

A review of banana research and development in the english speaking Caribbean.

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INVENTAIRE DES ACTIONS DE RECHERCHE ET DE DEVELOPPEMENT SUR LES BANANES DES CARAIBES DE LANGUE ANGLAISE.

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RESUME - Ces recherches dans les Caraïbes anglophones ont débuté (1955-1959) sous l'égide du Banana Board en Jamaïque et du Banana Growers Association aux Windward Islands. En 1966, WINBAN créait le centre de recherche de Roseau (St Lucia). Les recherches, déjà anciennes pour la génétique (Trinidad, Jamaïque) portaient sur l'agronomie, les parasites, insectes, nématodes, ainsi que sur la qualité (technologies nouvelles). Une attention particulière est accordée au transfert des techniques adaptées à de petits producteurs de bananes, nombreux dans les îles.

For purposes of this paper the «English Speaking Caribbean» will include the islands of Jamaica, Dominica, St. Lucia, St. Vincent and Grenada. The last four are referred to as the Windward Islands.

Banana Research and Development had its major beginnings in these islands around 1955 and 1959 in Jamaica and the Windward Islands under the umbrella of the Jamaica Banana Board and the Windward Islands Banana Growers Association (WINBAN), respectively.

The early banana research for the Windward Islands was performed at the Imperial College of Tropical Agriculture (ICTA) in Trinidad, which was later merged with the University of the West Indies. This function was taken over by WINBAN in the early sixties and a Research Centre was officially opened in Roseau, St. Lucia in 1966. Banana Breeding Research was started at ICTA in Trinidad in the

second quarter of this century but became centralized in Jamaica in 1960.

Research on Banana Breeding will be covered by a specialist in this field in the course of our meetings.

Jamaica and the Windward Islands can therefore boast of over thirty years of Research and Development of bananas.

It would be impossible to give a complete literature review of research activities at these research centres from the 50s to this present times. WINBAN alone has published over 470 papers on bananas and this has been put together under the title «Register of Reports, Publications, Personnel» covering 1960-1981. This publication can be made available to research stations upon request.

The major initial research to have an impact on the industry in Jamaica and the Windwards was the work on Sigatoka.

Much of the early work on the causal organism for leaf spot, its nomenclature, epidemiology and control was

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done in Jamaica in the mid 50s, at the time of Bordeaux mixture was used as the control chemical.

Following a tour of this country (Guadeloupe) in 1964, arranged by the then Carribean Commission, leaf spot control took on a new slant and both the Jamaica Banana Board and WINBAN embarked upon a number of field trials with different types of oils, alone, and in combination with different additives e.g. diesel, cupious oxide, etc.

The results were dramatic to the extent that, by the late 50s both Jamaica and the Windward Islands had shifted completely from Bordeaux mixture to the use of oil for spot control.

Further research with various systemic fungicides added to the oil, indicated that the interval between control cycles could be increased. This led the Windwards to implement a total switch in the early 70s from oil alone to oil plus benzimidazol mixtures. Jamaica introduced this practice at a less rapid rate.

In the Windward Islands today, spray cycles have been reduced from an average of twenty three (23) to eight (8) cycle per year. The savings to the industry have no doubt been most significant.

This has been achieved through the use of a fungistat (oil) mixed with a systemic fungicide (Benlate and more recently Sigma) as well as through a monitoring system for disease development from a network of stations in the islands. Today, in some well defined areas where cycles were effected every twenty one days, one cycle is applied per year.

In order to reduce in the development of resistant or tolerant strains of the fungus to the benzimidazoles, alternate sprays with a tridemorph (Calixin) and in some cases with carbamates (Mancozeb) are now being recommended in the Windward Islands. This reduces the benzimidazoles to 4 - 5 applications per year. It is intended that this programme will minimize the development of resistance to fungicides. Dr. CRONSHAW, WINBAN's Pathologist will present a paper at this meeting on «The Monitoring of Sigatoka disease Leach ex Mulder in the Windward Islands for tolerance to Fungicides».

To date, no tolerance has been detect, neither have we been able to isolate the Black Sigatoka organism.

The problems related to occasional outbreaks of leaf spot in the Islands are those of poor management of the control programme due to no oil being present when it was needed, shortages of fungicides through no fault of the producers and absence of local transport facilities to carry the oil to the depots in areas where aerial spraying is not possible. The problems have not been technological. They are related to the management of the technologies.

Another disease of importance to the banana industry which received concentrated research is that caused by Nematodes. Although the disease was first described as «Black Head disease» in the island in 1915. (In depth work was first started in Jamaica in 1959).

The major research thrust or activity, in this area in the region occurred in the mid-60s, primarily at WINBAN, with intensive surveys, host range studies, assessment of damage and approaches to control. Mr. AMBROSE, WINBAN's Crop Protection Officer will review this area at this meeting in his paper entitled «Research and Development in Banana Crop Protection (excluding Sigatoka) in the English Speaking Caribbean».

Suffice it to say that *Radopholus similis*, *Helicotylenchus multicinctus* and *Rotylenchus reniformis* were found to be the most prevalent nematodes associated with bananas in the islands. The very high number of the latter in the feeder root system and the necrotic symptoms caused, led WINBAN Nematologist to conclude that this nematode is pathogenic to bananas.

Different experiments on bare fallow and weed fallow for six months and continuous banana growing with no nematode control versus chemical control and replanting were conducted and subjected to economic analysis. It was found that chemical control and replanting offer the best economic advantage to the banana farmer.

The first chemical control method recommended was the use of clean seed material followed by the injection of DBCP every six (6) months. This was followed by research and recommendations for the use of granular nematicides - Furadan, Mocap, Vydate, Nema-cur P, Miral, Lannate, Temik and others applied at different intervals and dosages.

With the exception of Lannate, these nematicides are now available for use. Their useage will depend upon their relative safety and their cost effectiveness.

In more recent times, much research and development has taken place in the spot gun application of Vydate L liquid. The technique used is that of squirting on a calibrated quantity of the nematicide onto the soil around the banana plant base. The advantage of this technique is that (a) the exposure of human beings to the chemical is minimal (b) the placement is precise and (c) the volume or rate applied is well calibrated.

From research results in the islands it was found that in the ratoon field, emphasis should be placed in protection of the follower which is selected to produce a bunch i.e. the nematicide must be applied around the follower alone not around the complete mat. This avoids the wasteful use of nematicides.

Banana nematode research went hand in hand with ba-

nana borer research ; the quest being for materials with dual control properties at the same time of application. Through laboratory tests, the borers were found to have developed resistance to the chlorinated hydrocarbons.

At present, such dual control of nematodes and borers has been achieved with the use of the nematicides mentioned earlier.

In cases of very high infestations of borers, Primidic is used in the Windward Islands for a quick knock down of the population followed by applications of the granular nematicides.

In some areas of Latin America, banana borers are not considered to be of economic importance. In the islands, particularly St. Vincent, without borer control there would be no bananas.

Moko disease was recently identified in Grenada and this disease has now become a major research and development matter at WINBAN.

At this stage, it is also important to consider the area of pests and diseases as it relates to the banana fruit.

It must be remembered that up until the mid 60s, some bananas were still being shipped from the islands on the bunch i.e. the whole bunch was exported. The change to dehand, boxed fruit also brought with it problems associated with crown fruit rots.

In the Windward Islands, fungi isolate from the crown of the banana hand were *Colletotrichum musae*, *Fusarium semitectum*, *F. moniliforme*, *Nigrospora sphaerica*, *Botryodiplodia theobromae* and *Ceratocystis fimbriata*. It was found that *F. semitectum* and *C. musae* were the most important rotting fungi in the complex.

In Jamaica *Fusarium semitectum* and other *Fusarium* spp., *Verticillium theobromae*, *Colletotrichum musae*, and *Botryodiplodia theobromae* were identified as the major crown rotting fungi. The wound anthracnose and neck rot being caused primarily by *C. musae*.

Jamaica's research pointed the way to the need for proper sanitation in and around boxing plants and the realisation that the major crown infection occurs at the packing plant.

After considerable research in Jamaica and at WINBAN, Benlate and TBZ applied as a dip, a spray, or both, were recommended for crown rot control.

In the Windward Islands rust thrips damage to the fruit on the bunch have been observed in some of the islands and is a problem only in well defined areas. Sleeving is the basic measure. Flower thrips do not constitute a major problem.

Of the other insect pests of bananas, grasshoppers and crickets are usually associated with poor field sanitation. In localised areas in Dominica, *Lachnopus* spp. has been found to damage the banana peel. Mr. AMBROSE will report on this finding at this meeting.

Hand in hand with research work on pests and diseases, both research centres embarked upon work on soils and nutrition to solve their particular problems. The soils of the Windward Islands are mostly of an acid nature while those in Jamaica are, for the most part, of a higher pH than the Windwards.

Extensive soil surveys were done in the 1950s and fertiliser maps were produced indicating the major nutrient requirements for the most banana growing areas of the islands.

Extensive factorial experiments resulted in the recommendation of 11:11:33 as the major fertiliser for the Windward Islands and 12:8:30 and later 12:4:28 for Jamaica.

Bananas were found to be very heavy feeders of potassium and most of the soils were found to be deficient in nitrogen.

WINBAN established a network of soil monitoring stations in all the islands representing well defined soil types and climatic zones in order to keep a check on the nutrient status of banana plants and soils in these areas.

Through this system of close monitoring twice a year, it was found that the high potassium in 11:11:33 was affecting the uptake of magnesium and that fields were being run down i.e. losing productivity.

This led to the recommendation of 12:12:17 = 2 MgO to replace 11.11.33 in certain parts of the islands.

The extensive surveys also indicated a widespread deficiency of sulphur and research showed that by increasing the sulphur in the fertiliser this deficiency can be removed. Today it is required that all WINBAN fertilisers contain at least 4 % sulphur.

Further research indicated that it is possible to reduce on the P in the fertiliser without affecting yield performance. This led to the recommendation of 16:4:24 with or without magnesium.

On the use of nitrogen, I should explain that WINBAN had found that in the dry season banana nitrogen uptake was suboptimal and side applications before the dry season averted a decrease in crop yields. This practice was therefore recommended. This recommendation worked very well when implemented, but most farmers did not follow the practice. WINBAN therefore recommended an increase in the N content in the mixed fertilisers in order to assure that a larger number of farmers used this required nutrient at the correct dose.

The greatest thrust in banana nutrition in recent times first started with work in Jamaica in 1975 and continued with intensity at WINBAN ; I refer to fertiliser placement.

The Jamaica work consisted of placing fertiliser in micropore bags about 45 cm away from the plant base. The concept here is that the banana roots would be subjected to localized feeding, there would be less runoff of fertiliser with surface water and less labour required for application.

WINBAN's research approach included treatments without the micropore bag i.e. the fertiliser was placed in a hole in the soil 45 cm from the pseudostem and about 5 to 8 cm deep.

Placement of fertiliser without the micropore bag was found to be better than with the bag and the advantages of economic use of fertiliser (less runoff losses and reduced rate of application) with reduced labour input are being evaluated. Some farmers have already adopted this practice, particularly in lands close to rivers that flood from time to time.

There are three fundamental findings in this fertiliser placement research which would be of interest to all of you

- 1) The nutrient supply can be improved by placement without increasing the amount of fertiliser i.e. the fertiliser use efficiency is improved.
- 2) Higher yields were produced by placement using the same amount of fertiliser and under some circumstances with a smaller amount of fertiliser than used in broadcast application.
- 3) There was less toppling with fertiliser placement, probably because of a deeper root system.

WINBAN improved upon its soils laboratory with the introduction of Technicon Autoanalyser giving the Centre the capacity to process and report upon several thousand advisory and experimental samples per month.

When we think of the banana industry of the islands we must bear in mind (unlike in Latin America) an industry with over thirty thousand banana growers scattered over five (5) islands and growing bananas on a wide range of slopes, soil and climatic conditions, sometimes at great distances from a motorable road. All these growers have to be serviced with inputs and technology.

Therein lies the problem of Fruit Quality and the need for special research and development approaches to tackle these problems which are essentially the same in Jamaica and the Windwards.

Up until the mid 60s, the islands exported bananas on the bunch to the United Kingdom. This was changed to

shipments of hands in cartons. After much research, the carton now being used (average 14 kg) was found to be the most convenient for our market, both in terms of the suitability for fruit as regards variability conformation and market acceptability. Commercial experiments with larger boxes and clusters rather than hands, revealed that, as a result of the wide variety and diversity of conditions from which the fruit emanate, they carry the inherent problem of physiological non-uniformity and the associated non-uniformity in ripening.

Conventionally, bananas are carried to central packaging where they are selected, washed, treated against fungi, packed in cartons and transported to depots for shipment overseas.

Because of the difficult terrain over which the bananas have to be carried and in many cases the long distances between field and packaging centres in Jamaica and the Windward Islands, much of the fruit is rejected at the centres due to excessive handling and mechanical damage in transit.

The concept of minimising the handling of fruit was researched upon and Jamaica and WINBAN introduced a plastic field box to the industry, particularly for the small farmers, allowing them an opportunity to carry selected good quality hands protected in boxes rather than bunches, to processing centres. The carrying load became less (the stalk was left in the field), the fruit was given better protection, the quality was maintained and the reject percentage was reduced. The special features of the boxes are that they can nest in each other when empty and vertical and cross stack when filled with bananas.

With the oil crisis the cost of plastics increased and so did the price of the box by over 500 %. WINBAN has designed a «Do It Yourself» box made of local plant material put together to achieve as close as possible the carrying and stacking features of the field box.

Research continued on ways and means of reducing on transport damage and the number of times bananas have to be handled i.e. the number of times they can be subjected to damage, by the grower and workers in the field, by the worker at collecting point, by the truckers in transit, by the workers the packaging plant and by the transport workers.

After extensive research, a development by WINBAN is now being given to pack the bananas in the field as close as possible to the banana plant. The bunch is dehandled when it is still attached to the plant. In effect, the bunch is made to hang low by an incomplete cut of the pseudostem. It may also be dehandled on a cross bar from a frame in the field. After cutting the hand, the crown of the hand is immediately covered with a fungicide impregnated pad and the hands are immediately packed in cartons in the field on a table under the plant or at a small shed in the field.

In so doing we achieved a decentralisation in banana processing operations, where the grower or groups of growers (cooperatives) become more and more responsible for the quality of their fruit. The rejects are reduced substantially and the quality of fruit improved significantly as compared to a central processing system. About 60 % of the exported fruit is now being field packed in one of the islands. It must be realised that field packing by itself is not the answer. For a grower to qualify as a field packer he has to be registered. To be registered his field sanitation must be good and he must both deflower and sleeve his bunches.

The field packing case is a classical example where through advances and developments in one direction disciplines were imposed which were previously slow implementation e.g. sleeving and deflowering by the small grower.

This is also a classical example where it was necessary to depart from a conventional system to a non-conventional one, to meet the particular circumstances of our industry - it is in essence an example of appropriate technology. Agronomic research at both centres have revolved around tests on varieties plant density, propping, weed control, flower setting, bunch care and maturation and yield parameters as they relate to all these.

On the question of varietal preferences this has been dictated over the years by a series factor, (1) pests and diseases, (2) environmental conditions, (3) market preference and to a certain extent (4) individual choice.

The movement of our market from the preferred variety Gros Michel to the Cavendish group due to the ravages of Panama disease is a clear example of the effect of a disease on the shift to a new variety.

Several commercial varieties, Grande Naine, Giant Cavendish, Williams Hybrid, Robusta, Dwarf Cavendish, Lacatan, were tested at both centres. It can be generally concluded from the results, that Giant Cavendish is very susceptible to drought conditions and should not be grown in areas with water deficits. The Valery and Robusta cultivars gave the best results and they appeared to stand up best to the conditions in the islands. In the Windward Islands, Robusta is recommended as the most versatile cultivar and is extensively grown.

Plant density research has led to the recommendation of densities ranging between 1700-2000 per hectare depending upon altitude with one follower.

Bunch care and protection are related to eventual yield parameters. It was found that removal of the male flower resulted in a reduced bunch maturation period i.e. shoo-

ting to harvesting, from 92 to 88 days and that sleeving did not only improve quality through a protection mechanism but it also resulted in less rejects (more returns) and increased bunch weights by up to 13 %.

WINBAN's work of Cropping Systems will be reported by Dr. RAO in the course of this meeting.

In spite of the considerable amount of research done on weed control in bananas using a variety of weedicides and weedicide combinations, Paraquat (Gramoxone) continued to be the household word amongst banana farmers. The applicability of some of WINBAN's recent findings involving herbicide combinations e.g. the development of the herbicide Talent which is a paraquat/asulum mixture will be presented in my paper on Research perspectives to be delivered later in the programme.

It must nevertheless be mentioned that the application of our Research and Development would not have been successful without a strong Extension-Research-Farmer link and feedback system with the assistance of our Communication Centre attached to Research.

In synthesis, Research and Development in Jamaica and the Windward Islands has been directed at the problems of a larger number of growers (over 30,000) scattered over a wide variety of topographic, edaphic and climatic zones.

In addition to Research and Development, both centres at WINBAN and Jamaica have included monitoring and servicing aspects e.g. leaf spot monitoring, soil and leaf analyses, as well as short and long term education aspects e.g. the development of a strong extension-research-farmer link. The research policies have had to be directed at the introduction of technologies that are relevant to the particular circumstances of the industry and which are cost effective although sometimes non-conventional e.g. the introduction of field boxes, field packing and fertiliser placement.

It is my view that one of the reasons for the survival of the complex industry of the islands is because of a dynamic and sound technological base, grounded in our Research and Development Division. It is my strong feeling that if this base is diluted or denuded, our export industry will perish as has perished the banana industries in some islands in the South Pacific.

REFERENCES

1. Jamaica Banana Board Annual Reports.
2. WINBAN Research and Development Annual Reports.