lisse 717 and College Challenger produced good weights of fruit per plant, well above the average for Trinidad.

These experiments demonstrate that with the use of suitable tomato varieties good yields of high quality tomatoes can be obtained by using the CFW-fertilizer medium.

White (Irish) Potato (*Solanum tuberosum*, L.)

Potato tubers were planted at a depth of 7" in the following media:

(i) CFW (no fertilizer)

(ii) CFW + 2.5% MagAmp

(iii) CFW + 2.5% MagAmp + 2.5% NPK (15:15:15)

(iv) Soil + 2.5% MagAmp + 2.5% NPK (15:15:15)

Data on germination, growth rates and yields were recorded from the plants grown in the different media.

Germination and emergence occurred at 17 days after planting in each of the media containing CFW, but not in soil. Upon examination it was found that the tubers planted in soil had deteriorated, presumably as a result of fungal attacks.

There were no visible differences in the rate of growth, at the end of four weeks, of potato stems grown in the different media containing CFW. But after seven weeks it was apparent that growth in CFW + MagAmp and in CFW + MagAmp + NPK had surpassed that in CFW (no fertilizer).

After nine weeks a crop of new potatoes (approximately 1.5 lb. per plant) was harvested from plants grown in CFW + MagAmp and from CFW + MagAmp + NPK.

This experiment illustrated two points. First, potato tubers often do not germinate or emerge when planted in heavy tropical soils, and secondly, <u>initial</u> growth rates of potatoes in CFW without fertilizer are equivalent to growth rates in CFW + fertilizer. Probably this is so because stored food supplies in the tuber support early growth. After seven weeks of growth, however, it was noted that rates of growth were superior in CFW containing MagAmp and NPK.

<u>Lettuce</u> (<u>Lactuca sativa</u>, L.)

<u>Experiment 1.</u>

Seed of the variety <u>Mignonette</u> were sown in the "trough" lined with plastic (as described in Tomato Expt. 2.) They were planted on 6th May 1963 in one section of the "trough." The yield data from twenty-five plants of this variety were recorded at the time of harvest.

Germination of the variety "Mignonette" took place within three days after planting. The lettuce was harvested on 4th June 1963 - 29 days after planting. Twenty five lettuce plants yielded 12 lb. of lettuce - an average of 0.48 lb. per plant.

Experiment 2.

Hollow, clay bricks were used to line the walls of another "trough" excavated in the soil. This "trough" was also 60' x 4' x 1' and the base consisted of layers of coarse and fine gravel sloping to one end to ensure adequate drainage. No cover was placed over the "trough." The "trough" was filled to a depth of 10" with CFW in which MagAmp at 2.5%, NPK (15:15:15) at 2.5% and ground limestone at 5% had been incorporated. Plants of the two Queensland lettuce varieties Early Great Lakes and MR-52 were planted in the "trough" on 19th November 1963. Yield data were kept at harvest.

Growth of the two varieties Early Great Lakes and MR-52 was excellent in this medium. The lettuce was harvested between 3rd and 10th January 1964 - some 8 to 10 weeks after sowing. The yield data are presented in Table 4.

Table 4.

Yields of Two Lettuce Varieties Grown in One Medium

Variety	Area (sq. ft.)	Total Weight of Lettuce (lb.)	No. of Plants Harvested	Average Weight per Plant (lb.)	Average Weight per sq. ft. (lb.)
Early Great Lakes	30	39.67	45	0.88	1.32
MR-52	45	27.43	28	0.98	0.61

The variety Early Great es formed true "heads", a rare occurrence under Trinidad co..itions MR-52, however, did not "head."

Experiment 3.

Seed of the variety Imperial were sown in the following media:

(i) CFW + 2.5% Ma_ mp + 2.5% NPK (15:15:15)

(ii) Soil + 2.5% MagAm + 2.5% NPK (15:15:15)

Germination and emergence of this variety occurred within 3 days after planting in the medium containing CFW, but requ..ed at least 5 days in soil + NPK + MagAmp.

Imperial lettuce was in the 4-leaf stage at 8 days in the medium containing CFW, but required 15 days to reach this stage in soil.

Only observations on the germination and growth rates of this variety were made.

Other Crops

Beet (Beta vulgaris L.)

Seed of the variety Detroit Dark Red were sown in the "trough" lined with bricks on 14th March 1963. No limestone was incorporated at this stage. After thinning sixty plants occupied an area of sixty-eight square feet. The total root weight harvested from this area was recorded.

Endive (Cichorium endivia L.)

Comparisons were made between endive (var. Full Heart) grown in CFW + 2.5% MagAmp + 2.5% NPK (15:15:15) and in soil + 2.5% MagAmp + 2.5% NPK (15:15:15). Yield data were recorded at harvest.

Sweet Pepper (Capsicum frutescens, L.)

Seed of sweet pepper (var. California Wonder) were planted in CFW + 2.5% MagAmp + 2.5% NPK (15:15:15) on 10th May 1963. The plants were grown in the "trough" lined with plastic. At the same time plants of this variety of sweet pepper were grown in soil treated with equivalent amounts of NPK (15:15:15) and MagAmp. At harvest the yield of peppers from plants grown in each of the media was recorded.

Bean (Phaseolus vulgaris, L.)

Seed of the Contender variety of Bean were planted in CFW + 2.5% MagAmp + 2.5% NPK (15:15:15) on 11th May 1963. Ten plants of this variety matured and the weight of edible beans harvested was recorded.

Carrot (Daucus carota, L.)

Two varieties of carrot (Long Impe. ɔor and Chantenay) were planted in soil, in CFW alone and in CFW + 2.5% MagAmp + 2.5% NPK (15:15:15). The seed were sown on 11th May 1963. At harvest yield data were kept from each medium.

Celery (Apium graveolens, L.)

Seed of celery (var. Long Golden) were planted in CFW + 2.5% MagAmp + 2.5% NPK (15:15:15) in CFW alone and in soil on 11th May 1963. Comparisons were made between the yields obtained from each of the media. The yield data for the other crops are presented in Table 5.

Table 5.

Yield Data of Six Crops Grown in Different Media

Crop	Variety	Medium	Total Weight (lb.)	No. of Plants	Average yield per plant (lb.)	Average yield per sq. ft. (lb.)
Beet	Detroit Dark Red	CFW + MagAmp + NPK	7.1	60	0.118	0.103
Endive	Full Heart	CFW + MagAmp + NPK	24.0	60	0.40	0.51
		Soil + MagAmp + NPK	-	-	0.25	-
Sweet Pepper	California Wonder	CFW + MagAmp + NPK	13.1	6	2.18	-
		Soil + MagAmp + NPK	-	-	1.60	-
Carrot	Chantenay	CFW alone	0	0	0	0
		CFW + MagAmp + NPK	5.28	25	0.21	0.35
		Soil + MagAmp + NPK	0	0	0	0
	Long Imperator	CFW alone	0	0	0	0
		CFW + MagAmp + NPK	2.26	25	0.09	0.15
		Soil + MagAmp+NPK	0	0	0	0
Bean	Contender	CFW + MagAmp + NPK	5.64	10	0.56	-
Celery	Long Golden	CFW + MagAmp + NPK	11.15	25	0.45	0.74
		Soil + MagAmp + NPK	0	0	0	0

Beet (Beta vulgaris, L.)

The beet roots were harvested on 5th and 15th July 1963 and a total root weight of 7.1 lb. was obtained from the medium containing CFW + MagAmp + NPK.

Endive (Cichorium endivia, L.)

An average yield per plant of 0.48 lb. was obtained from the endive planted in CFW + MagAmp + NPK while only 0.25 lb. per plant was obtained from soil treated with equivalent amounts of fertilizer.

Sweet Pepper (Capsicum frutescens, L.)

Fruits of sweet pepper were harvested between 9th July and 5th October 1963. Six plants yielded a total of 13.1 lb. over this period at an average yield of 2.18 lb. per plant. Similar plants grown in soil yielded an average of 1.6 lb. per plant.

Bean (Phaseolus vulgaris, L.)

Ten plants of the variety Contender yielded a total of 5.64 lb. of beans in two pickings on 24th June and 9th July 1963 (44 and 60 days after planting). This represents an average yield of 0.56 lb. per plant.

Carrot (Daucus carota, L.)

Both varieties of carrot (Long Imperator and Chantenay) were unproductive in soil + MagAmp + NPK and also in CFW alone. The variety Long Imperator produced 2.26 lb. of carrots when harvested on 13th July and 6th September 1963. The variety Chantenay, when harvested at this time yielded 5.28 lb. of carrots.

Celery (*Apium graveolens*, L.)

After 12 weeks plants of the variety Golden Wonder yielded an average weight of 0.45 lb. per plant when grown in CFW + MagAmp + NPK. Plants grown in soil were unproductive.

In each case, where direct yield comparisons were made between plants grown in CFW + MagAmp + NPK, in Soil + MagAmp + NPK and in CFW alone, superior yields were obtained from the crops grown in CFW + MagAmp + NPK.

Experiments with different CFW/Fertilizer Mixtures under Different Types of Cover.

Early in 1964 an area was set aside for growing various crops in CFW under two types of cover. The floor of the area was paved and a "lean-to" building erected. The building is 10 ft. high sloping to 9 ft., and 60' long by 15' wide. It is roofed in part with lumite saran providing 36% shade and part with a rigid neutral vinyl plastic product.

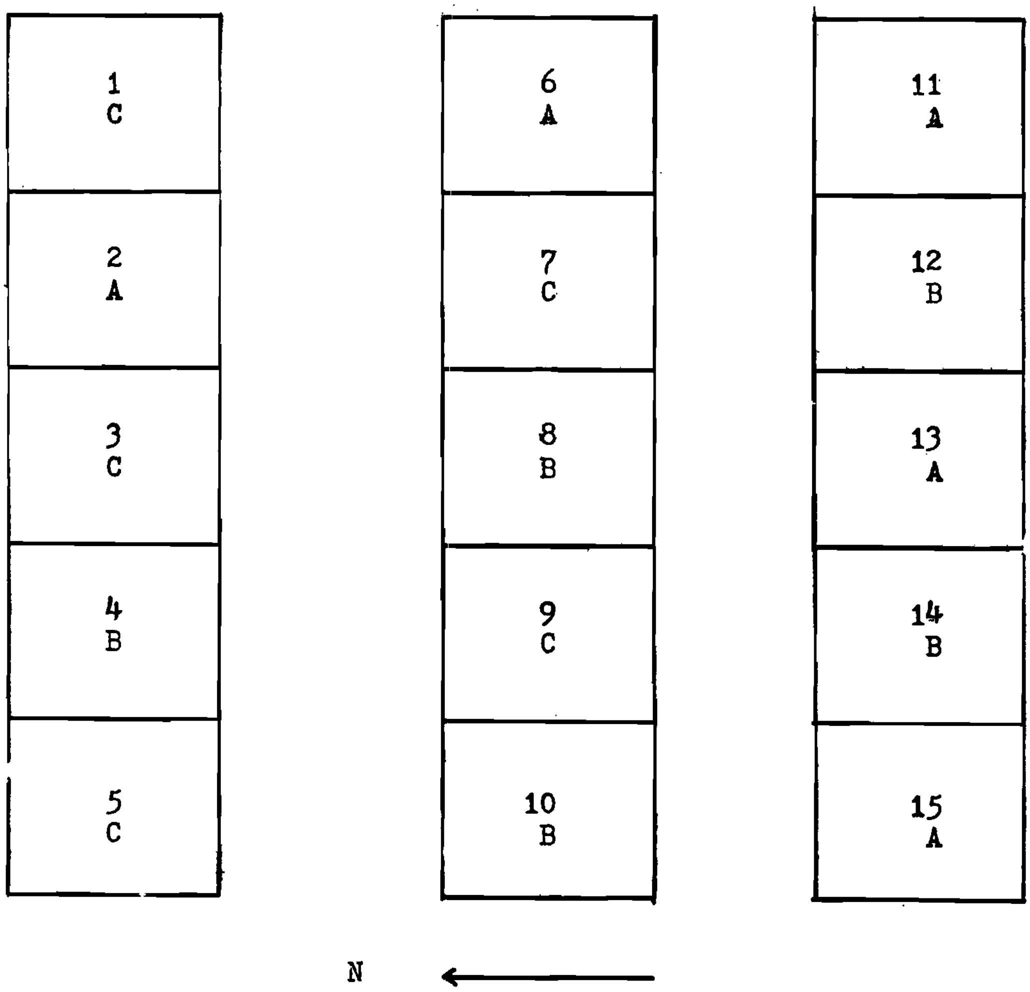
Fifteen rigid polyvinylchloride containers each 10'x 2.75' x 10" were placed on the floor of the building in three rows of five containers. Each container was provided with an external wooden "cradle" as additional support.

Coconut fibre waste was placed in each container to a depth of 9". Three fertilizer mixtures were incorporated at random so that each mixture was present in five containers. The fertilizer mixtures, on the basis of weight of CFW, were as follows:-

<u>Mixture A.</u> 5% Ground Limestone
2.5% MagAmp
2.5% NPK (15:15:15)

<u>Mixture B.</u> 2.5% MagAmp
2.5% NPK (15:15:15)

<u>Mixture C.</u> 5% Ground Limestone
2.5% MagAmp with K (7:40:4 + 12% Mg.)



<u>Figure 1.</u> Layout of Different Fertilizer Mixtures in Lean-to Building.

The containers numbered 5, 10 and 15 were positioned under the complete cover.

Planting of the crops in the different media took place as follows:-

(i) Onion (Allium cepa, L.)

Seed of the following ten varieties were sown in each of the CFW/fertilizer mixtures on 23rd March 1964:-

vars. Yates Selection 590
Yates Selection 595
Yates Selection 602
Yates Selection 608
Yellow Bermuda
Early Grano
Hybrid Granex
Excel Bermuda 986
Early Lockyear White
Early Lockyear Brown
Texas Grano 502
and Evergreen Long White Bunching

The onions were sown in tanks 5C, 12B and 15A.

Germination was observed in all varieties and yield data were kept at harvest.

(ii) Lettuce (Lactuca sativa, L.)

Four seedlings of each of the varieties Early Great Lakes, MR 52 and Imperial were planted in the different media on 29th April 1964. The growth of the varieties was observed in each medium and the yields were recorded at harvest. Tanks 2A, 7C and 14B contained the lettuce plants.

(iii) Tomato (Lycopersicon esculentum, L.)

One seedling of each of the following varieties of Tomato was planted in each of tanks 1C, 10B and 11A on 9th April 1964:-

vars. San Marzano Lampadina
A Grappoli Red Top V.9
Spartan Red 8
Spartan Pink 10
Manapal
Floralou
College Challenger
and Burpee Big Boy

Differences in growth in the different media were noted and the yields were recorded.

(iv) Bean (Phaseolus vulgaris, L.)

Seed of the variety Contender were planted in the different CFW-fertilizer mixtures in tanks 4B, 9C and 13A on 9th April 1964. Observations were made on the germination, growth and yield in the three media.

(v) Potatc (Solanum tuberosum, L.)

Tubers of the variety Ona were planted at a depth of 7" in each of the media on 11th April 1964. The tubers were planted between 10" and 12" apart so that each tank contained twelve tubers. The potatoes were planted in tanks 3C, 6A and 8B. The results of these experiments are recorded in Table 6.

Table 6.

Yield Data of Four Different Crops Grown in Three Different CFW/Fertilizer Mixtures

Crop	Variety	Date Planted	Date Harvested	Yield Data (lb.)		
				A	B	C
Onion	Selection 590	23.3.64	17.6.64	0	0	No Germination
	Selection 595	23.3.64	17.6.64	0.14	0	
	Selection 602	23.3.64	17.6.64	0.11	0	
	Selection 608	23.3.64	17.6.64	0.52	0	
	Yellow Bermuda	23.3.64	17.6.64	0.54	0	
	Early Grano	23.3.64	17.6.64	0.39	0.10	
	Hybrid Granex	23.3.64	17.6.64	0.86	0.11	
	Excel Bermuda 986	23.3.64	17.6.64	0.55	0	
	Early Lockyer White	23.3.64	17.6.64	0.13	0	
	Early Lockyer Brown	23.3.64	17.6.64	0.11	0	
	Texas Grano 502	23.3.64	17.6.64	3.08	0	
	Evergreen Long White Bunching	23.3.64	17.6.64	0	0	
Lettuce	Early Great Lakes	29.4.64	17.6.64	3.18	2.98	0
	MR 52	29.4.64	17.6.64	2.69	2.86	0
	Imperial	29.4.64	17.6.64	2.53	3.04	0
Bean	Contender	9.4.64	25.6.64	0	0.20	0
Tomato	San Marzano	9.4.64	19.6.64 to 9.7.64	4.00	0	0.15
	A Grappoli Red Top	9.4.64	19.6.64 to 9.7.64	1.63	0	0.04
	Spartan Red 8	9.4.64	19.6.64 to 9.7.64	4.46	0	0
	Spartan Pink 10	9.4.64	19.6.64 to 9.7.64	3.80	0	0
	Manapal	9.4.64	19.6.64 to 9.7.64	3.92	0	0
	Floralou	9.4.64	19.6.64 to 9.7.64	2.76	0	0
	College Challenger	9.4.64	19.6.64 to 9.7.64	4.49	0	0.40
	Big Boy	9.4.64	19.6.64 to 9.7.64	3.83	0	0

Onion (A. cepa, L.)

The yield data represent the total weight of onions harvested from a 2' 6" row across a container. The onions in tank A and in tank C were grown under complete cover and were watered as required. Tank B was positioned under the lumite saran and the onions growing in it were exposed to natural rainfall. The force of the rain was reduced by the mesh of the saran.

The results in Table 6 indicate that the composition of the medium has a marked effect on the growth and yield of onions. The onion seeds germinated well in both CFW + Limestone + MagAmp + NPK and CFW + MagAmp + NPK but no germination was observed in the CFW + Limestone + MagAmp with K. However, after germination, the plants in CFW + MagAmp + NPK made very little growth.

It is known that onion cultivars differ markedly in the minimum photoperiod required for bulb formation. Temperature is another factor which is known to affect bulb formation in onions.(2) It is probable that combinations of these two factors have contributed to the wide variations in yield between the different varieties in Tank A.

Lack of readily available nutrients after the food reserves of the endosperm were exhausted may possibly account for the non-emergence of plants in the tank from which NPK was omitted. It would appear from the results that the absence of ground limestone from the medium had an adverse effect on the growth of onion seedlings.

Lettuce (*L. sativa*, L.)

The lettuce plants in the medium containing no NPK had yellowed badly by the 11th May 1964 (12 days after planting). Both the media containing limestone and that without produced plants which averaged between 0.63 lb. and 0.80 lb. per plant. The different varieties showed slightly different responses in yield when grown in the two media, but in general there was little to choose between them.

Neither Early Great Lakes nor MR 52 produced true "heads" when grown at this time. Both varieties bolted.

Tomato (*L. esculentum*, Mill.)

Additional information on the numbers of fruit per plant and the average weight per fruit from Tank A is presented in Table 7.

Table 7.

Yield Data of Eight Tomato Varieties Grown in Tank A

Variety	Yield Data		
	Weight per Plant (lb.)	Number of Fruit	Average Weight per Fruit (oz.)
San Marzano	4.00	55	1.16
A Grappoli Red Top	1.63	24	1.08
Spartan Red 8	4.46	20	3.55
Spartan Pink 10	3.80	15	4.07
Manapal	3.92	21	3.00
Floralou	2.76	12	3.68
College Challenger	4.49	15	4.80
Big Boy	3.23	8	6.50

The tomato plants in the medium without NPK displayed acute symptoms of nitrogen deficiency(5). Growth was severely retarded, the colour of the foliage faded to a pale yellow and the plants eventually died.

In the medium lacking ground limestone, flowering and fruit development was very sparse. But in the CFW + MagAmp + NPK + ground limestone most varieties yielded well. The two Italian varieties, San Marzano and A Grappoli Red Top, produced he first fruits but the fruits displayed symptoms of blossom-end rot. It is possible that the two varieties are more susceptible to this disease. Since this medium was partially covered, and the crop was grown during the rainy season, the fluctuations in moisture content which must have occurred to a certain extent, were possibly sufficient to induce the disease symptoms.

The variety College Challenger produced the best yield per plant but the fruits were not as large as those of the variety Big Boy. Spartan Red 8, Manapal and Spartan Pink 10 also gave good yields of fruit.

White (Irish) Potato (S. tuberosum, L.)

Emergence of the foliage in both media treated with limestone occurred at 7 days after planting. In the medium lacking limestone, however, no shoots appeared. Examination of the tubers revealed that, in the absence of limestone, they had all rotted. Similar results were obtained when tubers of the same variety were again planted in this medium.

At about 14 days after the emergence of the foliage in the medium containing no NPK severe symptoms of nitrogen deficiency were observed(5). The foliage colour became very pale green to yellow. Vegetative growth in the other medium was very good.

The haulms began dying off about 70 days after planting and when they were removed from both tanks on 29th June 1964 no tuber formation had occurred. This was probably due to the photoperiod and thermoperiod being favourable to vegetative growth but not to tuberization(3).

Bean (*P. vulagris*, L.)

Germination of the bean seed occurred 4 days after planting in each medium. Initial growth was good in all the media but within 2 weeks the plants in the medium lacking NPK showed severe chlorotic symptoms and growth was retarded until they eventually died.

Flowering of the plants in the other two media occurred on 8th May 1964 (30 days after planting). But about two weeks later the plants became diseased and they also died. A very low yield of edible beans was obtained on 25th June 1964 from the medium which contained no limestone.

Discussion

The experiments described in this paper illustrate several important points. Most important is that superior yields are obtained when vegetable crops are grown in the combination of coconut fibre waste and fertilizers, than when the coconut fibre waste is replaced by soil. Coconut fibre waste alone is unable to support the growth of vegetable crops and fertilizers have to be incorporated to provide the plants with the essential nutrients.

Different crops vary to some extent in their performance when grown in the different media. But as a general rule the combination of CFW + 2.5% MagAmp + 2.5% NPK (15:15:15) + 5% ground limestone has proved to be the most successful combination used so far.

During the period when the experiments evaluating the different types of cover were carried out, heavy rainfall was experienced (17.93 ins.). Under these rainfall conditions there appeared to be no benefits from using one or other of the types of cover. Any differences there may have been were overshadowed by the different responses of the crops to the constitution of the medium in which they were grown.

Another important point which has emerged is that varieties of certain crops perform better in Trinidad at certain times of the year than at others. This, presumably, is due to their response to differences in photo- and thermo-periods. For example, when grown under shorter day lengths and lower night temperatures in December/January, the lettuce variety <u>Early Great Lakes</u> did not develop flowers and seed stalks, but produced true "heads." However, when grown under longer day lengths and higher temperatures in May/June, this variety "bolted" and produced low quality lettuce.

From these preliminary investigations it would appear feasible to grow high-quality temperate-zone food crops in the coconut fibre waste/fertilizer medium provided allowance is made for photo- or thermoperiodic requirements of the crop.

Summary

A number of experiments carried out during 1963 and 1964 have shown that high quality food crops can be grown in a medium consisting of coconut fibre waste compounded with fertilizers. Yields from plants grown in this medium are shown to be markedly superior to those from plants grown in soil under the same fertilizer regime.

Experiments are described in which the fertilizer constituents of the medium differ and in which the crops are grown under two types of cover. The results of these experiments are presented and discussed.

Acknowledgements

The authors wish to thank Messrs. K. Hakim and M. Mohammed for their valuable technical assistance in carrying out these experiments and in recording the yield data.

References

1. Campbell, J.S. (1958). "Commercial Tomato Growing in the West Indies." World Crops. Vol. 10. No. 5. pp. 165-168.

2. Jones, H.A., and L.K. Mann (1963) "Onions and their Allies." Leonard Hill (Books) Limited, London.

3. Piringer, A.A. (1962). "Photoperiodic Responses of Vegetable Crops." Proc. Plant Science Symposium. Campbell Soup Company 1962. pp. 173-184.

4. Tate and Lyle C.A.R.S. (1963). C.A.R.S. Annual Report for 1963.

5. Walker, J.C. (1952). "Diseases of Vegetable Crops." McGraw-Hill Book Company, Inc., N.Y.

THE MARKETING OF FOOD CROPS IN BARBADOS

(Towards a Concept of Food Distribution in the Caribbean)

by

J. M. Mayers[1]

Food crops in Barbados have played a traditional, though small part in the agriculture of the island. At the turn of the century until today when sugar is the main contributor to the economy, food crops have been planted in most cases as a cash crop to sugar and only in recent years has some attention been given to their production after it became lawful to plant a minimum acreage. This apathetic attitude to food crops has also spread to small producers throughout the island who are still prepared to plant their holdings completely in sugar cane.

It is reasonable to expect therefore that the marketing of food crops in Barbados has been rather less developed than in the case of sugar cane. As far as the latter crop is concerned, associations have been in existence over the years which look after the economic welfare of the producer. Even in the case of small producers, sugar producers have merged and co-operated and have reaped benefits from such cooperation. It is only recently with the formation of the vegetable section of the Barbados Marketing Corporation and the Barbados Vegetable Growers' Association, that some major attention has been given to the production of food crops and it is hoped that through the development of marketing channels, greater production will be forthcoming and greater rewards will be achieved by the producers.

Traditionally, the marketing of food crops such as yams, sweet potatoes, eddoes and cassava took place on the farm or plantation. In the case of yams, the owner or manager first reaped a quantity of the produce for personal consumption and as planting material for the next crop. After sampling a few holes of the crop, sometimes in the presence of an intended purchaser, the owner obtained an average weight per hole and used this average as a measure of price per hole. For example, if the average weight of a hole of yams was 5 lbs. and the price was 4 cents per lb., then the Manager was very likely to establish a price of $20.00 per hundred holes. This price would of course varies from field to field depending on the average weight of the sample obtained from the particular field. It is interesting to note that the manager had no problem of harvesting. The purchasers carried out their own harvesting and assuredly left the soil clean so that the next operation on the soil could proceed immediately. These transactions were generally done on a cash basis on the large estates so that the producer was freed from much paper work, etc. This method of marketing is similar for other root crops as well. In the case of sweet potatoes, there may be a special charge for potato slips and a reduced rate for small potatoes (pickings).

Carts and vans enter into the consumer market and dispose of their produce in a market of high demand. Price control on sweet potatoes and yams ensured that the consumer was not engaged and jibbed in a bargaining process. With the recent decontrol of prices the latter situation could develop as these

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crops are rather limited in supply and seasonal in production.

Most vegetable crops in Barbados with few exceptions can be produced all the year round. Cabbages, cauliflower and khol rabi generally succeed better in the wet districts from October to June; leek preferably from November to March and squash from about June to October in the wetter districts. The best results from tomatoes are obtained by planting them from October to May. These crops are generally not grown to any great extent on the large estates but mainly from numerous odd pieces of land managed by small proprietors who produce all types and qualities of these food crops for the island community. With such a large number of producing units and possibly as great a diversity in produce, marketing has got to be the key role, firstly by encouraging greater quality produce, and secondly by establishing an awareness of the availability of such produce through some kind of market intelligence.

Traditionally, it has been the custom for hawkers to visit small producers and purchase their produce. Little care was given to the quality of the produce, variety or grade. With futile promises to pay for some of the purchase at a later date, this produce found its way into the consumer markets at various and generally exorbitant prices. Indeed, the consumer and to some extent the producer have been fleeced by the hawker as the sole marketing agent.

With the large quantity of small producers of food crops as they are in Barbados, what is urgently required is a system of market intelligence and crop information. Such a scheme should be designed to give information to producers, middlemen and consumers as to the extent of availability and trend, quality and current prices of the types of produce available so that the producer would know if and what quantity of given commodity he should reap and whether the consumer should purchase a greater or lesser quantity at what prices. In fact such a service would protect the interest of the producer and consumer and thus enable the middlemen to function efficiently.

A market intelligence and crop information service should provide statistics on production, consumption and prices. These would provide producers with some broad, long term guidance as to future cropping programmes. Information as to whether current crop planting is high, normal or low relative to former years should be given as well as the progress of crops, expected yields and quality. It is felt that information of this nature should be released at least once or twice per month. The commencement and progress of harvesting and consequently the availability of supplies; day to day retail prices, the quality and quantities of produce entering the markets are also important factors to be included.

As far as standards and grades are concerned, a major requirement is to raise the general level of quality of produce by selection of varieties, choice of seed, sound agronomic practices and adequate pest and disease control. With regard to local trading, grading will not be necessary and under the traditional huckster system would result in little or no benefit to the producer. However, with the set up of the Barbados Marketing Corporation and the possibility of exportation, then grading would have to be set up for at least that part entering the export market and superior domestic markets.

One final aspect of marketing of food crops in Barbados would be through marketing societies which would facilitate the work of the extension service and assist in the application and spread of new and improved techniques. Such societies would have to aim at uniformity of production and sell collectively in retail markets with benefit to themselves, yet bringing influence to bear on the lowering of prices. It is very possible that bargaining power would be greater than at present in respect of sales to the hawker. With the existence of the Barbados Marketing Corporation such societies could enter into supply contracts and organise the collection of their members' produce in order to simplify delivery to the Corporation.

The above outline as stated with reference to Barbados undoubtedly exists in the other Caribbean territories. Indeed the symptoms of inefficient marketing are outstanidng in any under-developed area. The problem becomes acute when at sometime, in spite of our lack of resources and production we run into the inevitable glut which results in waste and disposal of food grown on the soil. The normally low production of food crops, the fact that different food crops are prevalent in different areas of the Caribbean, and the possibility of gluts at different times throughout the area are factors which point out the necessity for a market intelligence service throughout the Caribbean area. It is possible that through proper marketing facilities and information one territory in the area could be supplying another territory with produce. This could result in a reduction of the cost of living in the area and to some extent change the pattern of food production so that only economical crops would be produced, but in sufficient quantities for local consumption and inter-territorial export.

The major inhibiting factor to such a scheme would be the problem of communications. However, with the development of information on supply and demand of food in the area and the build up of a regular trade, reduced freight rates and increase services would likely result.

It is to be exported that an organization such as the Caribbean Food Crops Society would do all in its power to foster the development of a marketing service as an aim towards food distribution in the Caribbean.

TOUR OF THE SCOTLAND DISTRICT OF BARBADOS

by

J. Cumberbatch[1]

A- Introduction and Background

1- The Soil Conservation Section of Ministry of Agriculture, Lands and Fisheries began work in 1957 at Morgan Lewis.

2- The Scotland District is 22 square miles, out of a total of 166 square miles for the entire island. This, bounded on one side by the sea and on the other sides by an escarpment (limestone cliff) approximately 15 miles long sharply defined in some places, e.g. Hacleton's cliff, which stretches from Pico Teneriffe in the North to Consett's Bay in the South.

3- The area is entirely unlike the rest of the island, which latter is coral limestone. In the Scotland District, the coral limestone cap has been removed by geological erosion and activity, exposing the softer strata of Barbados, which have been and are still eroding at an alarming rate if this erosion continues, not only will approximately 12,000 acres of arable land be lost but indeed the whole island comprising upwards of 93,000 arable acres will be seriouslay threatened. If this is viewed against a perspective of a rapidly increasing population (1962/63 increase 3092) with deminishing emigration outlets, then the vital importance of anti-erosion measures for this part of the island will be appreciated. The rapid development of this area could absorb many of the additional labour hands each year.

4- There are four (4) main problems, and these are in the process of being solved.

a) Geological Erosion and Lanslips, due chiefly to the presence of spring water high up on the slopes.

b) The presence of Oil and Chemical Salts, especially Sodium Chloride, (table salt) which inhibit plant growth.

c) Overgrazing, which leads to bare slopes and serious loss of top-soil and vegetation.

d) The need for Village Resettlement occasioned by the serious land slips which are actively threatening some villages e.g. Chimborazo, St. Bernards, Coconut Grove, Mellowes.

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5- Our operations demand the use of heavy equipment, and we have two D 9 caterpillars tractor one D7, two D 4's, one D 2 and various other equipment -- a capital outlay of over 1/4 million dollars.

6- The cost of the operations approach 1/2 million dollars per year.

7- There is a Soil Conservation Board, which advises on the operations of the Scheme, and whose membership by Law comprises Civil Servants as well as knowledgeable representatives from the public.

8- In order to fully demonstrate the methods being used, and to assure the public of its confidence in the future of this Scotland Area, Government purchased in 1961 and 1962 two of the worst erodes estates namely Sedgepond and The Hill. These are contiguous, and are being worked as a unit on a commercial basis. Most of Sedgepond and a part of The Hill have already been treated with our methods, and prospects for the future are bright. In fact, of the total acreage of 380 over 150 acres have been reshaped and drained with approximately 5 miles of underground pipes; and a diversified agricultural programme providing for fish farming, forestry crops, orchards, pangola grass pastures, and green vegetables in addition to sugar cane, has been initiated, and crop growth and production is being stimulated by irrigation.

9- The following figures indicate briefly progress so far:

1)	Total length of underground drainage pipes laid since 1960.	20.35 miles
2)	Total area affected by pipe drainage	590 acres
3)	Total area land reshaped................................ of this 721 acres 350 acres are now arable land that used to be in swamps, boulders or was abandoned through land slips.	721 "
4)	Total area planted to trees and reafforested from "Rab". land.	50 "
5)	Total length of terraced drain/roads cut by tractor.....	20 miles
6)	Total area of fruit trees planted (coconut, citrus, mixed fruit)	11 acres
7)	Total area reafforested at Joes River Woods since 1963..	6 "
8)	Total area pangola grass planted.......................	37 "
9)	Total length of Highway; and Transport Main Road Especially stabilized......................................	2,400 feet.

10- During the dry season (January-May), sixteen (16) dams can yield 12 million gallons of water for irrigation, and an additional 5,800 gallons per hour collected in underground pipes from the numerous springs, provides 21 million gallons over 150 dry season days.

11- During this present dry season, one of the most severe for over a decade, the Soil Conservation Scheme has demonstrated, by use of a mobile tractor pump and portable aluminium lines, the value of irrigation at such varying localities as Haggatt's Orchard, Morgan Lewis foreshore, and the Sedgepond Banana Nurseries and fruit trees. Quite apart from this, the production of green vegetables at Sedgepond from irrigation has continued without pause: While at Morgan Lewis Estate, an excellent demonstration by private enterprise has laready fully vindicated the foresight in dam construction there.

12- The problem of oil and salts is being overcome by the use of "road waste" from gutters to reclaim "bad lands". In order to combat overfrazing, the worst area are closed to grazing by being declared "Protected" under the Act. Excellent success at Morgan Lewis and Walkers has persuaded us that this is the correct line of approach. Over 600 acres are currently "Protected".

13- The urgent need for speeding up the programme cannot be overstressed. At the present rate, it will take 40-60 years to complete the scheme, and it is horrifying to think what some areas will look like a decade hence if not stabilized.

14- The sheme every year attracts more and more visitors, especially schools, and there is no doubt that with the construction of the East Coast Road, the area has suddenly assumed a new and vital importance to the entire community.

(SGD) E.R.ST.J CUMBERBATCH

Senior Agricultural Officer
Soil Conservation
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SURVEY OF PLANT PESTS IN THE CARIBBEAN

by

Gerald Stell[1]

In November 1963 I accepted an offer by the Caribbean Food Crops Society to head a Committee to survey plant pests in the Caribbean including insects, nematodes, fungus diseases, viruses, etc. of food crops.

In December I received a list of members of the CFCS who were active in this field and $25.00 for postage, etc.

Also during this month a paper entitled "Regional Cooperation in Plant Quarantine in the Caribbean" (Appendix I) was presented at a FAO meeting in Jamaica. Reference was made to unified Plant Quarantine regulations, pest and disease surveys, Plant Quarantine stations, training of personnel and the development of a regional Plant Quarantine Agreement sponsored by FAO.

In February I represented Jamaica at the Banana Demonstration Tour held in Guadeloupe which was sponsored by the Caribbean Commission, The Republic of France and the 'Institut Francais de Recherches Fruitieres Outre-Mer' (IFAC).

I was also requested to visit Martinique after the tour and investigate the risks involved with the importation of pineapple planting material from that island.

The Surinam Government, learning that I was to be as far down the Caribbean as the French Antilles, invited me through the good offices of the CFCS to visit them at their expense in March. As I had to break my journey in Trinidad because of flight connections, the opportunity was taken to visit the Faculty of Agriculture and ... ted scientific institutions. On the return journey an overnight stop in British Guiana allowed some time to be spent at the Ministry of Agriculture and Bookers Agricultural Departament.

I was also requested to stop off in St. Croix and investigate the suitability of Jamaica importing quantities of various planting material.

Finally, a visit to Puerto Rico enabled me to make satisfactory arrangements for the importation of pineapple planting material from that country and meet several important scientist at the University.

As much opportunity as possible was taken on this offical trip to find out the cooperation and information that was available for a survey of pests and diseases of food crops in the area. I was only sorry that my plan to overnight in Barbados instead of Trinidad on the return journey did not come off, otherwise almost every territory which can provide assistance in this survey would have been visited.

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[1] Chairman of the Committee and Chie Plant Protection Officer, Ministry of Agriculture & Lands, Jamaica

A full report (Appendix II) is submitted so that only the observations relevant to this survey are now mentioned.

Guadeloupe:

Valuable contact was made at the Neufchateau Fruit Experimental Station with:

Mr. J. Cuille, Director of IFAC (Agronomy)
Entomologist, Head of the IFAC Department of Crop Protection

Dr. J. Brun, Plant Pathologist, IFAC, Paris

Mr. A. Vilardebo, Head of the IFAC, Entomology & Nematology Service, Paris

Dr. J. Bove, Virologist, Head of the Biochemistry Department of IFAC, Paris

A visit was also made to the Institut National de la Recherche Agronomique (INRA) when contact was made with the Director, Dr. Stel'e and the Entomologist, Mr. J. Bonflis. It was expected that a Plant Pathologist would soon be appointed there.

Martinique:

Mr. D. A. Blanche, Head of the French Antilles Plant Quarantine Service offered me every cooperation on plant quarantine matters. Details of their latest Plant Quarantine regulations were obtained which were recently revised.

Trinidad:

Discussions were held with Dr. J. Spence, Lecturer in Plant Physiology, Mr. R. Barnes, Lecturer in Plant Pathology, Mr. E. Iton, Plant Pathologist, Crop Protection Section of the Regional Research Centre, Mr. M. Emsley, Lecturer in Agricultural Zoology and Dr. F. Bennett, Entomologist, Commonwealth Institute of Biological Control. Some time was also spent with Dr. D. Fenwick, Nematologist and Director of Trinidad and Tobago Coconut Research Limited.

Surinam:

Only 2 1/2 days were spent in the country but it was long enough to be impressed by the development that is taking place in almost every phase.

The Research Station under Mr. Samson's dynamic leadership was very impressive. The entire staff were a most interested collection of research workers and together with extension colleagues provided a very lively audience for the reception of my talk on 'Plant Protection in the Caribbean'. Mr. F. del Prado, Head of the Plant Protection Service, was a very capable officer and much time was spent in discussion with him concerning their Plant Quarantine and Pesticide Regulations also research and field problems.

Detailed information was received on the insect pests and diseases of cultivated plants and very shortly a Nematologist was due to arrive to carry out a survey. Their Plant Quarantine regulations were also found to be recently revised and brought up to date.

I am most grateful for the opportunity afforded me by the Surinam Government through Mr. Samson on behalf of the Caribbean Food Crops Society whose unfatigable Secretary-Treasurer, Dr. A. Krochmal, contributed in no small way to my visit.

British Guiana:

Courtesy calls were made on the Acting Director, Dr. H. Paul, and Acting Deputy Director of Agriculture, Mr. E. Hugh, at the Ministry's headquarters in Georgetown. The Central Agricultural Station at Mon Repos was also visited when I met the Acting Assistant Director (Research), Mr. A. V. Wan-Ping, and the Entomologist, Mr. C. P. Kennard. Unfortunately, the Plant Pathologist, Mr. S. Bissessar, was indisposed. Shortly afterwards, I received from Mr. Kennard an up-to-date list of insect pests of crops in British Guiana.

St. Croix, Virgin Islands:

Although only half a day was spent there the opportunity to renew acquaintances with Drs. R. Bond and A. Krochmal of the United States Department of Agiruclture Research Station was worthwhile.

I was invited by Dr. Krochmal to talk to a meeting of prominent planters on the need for local plant quarantine regulations when the danger of uncontrolled plant importations was stressed. A resolution was taken by the meeting to petition the Governor for some early action. At that time St. Croix only had Federal Plant Quarantine Laws which did not prevent the movement of plant material from the United States of America, Puerto Rico and possibly Hawaii and the Canal Zone in Panamá.

I have since learned that a Plant Quarantine Law was passed by the Legislature and signed by the Governor.

Puerto Rico:

Valuable contact was made with Mr. H. Bowman, Chief Inspector, Plant Quarantine Division, United States Department of Agriculture. Useful discussions also took place with Drs. J. Román, Nematologist, J. Bird, Virologist and M. Pérez, Entomolgist of the University of Puerto Rico.

From this preliminary survey the following main points have emerged:

1) Nearly every scientist who I encountered was enthusiastic about the usefulness of such a survey and promised their support and cooperation.

2) There was still a lack of up-to-date lists of pests and diseases in many countries, even those with trained personnel.

3) A person should be appointed to head each discipline, i.e. Entomology, rology, etc.

4) Funds are essential to enable each head of a discipline to travel through the area.

5) Each head of a discipline will be in the best position to advise on funds required and sources of information, literature, etc.

6) The following people are suggested to constitute the nucleus of subcommittees for each discipline:

Entomology:

G. Stell (Jamaica and Trinidad) assisted by M. Pérez (Puerto Rico and Virgin Islands), J. Bonfils (French Antilles), L. W. Van Whervin (Barbados) F. Bennett (remaining British West Indies), C. P. Kennard (British Guiana) and G. van Vreden (Surinam).

Mycology and Bacteriology:

R. I. Leather (Jamaica) assisted by a Pathologist of Puerto Rico University (Puerto Rico and Virgin Islands), R. Barnes, E. Iton and H. Spence (Trinidad and British West Indies), The Pathologist of INRA (French Antilles), S. Bissessar (British Guiana) and F. del Prado (Surinam).

Virology:

J. Bird (Puerto Rico and Virgin Islands) assisted by A. G. Naylor (Jamaica) and J. Bove (French Antilles).

Nematology:

J. Román (Puerto Rico and Virgin Islands) assisted by W. B. Dixon (Jamaica), D. W. Fenwick (Trinidad), A. Vilardebo (French Antilles) and the Nematologist (Surinam).

Plant Quarantine:

H. Bowman (Puerto Rico and Virgin Islands) assisted by G. Stell (Jamaica), L. W. Van Whervin (Barbados), Government representative (Trinidad), Secretary of Central Plant Quarantine Station (British West Indies), D. A. Blanche (French Antilles), C. P. Kennard (British Guiana) and F. del Prado (Surinam).

In July, Mr. R. Leach, Banana Pathologist from the United Kingdom passed through Jamaica and described to us a new disease of bananas that had recently been found in the Pacific Islands of Fiji and Tonga. The disease is called Black Leaf Streak Disease, *Mycosphaerella fijiensis*, and is reported as being more virulent and harder to control than leaf spot disease, *M. musicola*. I reported this information and sent a detailed description of the disease to the Caribbean Commission in Puerto Rico and the Central Plant Quarantine Station in Trinidad for transmission to the countries which are served by these organizations. A plea was also made for a united approach to this problem, as I am very concerned that this disease does not reach the Caribbean.

I would have liked to have accomplished more in this first year but, due to extreme pressure of work brought on by an acute shortage of Entomological staff (2 Graduate vacancies) and also personal reasons, I have not been able to devote enough of my spare time to this project.

I am also sorry that I could not attend this meeting but my government could only be asked to defray expenses for one member of my department when I recommended Mr. A. G. Naylor to be our representative.

"DO NOT BRING YOUR ENEMY HOME"

by

H. D. Bowman
Plant Quarantine Division, U.S.D.A. San Juan, Puerto Rico

A film indicating some of the means by which some pests can be brought to a country. Means such as imported cars, furnishers, buggages... etc.

"PLANNING FOR SMALL HOLDER FOOD CROPS PRODUCTION IN DENSELY POPULATED AREAS"

by

D. Edwards
University of the West Indies, Trinidad

"PLANNING FOR SMALL HOLDER FOOD CROPS PRODUCTION IN A SPARCELY POPULATED AREA, PARTICULARLY VENEZUELAN-GUYANAN AREA"

by

James Blaut
College of the Virgin Islands, St. Thomas, U. S. Virgin Islands

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"PICTURE STORY OF CASSAVA IN THAILAND"

by

Arnold Krochmal
Federal Agricultural Experiment Station, Kingshill, St. Croix, U.S. Virgin Islands

Series of slides showing the methods of Cassava cultivation and processing taken in a trip made to Thailand.

"SLIDES AND EXHIBITS OF SOLO PAPAYA PRODUCTION AND MARKETING IN THE CARIBBEAN"

by

Arnold Krochmal
Federal Agricultural Experiment Station,
Kingsh''l, St. Croix, U.S. Virgin Islands

Series of slides and fruit exhibits of the Solo papaya variety indicating research done on its potentiality and economics aspects for some Caribbean Islands.

"THE HIDDEN MENACE"

by

George Berg
FAO/OIRSA, San Salvador, Ei Salvador

"REGIONAL ORGANIZATIONS IN PLANT PROTECTION AND THEIR IMPORTANCE"

by

George Berg
FAO/OIRSA, San Salvador, El Salvador

A paper discussing the benefits d roles of regional cooperations among neighbouring countries in plant protection services. Also discussing the means of which the Food Agricultural Organi ation of the United Nation could render its services in the establishment of regional plant protection se ice organizations.

"INVESTIGATION OF CONTROL OR POSSIBLE ERADICATION OF THE MEDITERRANEAN FLY BY THE USE OF IRRADIATION"

by

Geroge Berg
FAO/OIRSA, San Salvador, El Salvador

A film showing the fast spread of the med. fly and its damages to citrus fruits. Also showing the methods and means that the State of Florida did to overcome this pest. Sterilization of the males by the use of irradiation could be a perfect control.

ACKNOWLEDGMENT

I would like to express my sincere appreciation to all the persons who had contributed their time in putting out this proceeding. Special thanks goes to Mr. H. Miller, Dr. G Samuels, and Dr. A. Sotomayor Rios, for their suggestions and help in compiling the materials.

Hassan Azzam
Editor and President
of the Society for 1965