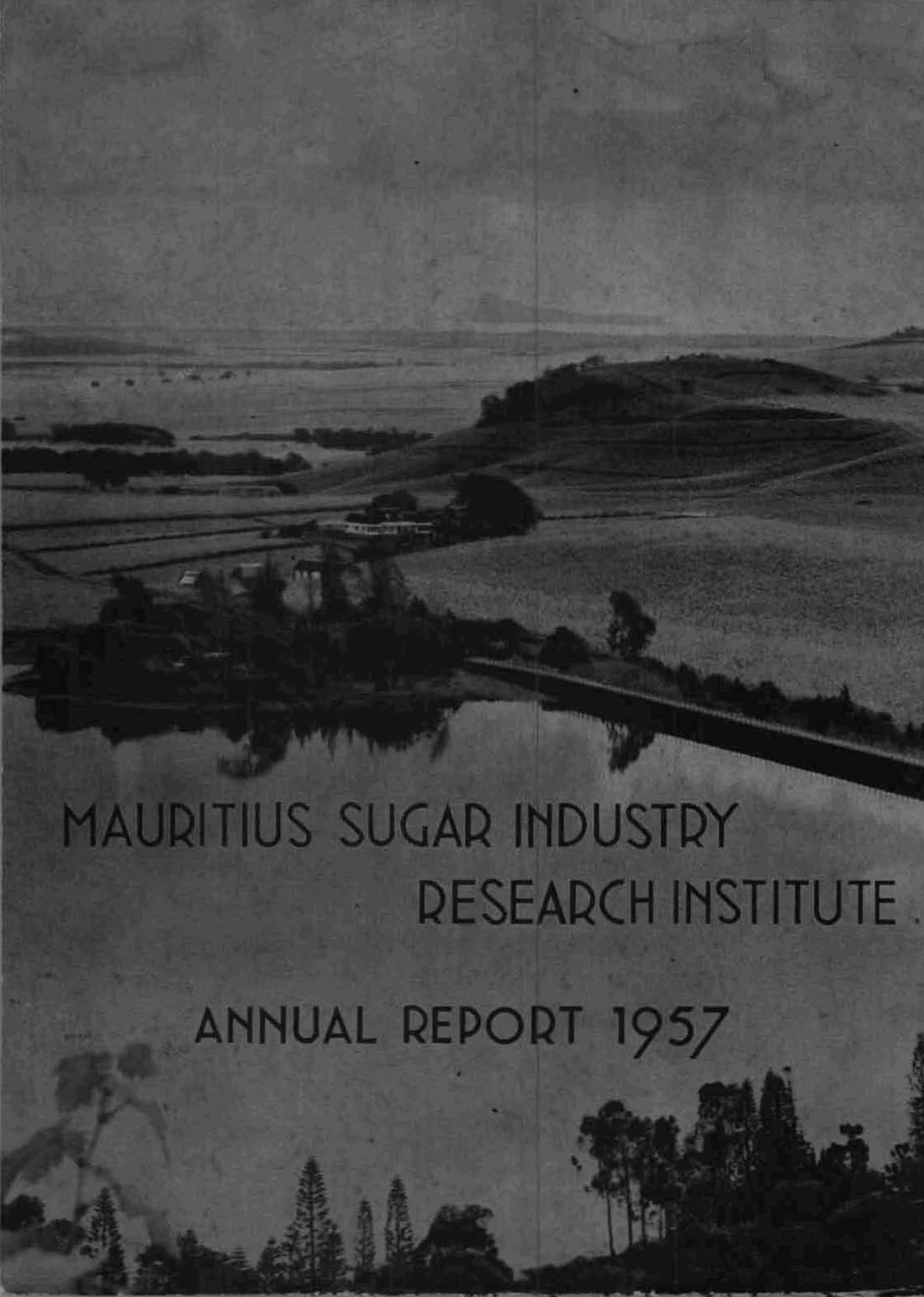

MAURITIUS SUGAR INDUSTRY RESEARCH INSTITUTE

ANNUAL REPORT 1957

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Port-Louis

CONTENTS

The photograph on the cover shows the northern sugarcane plains with La Nicolière reservoir in the foreground. (Photo L. de Réland).

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	Miss L. Kingdon

REPORT OF THE CHAIRMAN
EXECUTIVE BOARD, 1957

I should like to open this report with a word of commendation for the good work accomplished by my friend the Hon. A. L. Nairac, C.B.E., Q.C., my predecessor in the office of Chairman, who, with the valuable assistance of his colleagues on the Board and of the Director, has organized the working of the Sugar Industry Research Institute and made my task considerably easier in many respects.

On the withdrawal of the Hon. A. L. Nairac and Mr. Pierre P. Dalais at the end of 1956, Mr. George R. Park, Manager of Bénarès Estate, and myself were appointed to represent the Factory owners and the Chamber of Agriculture respectively; the composition of the Board for 1957 remaining otherwise unchanged. It was barely two months later that we heard with mixed surprise and grief that our friend Park had passed away. It is my painful duty to record here our deep sense of the loss which the Institute in particular, and the scientific branch of the sugar industry in general, have sustained by his premature death. Mr. Park was an active member of the Research Advisory Committee where his loss will be particularly felt by his colleagues. Mr. Jean A. Harel was appointed to replace Mr. G. Park.

Mr. Georges Rouillard, who represented large planters, left the Colony in May and was replaced by Mr. Roland Ducler des Rauches.

Mr. P. G. A. Anthony, who had been a member of the Board since its foundation, went on leave at the end of September and was replaced by Mr. L. H. Garthwaite.

The Board held 14 meetings in the course of the year, including a joint meeting with the Research Advisory Committee, and visited the four Experiment Stations of the Institute.

ESTABLISHMENT

It has been possible this year to complete the structure of the Establishment as originally planned, and this has been achieved by the following appointments:

Mr. J. R. Williams, M.Sc., D.I.C., formerly attached to the Department of Agriculture, was appointed Entomologist with effect from 1st March 1957; Mr. A. Rajabalee was selected for the post of Laboratory Assistant, Entomology division, and Mr. G. Harvais, B.Sc. (Aberdeen), was appointed to the post of Assistant Plant Breeder in August. Mr. E. F. George, B.Sc., A.R.C.S., Geneticist, also assumed duty in August.

The following officers went on overseas leave in the course of the year: Messrs. Guy Rouillard, F. Mayer, P. G. du Mée and D. H. Parish.

Mr. J. Dupont de R. de Saint Antoine represented the Institute at the "Lead Error Conference" and at the "Conférence Internationale de Technologie Sucrière" held in London in May.

Messrs. R. Antoine and J. R. Williams spent three weeks in Madagascar in May to visit the sugarcane zone infected with Fiji disease.

Dr. P. O. Wiehe attended the 3rd P.I.O.S.A. Congress in Madagascar in October and the 7th meeting of the "Comité de Collaboration Agricole Maurice—Réunion—Madagascar", which was held this year in Réunion, in the first week of November.

VISIT OF DR. H. W. KERR

The Institute is indebted to Dr. H. W. Kerr, Director of the Sugar Research Institute, Mackay, Queensland, who kindly accepted an invitation to spend two months in Mauritius to act in a consulting capacity to the Institute on problems of sugar manufacture.

Dr. Kerr's recommendations on the future development of the Sugar Technology Division of the Institute are being studied by the Board.

Dr. Kerr also visited all the factories of the island and his views on many technical questions have proved most helpful.

BUILDINGS

The Board has now received an assurance from the Government that the former Government Bacteriological Laboratory will be delivered to the Institute in April 1958. Meanwhile the construction of a new wing adjacent to this building has started. These new laboratories covering approximately 3,000 sq. ft. of floor space will be devoted to the biological sections of the Institute and will be completed in the first quarter of 1958.

The Board has also acquired a house in Vacoas which is used at present by the Geneticist.

FINANCE

During the financial year ending on 30th June 1957, revenue exceeded current expenditure by Rs. 266,108.22. This has brought accumulated funds at 30th June 1957 to Rs. 942,454.40 and thus enabled the Board to continue with its capital expenditure programme. It is important to note that the fixed assets of the Institute amounted to Rs. 1,102,979.03 at 30th June 1957. The acquisition of these has been financed mainly out of current expenditure and the loan from the Anglo-Mauritius Assurance Society Ltd. The large balance of cash on hand was due to the fact that it was still uncertain when the Bacteriological Laboratory purchased from Government would be handed over for reconversion. Since then a large part of this balance has been invested on short term fixed deposit until such time as it will be needed.

It is my privilege to place on record our deep appreciation of a generous monetary gift made to the Institute by an anonymous donor. This gift which has been utilised for the creation of a "Special Studies Fund", in accordance with the objects outlined by the donor, will enable the Institute for a period of five years to "pay all disbursements and expenses that may be incurred in connection with specialized training or study tours of any member of the Institute's staff".

To conclude this brief survey of the Institute's activities and financial situation, I wish to express the Board's satisfaction at the readiness of every member of the staff to cooperate in making its working a success

Now that the Mauritius Sugar Industry Research Institute is working at full capacity we must make it our duty to maintain, and endeavour to raise, the standard of efficiency in sugar production which is of such significance to the economy of Mauritius.

CHAIRMAN.

10th January, 1958.

REVENUE & EXPENDITURE ACCOUNT

YEAR ENDED 30TH JUNE 1957

RUNNING COSTS, MAINTENANCE & DEVELOPMENT OF STATIONS & LABORATORIES	486,855.73	CESS ON SUGAR EXPORTED ...	1,371,559.46
FEES — BOARD MEMBERS, AUDITORS & LEGAL ADVISER	4,425.—	MISCELLANEOUS RECEIPTS ...	47,535.40
PERSONAL EMOLUMENTS & PENSION FUND CONTRIBUTIONS ...	415,045.56		
GENERAL OFFICE & LIBRARY EXPENSES	72,611.82		
INTEREST ON LOAN	22,916.67		
TRANSFER TO REVENUE FUNDS — LEAVE & MISSIONS	60,000.—		
DEPRECIATION	91,131.86		
	1,152,986.64		
Excess of Revenue over Expenditure for the period carried to Accumulated Funds	266,108.22		
Rs.	1,419,094.86	Rs.	1,419,094.86

BALANCE SHEET

AS AT 30TH JUNE 1957

ACCUMULATED FUNDS	942,454.40	FIXED ASSETS (at cost less depreciation and amounts written off)	
REVENUE FUNDS	71,001.24	Land & Buildings 1,049,087.57	
LOAN FROM A.M.A.S. LTD. ...	700,000.—	Equipment & Furniture — laboratories, houses & offices 34,652.46	
GOVERNMENT OF MAURITIUS (Purchase of buildings)	229,895.10	Agricultural Machinery & Vehicles 19,239.—	1,102,979.03
		CURRENT ASSETS	
		Sundry Debtors ... 48,292.90	
		Cash on Deposit ... 125,000.—	
		Cash at banks & on hand 667,078.81	840,371.71
Rs.	1,943,350.74	Rs.	1,943,350.74

AUDITORS' REPORT

We have examined the Books and Accounts of the Institute for the year ended 30th June, 1957, and have obtained all the information and explanations we have required.

In our opinion, proper books of account have been kept by the Institute so far as appears from our examination of those books, and the foregoing Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Institute's affairs as at 30th June, 1957, according to the best of our information and the explanations given to us and as shown by the books and Accounts of the Institute.

(sd) RAYMOND HEIN
(sd) P. de L. d'ARIFAT } *Board Members*

(sd) P. O. WIEHE *Director*

Port-Louis,
Mauritius,
22nd July, 1957

(sd) G. de CHAZAL, C. A.
p. p. de Chazal, du Mée & Co.
Chartered Accountants.

INTRODUCTION

THE fourth year of activity of the Sugar Industry Research Institute was marked by the completion of the Establishment as planned originally in 1953. Five officers were appointed or assumed duty during the year and investigations on cane pests were started with the opening of an Entomology section in March. In this way, research on the major aspects of sugar production from field to factory are now covered by the different sections of the Institute. It is therefore possible to implement fully the research policy laid down initially and to pursue vigorously those projects of the research programme which are of most consequence to the sugar industry of the island.

The problem of accommodation, however, was rendered more acute by the increased staff and the postponement by Government of the delivery date of buildings purchased some years ago. In this connection it is with pleasure that I record my thanks to the Director of Agriculture for his kind assistance in temporarily providing additional rooms. As reported by the Chairman, the Board decided to build a new wing adjacent to the main building of the former Bacteriological Laboratory. This new structure, which was started in August, will accommodate the cane breeding, botany, entomology, pathology and field experimentation sections. In addition there will be a collection room for cane pests and diseases while adequate space has been provided for the herbarium of the Mauritius Institute which will be transferred to our custody.

Plans were completed for the conversion of the buildings, occupied at present by the Medical Department, into a library and conference room, and for the administrative section and ancillary services.

Development of experimental stations continued according to plans. At Réduit an insectarium and fertilizer stores were constructed. Work was started on a new cane nursery site and fencing of the lower part of the station was completed. At Pamplemousses an additional area of 10 arpents was leased from Mon Rocher estate. Land development was continued at Belle Rive where 30 arpents are now under cultivation. Part of the new area leased at Union Park was used for planting seedlings bred in 1957. Cane production at the four stations amounted to 1570 tons. Essential climatic data are recorded at each station and will provide important information in due course. The Dines anemometers purchased by the Institute were erected at Médine and Union Flacq estates and, as reported last year, will be maintained by the Observatory Department.

THE 1957 SUGAR CROP

Essential data on the 1957 sugar crop are published as usual in the appendix to this report. The total area under sugar cane was 182,000 arpents of which 169,300 arpents representing 93% of the cultivated area was harvested. The average yield of cane per arpent was 25.6 tons, a figure which exceeds the normal by 0.7 tons, while sugar manufactured % cane was 12.93*, also higher than the normal by 0.6 unit. The 26 factories of the island crushed in 105 days 4,344,000 tons of cane which produced 561,600 tons of raw sugar at 98.5 polarisation. The yield of sugar per arpent harvested amounted to 3.31 tons. The island benefited once more from the absence of cyclones and, from a climatic point of view, the year was normal except for intense local variations in distribution of rainfall during the growing season. Thus the sums of monthly rainfall deficits from November 1956 to June 1957 amounted to 14.3" for the island as a whole against an 80 - year average

* Equivalent to 7.73 tons of cane per ton sugar.

of 15". The deficits for the west were markedly below average, the other sectors were normal except for coastal areas of the north and east. Several areas in the north of the island suffered particularly heavy losses. An extreme case of stunted growth due to lack of rain in the north is illustrated in fig. 11 (page 28).

Climatic conditions during the maturing season were almost optimal. As a result, sucrose content was markedly high and reduced to some extent the drought effects which prevailed locally. Compared to 1956, sugar production was reduced by 15.9% in the north and 5.6% in the east, while the south, centre and west of the island produced, respectively, 6.8, 7.8 and 15.9% more sugar.

In this connection it must be pointed out that in order to assess correctly the effect of rainfall on cane and sugar yields in different sectors of the island, the appropriate coefficients must be used. An analysis of available data has revealed that one inch of rainfall deficit during the growing season reduces cane production as follows:

Island	0.31	Tons per	arpent
West	0.67	,,	,,
North	0.64	,,	,,
East	0.23	,,	,,
South	0.09	,,	,,
Centre	0.16	,,	,,

while an excess of one inch during the maturing season reduces sugar manufactured % cane by:

0.21	unit	in the	West
0.86	,,	,,	North
0.14	,,	,,	East
0.21	,,	,,	South
0.10	,,	,,	Centre

and 0.27 for the island as a whole.

It is clear therefore that all sectors of the island do not suffer in the same proportion from the effects of drought during the growing season or from those of excess rainfall when the crop is being harvested. Further information on this problem is published elsewhere in this report.

Ratoon canes in 1957 represented 85% of the total crop weight and the comparative yield of virgins and successive ratoons is shown in fig. 1. The higher levels attained during the year under review reflect largely the favourable climatic conditions which prevailed during the growing season. It will be observed that the decline in yield from virgin to 6th ratoon in 1957 was 0.8 tons per arpent per year as opposed to a normal which is approximately 1 ton per arpent per year.

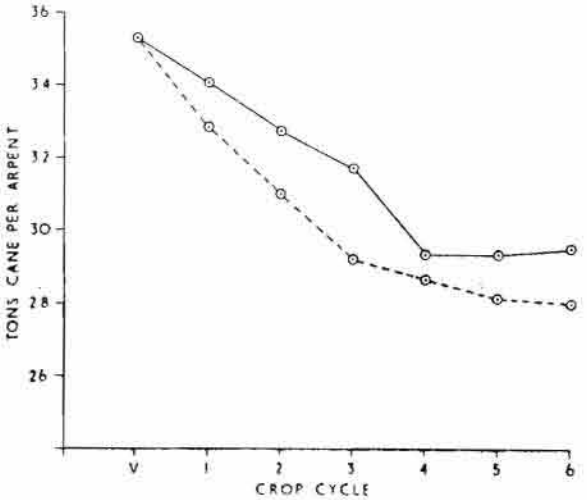

Fig. 1. Yield of virgin and successive ratoons on estates. Plain line: 1957; broken line: average 1948 - 1956.

Variations in sucrose content throughout the grinding season are illustrated in fig 2. and are almost identical to those observed in 1956. In the north, sugar manufactured % cane reached levels which had never been attained previously in the island and two factories

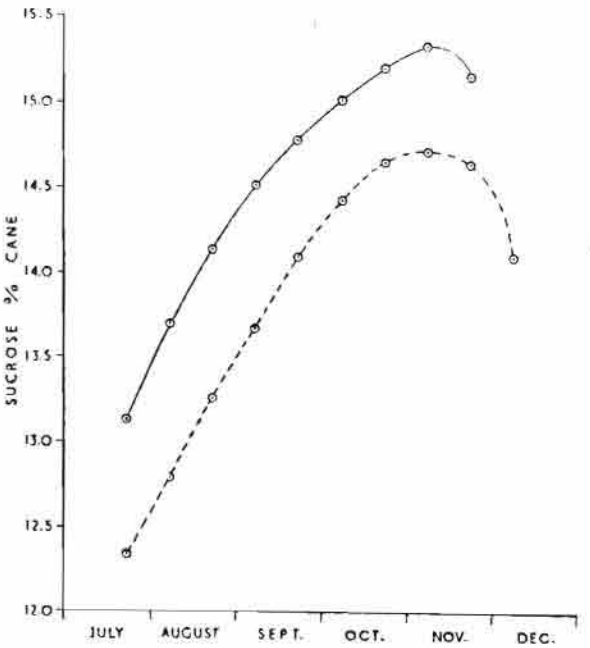

Fig. 2. Seasonal variation in sucrose % cane for all factories of the island. Plain line: 1957; broken line: average 1947 - 1956.

averaged the high figures of 14.98* and 14.90*, respectively. Fortnightly variations in commercial sugar manufactured % cane are shown graphically for two factories at which the average crop figures were lowest and highest, respectively (fig. 3). It will be observed that while the curves follow the same trend, there is a wide difference between the two cases studied. On the average 2.8 tons of cane more were required to make a ton of sugar at the factory where sugar cane does not mature satisfactorily.

Data on the duration of the crushing period and weekly crushing rates of factories were assembled and are presented for the first time in Table XVI of the appendix. The significant increase in the weekly crushing rate of factories (fig. 4) shows clearly the progress achieved in this field during the last ten years. It appears from these figures that present day equipment of factories and transport organization on estates are such that a cane crop amounting to five and a half million tons can be processed during a normal crop period extending over approximately 24 weeks from July to early December.

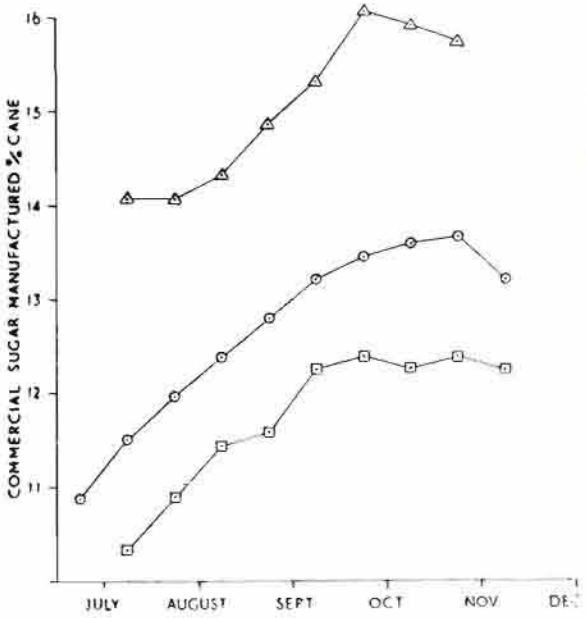

Fig. 3. Fortnightly variations in commercial sugar manufactured % cane during the 1957 crop. Circles: island average; squares: lowest factory; triangles: highest factory.

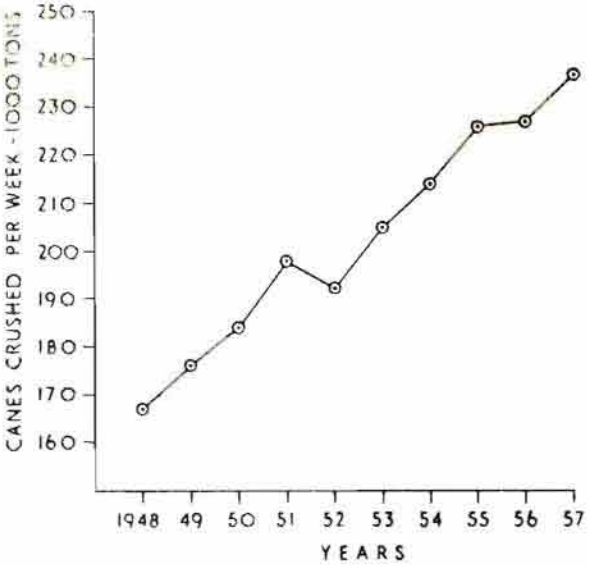

Fig. 4. Weekly crushing rate for all factories of the island from 1948 to 1957.

CANE AND SUGAR YIELDS 1947 - 1957

In an attempt to assess the progress achieved by the sugar industry since 1947, it is possible to eliminate climatic variations by calculating the theoretical cane and sugar yields of different sectors under 'normal' rainfall conditions. A detailed study published by P. Halais in this report reveals the following facts:

Cane yields have increased by:

7.3	tons	per	arpent	in the West
1.9	"	"	"	South
2.1	"	"	"	Centre

and have decreased by:

1.8	tons	per	arpent	in the North
0.2	"	"	"	East

with an overall increase of 0.3 tons cane per arpent for the island during the period 1947-1957. Sugar manufactured % cane has increased throughout by:

0.43	unit	in	the	West
0.45	"	"	"	North
0.57	"	"	"	East
0.43	"	"	"	South
0.13	"	"	"	Centre
0.53	"	"	"	Island

* Equivalent to 6.65 and 6.71 tons of cane per ton sugar.

The average yields for the island as a whole now stand as follows:

Tons cane per arpent = 24.9 (24.6 in 1947)

Commercial sugar manufactured % cane = 12.33 (11.80 in 1947)

Tons sugar manufactured per arpent = 3.07 (2.90 in 1947)

Increases in cane yields recorded above are due mostly to irrigation in the west, to the cultivation of better adapted varieties in the centre and upper regions of the southern sector of the island. The decrease of cane yield in the north can be attributed to extension of cultivation without irrigation and possibly to ratoon stunting disease. The dominant factor in the improved sugar manufactured % cane everywhere is to be attributed primarily to better equipment and to the increased grinding rates of factories which can thus complete crushing during the period when the sucrose content is high.

THE CANE VARIETY POSITION

The composition of the 1957 cane crop, as shown in fig. 5 indicates the proportion of estate grown canes crushed by factories in different sectors of the island. M. 134/32 still represented approximately 60% of the canes crushed, followed by Ebène 1/37 (20%), Barbados varieties (12%) and other M. seedlings (8%). M. 134/32 was still the dominant variety in all sectors except the central plateau where nearly 65% of cane crushed during the 1957 season was Ebène 1/37.

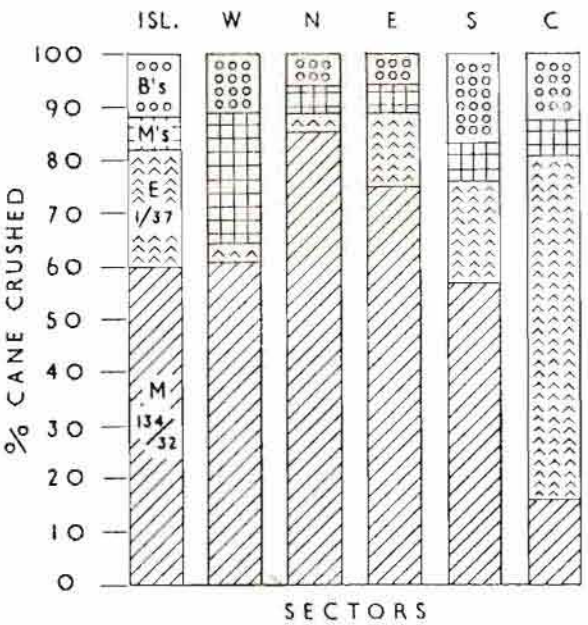

Fig. 5. Varietal composition of 1957 crop in different sectors (estate grown canes).

The actual trend in varieties, however, is illustrated in fig. 6, which shows the percentage area planted under different varieties on estates since 1954. The decline of M. 134/32 is striking: the area planted under Ebène 1/37 remained at approximately the same level while the popularity of recently released Mauritius varieties is reflected in the sharp rise from 1954 to 1957.

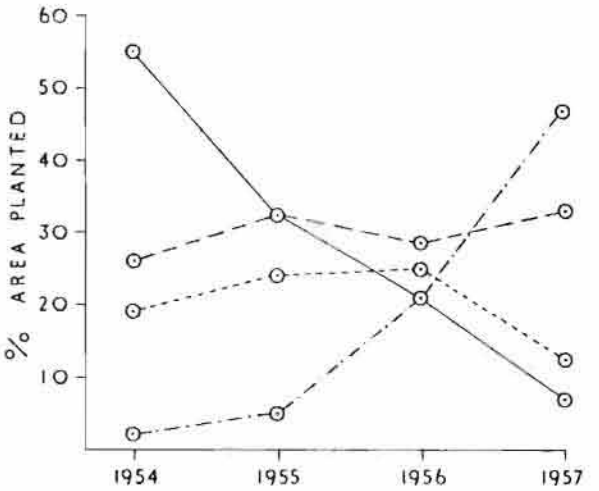

Fig. 6. Variety trend since 1954. M. 134/32: plain line; Ebène 1/37; broken line; Barbados varieties: dotted line; M. varieties (147/44, 31/45, 112/34): dots and dashes.

An analysis of the 1957 plantations in different sectors (fig. 7) reveals local changes which have taken place. M. 134/32 is losing ground everywhere; Ebène 1/37 accounted for nearly 80% of plantations made in the central plateau, and is gaining ground both in the south and east. Of the new M. seedlings, large areas of M. 147/44 were planted throughout the island.

It is now desirable to consider to what extent the variety trend indicated above is in agreement with experimental findings at the Institute. Two sets of data are available for this purpose: (a) results of "post-

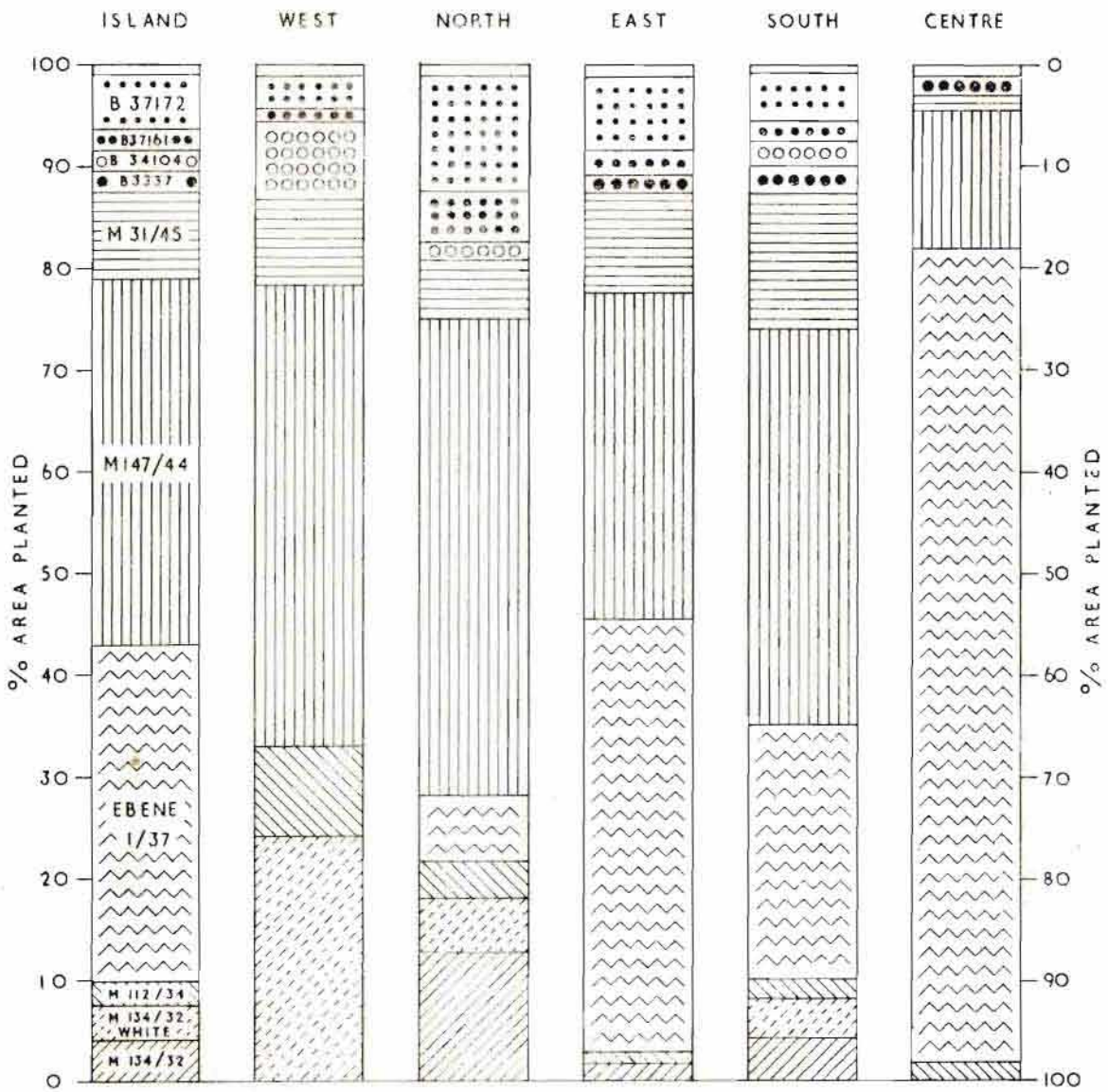

Fig. 7. Varietal composition of 1957 plantations on estates.

release trials" established in 1954, which include Ebène 1/37, the four Barbados varieties 3337, 34104, 37161, 37172, and M. 134/32 as standard; (b) results of "pre-release trials" concerning M. 147/44 and M. 31/45.

Post-release Trials. For the purpose of the following discussion it is necessary to give a brief outline of these experiments. There are six varieties planted in a latin square in six trials, of which two were established under rainfall conditions of 60" p. a., two under rainfall varying from 60" to 80" and two in high rainfall regions. Each plot is subdivided into 3 sub-plots receiving 20, 40 and 60 kgs N per annum. P and K fertilization is maintained at an optimal level in all the plots. The trials are reaped at different dates: two blocks in July, two in September and two in November. Results obtained in virgins are not included in the analysis because of the greater importance of ratoons in cane agriculture in Mauritius. From the large mass of data obtained in 1st and 2nd ratoons, which will be fully discussed elsewhere, it is possible to draw the following broad conclusions:

(i) Ebène 1/37 is an outstanding variety in regions receiving more than 70" of rain. In the very wet regions it has outclassed M. 134/32 by 1.3 tons of sugar per arpent and in the intermediate rainfall zone by 0.7 tons.

(ii) B. 37172 is the best variety under rainfall conditions approximating 60" per annum, and is equally good in regions of intermediate rainfall. It is not adapted to conditions of high rainfall.

(iii) B. 34104 is a suitable variety for drier regions, having exceeded on the average the yield of M. 134/32 by 0.7 tons sugar per arpent.

(iv) B. 37161 offers no serious advantage over M. 134/32 and is inferior to the other varieties considered.

(v) B. 3337 has performed well everywhere in yield of sugar per arpent, but because of its poor juice quality and high fibre content large scale planting is not recommended. For instance, average sucrose content was two C. C. S. units lower than Ebène 1/37 in wet localities and one unit lower than B. 37172 under dry conditions. It may, however, find a restricted position in the overall cane production of the island. An interesting feature of this variety, apart from its exceptional vigour is its ability to respond to Nitrogen without a decline in sucrose content. Thus, plots having received the highest dressing of Nitrogen (60 kgs/arpent) did not show a decrease in sucrose content, while cane yields continued to rise significantly with increasing doses of nitrogen. The performance of these varieties is illustrated graphically in (fig. 8) from which data concerning B. 3337 have been omitted, owing to its low sucrose content.

Pre-release Trials. From an analysis of 17 pre-release variety trials, of which two were established in the sub-humid zone, 8 in the humid, 4 in the super-humid and 3 under irrigation, it may be concluded that:

(i) M. 147/44 is particulary adapted to the sub-humid and humid zones; it has produced sugar yields far in excess of the standard variety under irrigated conditions. This variety does not appear to be ideally suited to high rainfall regions where Ebène 1/37 performs exceedingly well.

(ii) M. 31/45 has proved generally superior to M. 134/32 in all climatic zones of the island.

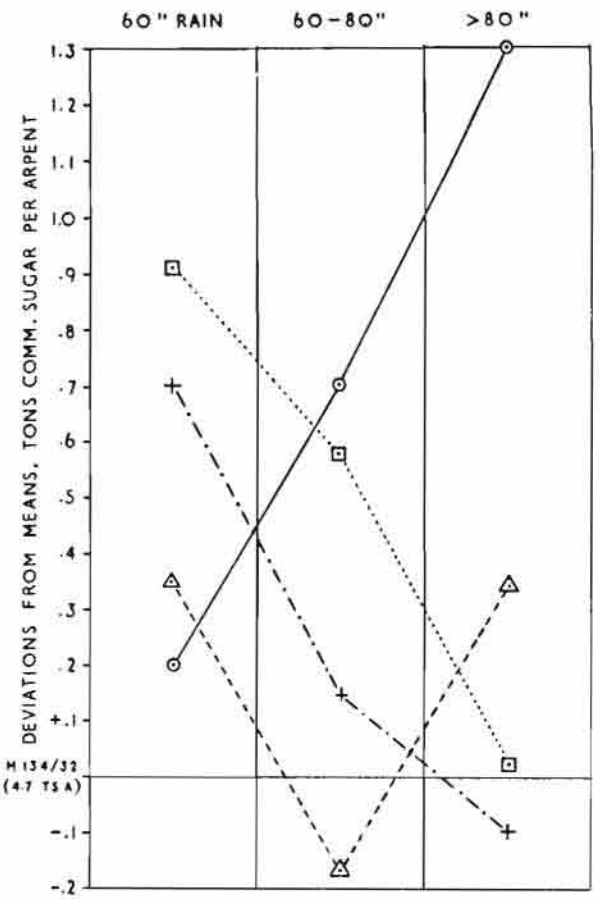

Fig. 8. Performance of 4 cane varieties in relation to M. 134/32, in 1st and 2nd ratoons in 6 post release trials. Plain line: Ebène 1/37; broken line: B. 37161; dash and dots; B. 34104; dotted line: B. 37172.

It is necessary to point out that, in drawing these conclusions, we have taken into account the number of times these varieties have proved superior to the standard in both yield of cane and sugar. Thus M. 147/44 has exceeded the standard M. 134/32 in yield of sugar 68 times out of 81 cases studied, while M. 31/45 has given better yields in 77 cases out of 96 when compared to M. 134/32, and in 50% of the cases when Ebène 1/37 was the standard.

Characteristics of commercial varieties. Essential characteristics of commercial cane varieties cultivated at present are summarized in table I (pages 26 - 27) with a view to assisting cane growers in the choice of varieties for future plantings. Some of the information presented, particularly that concerning resistance to diseases and pests, is of a preliminary nature and may have to be modified in the light of future observations.

In concluding these brief remarks on the merits and defects of commercial varieties cultivated at present in Mauritius, we wish to refer to the excesses of optimism and pessimism which prevail concerning in particular the varieties M. 147/44 and M. 31/45. For example we know that some planters have uprooted canes planted 10 months earlier because sucrose content was not up to the standard expected. Others simply " do not like the look of the cane ", and finally at the other extreme are those planters who consider that M. 147/44 and M. 31/45 are the only varieties worth propagating. Experimental evidence available from field trials and crushing tests at factories justify the conclusion that both these varieties have an important role to play in sugar production, provided they are planted judiciously, i. e. in regions where they perform best. Such local factors as availability of labour, borer incidence and normal maturing conditions must also be taken into account.

Varieties under study. The material available for future selection must now be briefly reviewed. Crosses made in 1957 numbered 305 from which 40475 seedlings were obtained, and 35153 planted in December at the experimental stations, as follows:

Réduit: 11923, Pemplemousses: 11337, Belle Rive: 5853, Union Park: 6040.

Populations for study from earlier crosses include:

1956 seedlings for selection in 1958	...	28200
1955 seedlings selected in 1957 and planted in propagation plots I	...	428
Varieties in 1st selection trials	...	244
" selected from 1st trials in 1957 and now in propagation plots II	...	44
" in pre-release trials on estates	...	186

In addition there are 11 foreign varieties in propagation plots and 23 varieties in the quarantine greenhouse.

The variety M. 129/43, to which reference has been made in previous reports, is not considered now to merit further study.

Of the promising new varieties special mention must be made of M. 202/46 (Co. 281 x M. 63/39), M. 93/48 (Ebène 1/37 x M. 63/39), M. 253/48 (B. 34104 x M 213/40), M. 305/49 (Ebène 1/37 x M. 47/38) and Ebène 1/44 (Ebène 1/37 x Co. 213). They have been included in several pre-release trials in different climatic zones, and whenever possible small quantities of planting material have been issued to growers and to the extension Service of the Department of Agriculture. It is hoped therefore that when the time comes to consider the release of these varieties some data will have been obtained on their field performance, and more planting material of those varieties which merit release will be available for distribution.

NUTRITION AND SOILS

Fertilization. Foliar diagnosis analysis has shown again this year the marked deficiency of phosphate prevailing in Mauritius. This deficiency occurring on such a wide scale casts a shadow on an industry which has thrived so spectacularly over the last ten years and which has generally set a high standard of agricultural practice.

A fundamental tenet of agriculture has always been that unbalanced fertilization is not only unwise but dangerous through its effect in gradually destroying the nutrient balance of the soil, a balance which may have been built up slowly through sound past management.

From the article discussing chemical fertilization in Mauritius it will be seen that whilst imports of nitrogenous and potassic fertilizers have risen steadily with the sugar production, phosphate imports have remained almost static until 1954 at about 1,000 tons of P_2O_5 per annum.

In fig. 10 (page 25) sugar production is compared to the annual importations of fertilizers expressed as N P K values. Statistics after 1954 have been excluded purposely, since fields sampled in 2nd ratoons for foliar diagnosis in 1957 received phosphate applications at planting in 1954. Imports of phosphates in 1956 and 1957 have been approximately 2300 tons P_2O_5 per annum, and therefore show an improvement. In this connection it is important to stress that several factors have been operating during the last 20 years to accentuate phosphate deficiency : thus new varieties producing higher yields and standing to longer

ratooning have removed additional quantities of phosphates from the soil; cane cultivation has been extended on marginal lands and finally there has been a steady fall in the phosphate content of the marketed guano.

In order to avoid widespread loss in yields and waste of expensive nitrogenous and potassic fertilizers, work by the Chemistry divison has been directed towards finding the most effective method of correcting phosphate deficiency and a wide programme of research on this subject is still under way. Results obtained so far indicate that annual applications of soluble phosphate can be beneficial in producing significant increase in yields, although the best method of placement has not yet been decided. It is important that these soluble phosphatic fertilizers be studied as they are now approaching in cost per unit P_2O_5 the cost of "guano phosphaté", and because of their potential use in annual applications.

Laboratory experiments with urea can now be definitely taken to indicate that the suspected deleterious effects of biuret when the urea fertilizer is applied directly to the soil are insignificant even when the biuret content largely exceeds the small contents of this substance which may be met with occasionally in fertilizer urea. The results of field experiments laid down in 1956 to compare urea and sulphate of ammonia on virgins and ratoons have shown that there is no difference between the efficacy of these two forms of nitrogen. The choice between these fertilizers therefore rests in the unit cost of nitrogen.

Foliar diagnosis. In spite of some scepticism shown in certain quarters we wish to emphasize once more the value of foliar diagnosis in helping to solve the problem of balanced fertilization of cane fields. During the year under review 6210 leaf samples from estates and planters' fields were analysed for P and K and appropriate comments were made on the results. In addition, determinations of N P K were carried out on 1706 leaf samples and 540 internode samples from experimental plots.

Organic acid content of cane juice. Organic acids constitute a variable but always significant proportion of the total soluble non-sugars of sugar cane and are responsible for most of the titratable acidity of the juice. Most of these acids are present in low concentrations as normal metabolic products but aconitic acid is an exception in that it occurs in relatively large amounts. This acid is widely distributed in most plant species but does not occur in appreciable quantities as commonly as does citric acid to which it is chemically closely related. That a high level of aconitic acid occurs in the sugar cane has long been known and, in view of its use on a large scale by the synthetic chemical industry, a scheme for the commercial exploitation of the acid has been developed by the sugar industry of Louisiana.

The levels of this important acid are very much higher in Louisiana juice than in the local juices which are in fact so low in this acid as to require column chromatographic techniques for its determination rather that the usual chemical determination by de-carboxylation. Results are presented in this report showing the amount of aconitic acid occurring in our two principal commercial varieties grown and harvested under a wide range of conditions. These results show that the levels of aconitic acid which may be expected locally are only at the most about one quarter of the levels occurring in Louisiana.

Growth substances. In view of conflicting reports from different sugar countries on the effect of various growth substances on cane maturity a preliminary experiment was carried out on an estate where sucrose content is usually below the island's average. The sodium salt of 2,4—D was sprayed at rate of 50 and 100 p.p.m. at weekly intervals on the variety B. 37172. No significant increase in sucrose content was observed. Further experiments will be carried out in 1958.

Small quantites of giberellic acid were made available through the courtesy of Messrs. Plant Protection Ltd. Effect on germination and subsequent growth is being studied in conjunction with heat treatment to control chlorotic streak and ratoon stunting disease. Giberellic acid is also being used at various concentrations in an attempt to induce arrowing in varieties which do not normally flower.

SOIL SURVEY

January of this year saw a start to the soil survey of Mauritius which is being carried out by the Institute.

This detailed survey will take several years to complete as, despite the smallness of the island, there is a complexity of mapping units

which will need considerable work to rationalize. Many studies have been carried out in the past and much information is available on the chemical properties of local soils. The work of Craig and Halais in particular has been important in showing the over-riding influence of rainfall on the character of the soils, and the classification and study of the Richelieu — Réduit — Sans Souci climato-sequence by these authors have given the very necessary sound foundations for future work. There is, however, ample scope for a detailed study both from the pedological and from the agricultural point of view.

Owing to the extremely uniform geology of Mauritius and the profound effect of climate, delineation of soil groups is mainly a pedological problem and will involve considerable chemical data, unlike other countries where the effect of a widely varied geology is paramount, and where a study of the rock formations has shown that underlying rock governs the classification of the soil. It will be realised that laboratory work in the local soil survey holds a key position and it is therefore with regret that we can record little progress in this direction due to the absence of a suitably trained analyst. In spite of the difficulty, however, a thorough stereoscopic study of aerial photographs of the whole island was carried out. This enabled many physical features of interest, which are sometimes difficult to spot on the ground, to be plotted on the base map. A preliminary field survey of most of the factory areas enabled a rough delineation of the rocky, free, alluvial, hydromorphic and mountain-slope soils to be made, thus permitting a schematic soil map to be compiled as a first logical step in planning more detailed study of these soils.

As work progresses, it is demonstrating clearly the potential importance of this survey to the sugar industry. A short description is given in this report on the nature of the rocks and soils at Plaine des Roches, an area where Mon Loisir S. E. is carrying out reclamation work of considerable magnitude.

CANE DISEASES

The two pathological problems confronting the sugar industry of Mauritius are still ratoon stunting disease and chlorotic streak. A full programme of investigations was carried out by the Pathology section during the year, the more important results obtained being summarized in the brief notes which follow.

Ratoon Stunting Disease. (i) A histochemical test was developed for the detection of the virus using 2,3,5–triphenyl tetrazolium chloride. The test is based on the difference in colour intensity obtained in diseased and healthy tissues under controlled conditions. Maximum colour differentiation is obtained with the lower nodes of mature cane stalks and the best sampling zone is immediately below the level of the leaf trace bundles. In view of difficulties in diagnosing ratoon stunting disease, the practical applications of this test are already proving of great value in experimental work and in disease detection in nurseries.

(ii) Previous reports have indicated that the disease was more acute in the wet areas of Mauritius. Data obtained in 1957 have now shown that ratoon stunting disease also greatly accentuates the effects of drought, and that under those conditions the marked decrease in yield is due to a reduction in size of stool as well as length of stalks (fig. 9). These observations are of particular significance in regions where M. 134/32 is still the dominant variety.

(iii) Positive information was obtained for the first time demonstrating that the virus affects adversely the germination of cuttings. Thus, in several trials established with healthy canes derived from heat treated nurseries and with infected canes, germination was depressed by 7 to 55% depending upon varieties.

(iv) A concern of this Institute has been the possible contamination, by ratoon stunting virus, of canes subjected to the short hot water treatment against chlorotic streak. In an experiment to elucidate this point, healthy cuttings were treated in a water bath at 52° C for 20 minutes simultaneously with others infected with ratoon stunting disease. No contamination took place.

(v) Studies on heat therapy were continued and revealed that temperature distribution within the cutting during the long hot water treatment is not affected by different fibre content.

Chlorotic Streak. (i) In a carefully controlled experiment carried out in containers in the super-humid zone, no aerial transmission of the

Fig. 9. Effect of ratoon stunting disease on M. 134/32 in 2nd ratoons at Pamplemousses Experiment Station. The first and third rows from the left were inoculated with the virus at planting. The second and fourth were derived from healthy cuttings. It should be noted that border effect tends to accentuate stunting due to the disease.

disease took place, but positive evidence was obtained that chlorotic streak is acquired through the soil.

(ii) Experiments conducted in order to determine whether apparently disease-free canes from a dry locality possess the disease in a latent form, have led to the conclusion that symptomless canes in a dry area are free from the pathogen. Diseased cuttings planted in a dry locality give rise to plants showing leaf streak, but there is a gradual loss of symptoms which is related to the disappearance of the disease.

(iii) In a two-year experiment carried out in the super-humid zone, it has been observed that time of planting has an important influence on the rate of natural infection by chlorotic streak. The highest incidence is observed in summer plantings with a gradual decrease to a negligible percentage when the cane is planted during the winter months. Plantations in areas where chlorotic streak prevails should be properly timed in order to escape the disease at least in virgins and early ratoons. In that connection it is interesting to note that the factor, mentioned above, may have contributed to the failure of summer plantations in the past, and led to the adoption of the practice of establishing cane plantations during the winter months in the super-humid zone. Furthermore, it appears that the plant contracts infection in young virgins and particularly during the summer months. The same trend seems to take place in first ratoons.

(iv) In the super-humid zone, reductions in yield of 73% on Ebène 1/37 were obtained in plots planted and recruited with cuttings derived from stalks showing typical leaf symptoms, as compared to plots planted with heat treated cuttings. The results confirm the belief that the cultivation of Ebène 1/37, a variety so well suited to the high rainfall areas, could not have been continued without heat treatment.

(v) In order to determine the efficacy of the short hot water treatment in the control of chlorotic streak, various experiments were conducted, the results of which have shown

that the internal temperature of cuttings should exceed 44°C during treatment. In order to achieve these conditions, the diameter of cuttings should not be greater than 5 cms.

(vi) Research on experimental transmission of chlorotic streak by bridging two plants by an organic connection afforded by a parasitic phanerogam, is being continued. The partial parasite *Cassytha filiformis* has proved unsuitable but the complete parasite *Cuscuta chinensis* has now been successfully established on the sheaths and blades of sugar cane plants. Such an establishment is possible only when *Cuscuta* is growing vigorously on a suitable "mother plant". Another method being tested is the possible passage of the disease through moisture transfer between the intertwined root systems of cane plants growing in sterilized soil.

Fiji disease in Madagascar. Fiji disease on the East Coast of Madagascar still represents a potential menace to the sugar industry of Mauritius The French authorities are pursuing their vigorous campaign aiming at the eradication of the malady. The measures adopted by the Government of Mauritius to safeguard this island from the introduction of the disease by sea or air have yielded positive results in that sugarcane stalks were intercepted in the luggage of an incoming passenger. The Pathologist and Entomologist visited the affected localities on the east coast of Madagascar in May and have reported that many difficulties will have to be overcome before complete eradication can be foreseen. Results have not yet been obtained in the assessment of varietal reaction in resistance trials, but in the meantime, it has been possible to obtain useful information on the field reaction to the disease on the east coast of Madagascar of several cane varieties cultivated in Mauritius.

HOT WATER TREATMENT PLANT

As a result of recommendations made by this Institute, the Sugar Producers' Association have decided to create a central station for the heat treatment of cuttings so as to provide all estates and large planters with nurseries free from ratoon stunting disease. This plant is being installed at Belle Rive Experiment Station and will begin to operate in April 1958. For reasons explained in previous reports hot water treatment is preferred to hot air.

The target is to treat 6500 tons of cuttings annually in two electrically heated tanks, each having a capacity of 1 1/2 tons per treatment. It is estimated that the area under nurseries will provide disease free material needed for all plantations to be made in 1960.

This station is entirely financed and administered by the Sugar Producers' Association, the Research Institute acting in an advisory capacity.

Similar recommendations were made to the Extension Service of the Department of Agriculture, which is responsible for technical questions concerning small planters. As a result, the Sugar Planters' Rehabilitation Fund is financing the development of nurseries. These will be of great value in providing not only disease-free planting material to small planters but also the more suitable cane varieties for a given locality. Cuttings for these nurseries will be heat treated in the hot water tank of the Institute at Réduit.

CANE PESTS

Mr. J. R. Williams, formerly of the Department of Agriculture, was appointed Entomologist on March 1st and was initially occupied with ordering equipment and supplies. An insectary was planned and its erection completed in December. Owing to lack of accommodation in the temporary quarters of the Institute, the Entomologist was obligingly provided with laboratory facilities by the Department of Agriculture.

The white grub, *Clemora smithi (Arr.)* The experiments on insecticidal control methods for the white grub, which had been started by the Entomologist while employed at the Department of Agriculture, were continued. The progress of these experiments is the subject of a separate article, in which the promising results given by application of Chlordane and Aldrin, are described. On the basis of these results, the application of the insecticides in areas where *Clemora* is numerous is now suggested to planters for trial on a field scale, particularly during planting operations.

As a corollary to insecticide experiments, work is in progress to obtain more precise information on the distribution and movements

of larval stages in different types of soils. This consists in digging trenches at regular intervals in selected fields and plotting the position of the different larval stages in relation to the cane stools.

Sugarcane leafhoppers. The two species of Delphacidae which breed upon sugarcane in Mauritius, *Perkinsiella saccharicida* Kirk., and *Dicranotropis muiri* Kirk , have been specially studied owing to the potential importance of the former as a vector of Fiji disease which is firmly established on the east coast of Madagascar.

The ecology of the leafhoppers in the island is now reasonably well known. Both species are found on cane in all cane growing regions and they appear restricted to that plant. Field populations are generally low and never large enough to cause direct injury. The higher populations are usually found on young virgin canes after the formation of a canopy, but before appreciable stem growth. There also seems to be a relation between cane variety and leafhoppers abundance, varieties with succulent, arching leaves being favoured. As for the different climatic zones, the leafhoppers are more numerous in the humid and sub-humid zones, in that order, and relatively scarce in the super-humid zone. Seasonal changes of abundance are not pronounced. Natural enemies, of which there are several species, are numerous and are considered to exert a high degree of natural control and to be the main factors governing population densities.

In order to augment, if possible, the beneficial action of the natural enemies present in the island, in particular those of *Perkinsiella*, an attempt is being made to establish the Mirid *Tytthus mundulus* (Breddin.) This well known insect, which preys upon leafhopper eggs, played an important role in the suppression of *Perkinsiella* in Hawaii, following its introduction there from Queensland in 1920.

During the course of work with *Tytthus mundulus*, local species of Miridae, previously unrecorded, have been found associated with cane in some localities. Their identity and habits are being studied. It is possible that they are predacious, at least to some extent, upon leafhopper eggs, in the manner of *Tytthus mundulus*.

The stalk borer, *Proceras sacchariphagus Boj.* Heavy attacks of the stalk, or spotted borer, were not uncommon during the year and the general incidence of this pest seemed above normal. This may have been the consequence of the dry weather experienced early in the year.

Data from variety trials show that M. 147/44 gives a good performance both in regard to yield of cane and sugar % cane when subjected to borer attack. It has consistently given higher yields of sugar per arpent than M. 134/32 in borer infected areas of the north. Observations upon the susceptibility of M. 31/45 to stalk borer attacks have been conflicting. In variety trials where appreciable borer infestation has occurred, and these are nearly all located in the north, M. 31/45 has been somewhat more attacked than other varieties but its yield and sugar content have compared with or exceeded that of the standard variety M. 134/32. It appears, however, that in fields of M. 31/45, as opposed to varietal plots, the borer population is liable to build up in this variety and the tendency is more pronounced, or more obvious, in superhumid areas.

M. 147/44 is a variety characterized by the facility with which it produces side shoots. It is planned to assess the extent to which this occurs as compared with other varieties, and to determine if borer attack is a factor which accentuates side shoot production appreciably.

Nematodes. The influence of soil-inhabiting nematodes upon root development and cane growth in Mauritius has not been investigated previously, although root galls caused by *Meloidogyne* are not uncommon and two other parasitic forms have also been reported in the past. The plant-parasitic and freeliving nematode fauna of the island has, in fact, not been explored at all. Apart from the direct injury to roots by parasitic species, and perhaps also by freeliving forms, nematodes may have a role in the root-disease complex in which *Pythium* figures largely. It may also be profitable to speculate upon the possibility of chlorotic streak disease being transmitted naturally by soil inhabiting nematodes.

A general study of the nematode species living in and around cane roots has been started. It is intended to include the various components of the nematode soil fauna, namely the root parasites, the free living external root feeders, the predacious and the saprophagous forms. This programme may prove over-ambitious in view of the abundance and diversity of species present in soils, but for the present, at least, it is being pursued. Some progress has already been made with species identification and a permanent slide collection is being built up.

WEED CONTROL

Investigations on the use of substituted ureas CMU and DCMU were continued this year. Unfortunately the drought period which followed the application of these herbicides affected their activity and it was not possible to assess their true value in the control of local weeds. Trials laid down with these herbicides to determine their effect on cane growth and sucrose content were harvested and it was found that CMU and DCMU at rates of from 2 to 10 lb per arpent did not have any marked effect on cane yield and sucrose content. Other experiments in which the effects of the substituted ureas and other herbicides on growth were studied, showed that in one trial ' Dalapon ' at rates of 10 to 12 lb per arpent depressed significantly cane growth.

Further studies were carried out on the control of *Cynodon dactylon* (" Chiendent ") by TCA. Preliminary observations indicate that of the factors affecting the efficacy of TCA treatment, time of application appears to be the most important. Critical periods when the best results are obtained under local conditions seem to be immediately before the beginning of active growth (September—October) and towards the end of the growth period (May—June). Satisfactory control of *Paederia foetida* (" liane lingue ") growing in stone walls of cane fields was obtained with a formulation containing the butyl glycol esters of 2,4—D and 2,4,5—T. Regrowth incidence was only of the order of 5 to 10% six months after treatment. The weed of recent introduction, referred to as *Verbena p.* (" Verveine sauvage ") in the 1956 Report, has now been identified as *Heliotropium amplexicaule*, native of tropical South America. Satisfactory control is obtained by using sodium chlorate at the rate of from 100 to 150 lbs per arpent in 200 gallons of water. Experiments on the control of *Paspalidium geminatum* (" Herbe siflette ") are being continued as it was found that the recommended treatment of TCA-Dalapon mixture failed to control this weed in several cases.

Work on the weed flora of the island is progressing satisfactorily. Description and plates of 6 species were completed and it is hoped to start publication in 1958. In this connection I should like to place on record our deep appreciation of the assistance received from Dr. R. E. Vaughan O.B.E.

OVERHEAD IRRIGATION

Funds were made available by the Government and the Sugar Industry Reserve Fund in May 1957 for the large scale irrigation experiment referred to in the previous report. By arrangement with Medine S. E. a suitable site covering approximately 150 arpents was selected at Palmyre.

The Senior Field Officer of the Research Institute is in charge of the experiment, which consists in a comparison between overhead and surface irrigation on gravelly and free soils. A fully portable system will also be compared to a semi-permanent installation. A block of 12 fields has been chosen on each soil type, half of which will be surface-irrigated and the other half watered by rainers.

The main purpose of this experiment is to determine comparative cane yields and water saving, hence the economics of the two systems under local conditions. In order to follow the course of growth and maturity throughout the season, weekly data will be collected from sampling plots measuring approximately half an arpent in each experimental field. Other problems which will be studied include the effect of spray irrigation on decomposition of trash, spotted borer incidence, weed dissemination and application of fertilizers.

The experimental site has been equipped with a full range of meteorological instruments; variations in soil moisture will be followed by means of Bouyoucos cells and leaf sheath moisture determined at weekly intervals. It is hoped that these data will provide a practical means of determining the water requirements of the plant.

The necessary equipment was ordered or made available locally and include 2 pumping units of 750 gallons and 450 gallons g. p. m. capacity; 1100′ of 10″ and 3800′ of 6″ of asbestos-concrete piping and fittings for the permanent installation; 1600′ of 6″ aluminium piping for the portable system and 1500′ of 4″ aluminium piping to be used for both systems.

Most of the equipment has been received, and the experiment will start effectively towards

the end of January 1958. It is hoped that funds will be available to pursue these important investigations over a minimum period of three years.

FIELD EXPERIMENTATION

The programme of field experiments carried out in 1957 is outlined below. Many of these trials are designed to be harvested at three dates during the crop, while individual plots of all fertilizer trials are sampled three times during the growing season for leaf analysis.

Pre-release variety trials	54
Post release variety and fertilizer trials	14
Fertilization & amendments	
(i) Urea v/s Sulphate of Ammonia	8
(ii) Levels, form & placement of phosphate	24
(iii) High & low fertilization (demonstration)	1
(iv) Balanced v/s unbalanced fertilization (demonstration)	2
(v) Basalt on highly leached soils	2
(vi) Gypsum " " "	2
(vii) Bagasse on hydromorphic soils	2
(viii) Trace elements	2
(ix) Organic matter	15
Ratoon stunting disease	13
Chlorotic streak	4
Other diseases	5
Control of Clemora by insecticides	17
Weed control	5

Specialist sections of the Institute depend largely upon the field experimentation section for the execution of field trials. It is appropriate therefore to place on record the part played by the "anonymous worker" i.e. field officers and other assistants for the thoroughness with which they have carried out a fairly exacting programme in addition to such other duties as extension work and the running of experimental stations.

SUGAR MANUFACTURE

The prominent feature in the field of sugar manufacture during the year was the visit of Dr. H. W. Kerr, Director of the Queensland Sugar Research Institute, who kindly accepted the invitation of this Institute to spend two months in Mauritius during the crop season. The main object of Dr. Kerr's visit was to make recommendations on the desirability of expanding the activities of the Research Institute in Sugar Technology, in the light of conditions prevailing in Mauritius. As mentioned by the Chairman, Dr. Kerr's report is being studied by the Board, meanwhile, it is a pleasure to express our deep appreciation of his valuable advice and guidance in the fields of research and applied technology.

The performance of sugar factories in 1957 is discussed at length in the Sugar Technology section of this report (Synopsis of factory data, 1957), to which reference is invited. The activities of the section during the year are briefly summarized below.

Routine. The usual routine work comprised the compilation and circulation at weekly intervals of chemical control data during the crop; analysis of 2749 cane samples from experimental plots of the Institute; the running of so called "long tests" at factories to assess the quality of commercial cane varieties; the standardization of hydrometers, repairs to saccharimeters and setting of thermoregulators, the control of polarization and moisture of raw sugars from cargoes shipped to Japan.

Advisory work. On many occasions the collaboration and advice of the Sugar Technology section were sought by individual factories or corporate bodies. Amongst the problems studied, special mention should be made of the pollution of rivers and streams by sugar factory effluents; local refining of sugar; advice on milling train projects of two factories; the control of milling work through the use of Stuart's formula and of a new disintegrator; difficulties in juice clarification which were experienced more often in 1957; the installation of pH controllers; boiling house practice; chemical control, more particularly in relation to undetermined losses at two factories, froth fermentation in C Massecuites, and determinations of phosphate, lime and magnesia in juices.

Research. In spite of the heavy programme mentioned above two research projects were completed, while further information was obtained on several investigations started in 1956. Thus in collaboration with the National Committee for ICUMSA the study of the effect of lead either as a dry or wet reagent for clarification of sugar solutions was completed. As a result the Committee recommended that no correction should be applied to the polarization of Mauritius sugars when wet lead is used as a reagent. Subsequently it was agreed at a meeting of the British National Committee of ICUMSA and Commonwealth representatives held in London in May that wet lead should be used as a defecant and that under these conditions no correction should be applied to the polarization of raw cane sugars.

A large number of comparisons were made during the year on various types of centrifugal linings, the results of which are reported separately.

The comparisons started in 1956 between coil and calandria pans were continued during the year, and further work is planned in this connection for the next sugar crop.

Research projects initiated in 1957 include continuous diffusion, heat transfer coefficient of juice heaters, viscosity of molasses at different temperatures, comparison between actual true purity and minimum theoretical purity of molasses.

GENERAL

Meetings. The Research Advisory Committee held two meetings during the year, one of them jointly with the Executive Board.

Several meetings were arranged with the M. S. P. A. and the Central Committee of Estate managers to discuss island wide measures to be taken for the control of ratoon stunting disease.

Regional meetings were held in January and June at the Experimental stations. The first series of these meetings was devoted to a talk on the parasites of major sugarcane pests in Mauritius by Mr. A. Moutia, Associate Entomologist of the Department of Agriculture. On the second occasion Mr. D. H. Parish gave an outline of soil survey work, after which the stations were visited.

In April Messrs de Sornay and Mazery addressed the "Société de Technologie", on new cane varieties and the overhead irrigation of sugarcane.

At a joint meeting of the "Société Royale des Arts et Sciences" and the "Société de Technologie", the Director reviewed the work in progress at the Research Institute. This lecture was followed by a visit of the laboratories and station at Reduit.

The Institute organised in conjunction with the "Société de Technologie", two meetings in September at which Dr. H. W. Kerr lectured on the Milling of Cane and the Manufacture of Sugar.

Publications, Reports and Circulars :

Annual Report for 1956.

Bulletin : No. 7. Williams, J. R. 1957. The Sugarcane Delphacidae and their Natural enemies in Mauritius (extracted from Trans. R. ent. Soc. Lond. *109* (2) pp. 65-110).

No. 8. Mazery, G. 1957. Preliminary notes on Overhead Irrigation in Mauritius. (extracted from Rev. agric. Maurice 36 (5) pp. 231-240).

Antoine R. 1957. A Staining Technique for Detecting Ratoon Stunting Disease in Sugarcane. Nature (in press).

Antoine, R. 1957. Le Traitement des Boutures de cannes dans la lutte contre la maladie du rabougrissement des repousses. Rev. agric. Maurice *36* (1) pp. 31-38.

Parish, D. H. & Feillafé, S. M. 1957. Preliminary Notes on the Soil Survey of Mauritius. Rev. agric. Maurice *36* (6) pp. 287-291.

Private Circulation Reports:

No. 7. Antoine, R. & Williams, J. R. 1957. Fiji Disease in Madagascar. Progress Report 1957. Mimeo., 24 pp., 1 fig., 2 photos.

No. 8. St. Antoine, J. D. de R. de. 1957. Report on a mission to the United Kingdom May 1957. Mimeo., 18 pp. Appendix

No. 9. Kerr, H. W. 1957. Observations on Mauritius Sugar Factories. Mimeo., 11 pp. 2 Appendices, 2 figs.

Technical Circulars :

No. 6. Diagnostic Foliaire.

No. 7. La Maladie du Rabougrissement des Repousses. R. Antoine.

No. 8. Notes on Sugar Manufacture in Reunion. J. P. Lamusse.

Twenty bulletins on the evolution of the 1957 crop and mutual control data were circulated at weekly intervals.

STAFF MOVEMENTS

Messrs. G. Rouillard, Chief Agriculturist and F. Mayer, Field Officer, were absent on overseas leave from January to June. Whenever possible they visited agricultural research organisations in U. K. and France.

Mr. P. G. du Mée, Secretary, was also on overseas leave from April to October.

Messrs Antoine and Williams visited Madagascar in May in connection with Fiji disease of sugarcane.

During the same month Mr. J. D. de R. de St. Antoine attended the Conference of the ICUMSA and the 10th meeting of the "Commission Internationale Technique de Sucrerie" held in London.

Mr. D. H. Parish, Chemist, left the island on overseas leave in October. Arrangements have been made for him to spend six weeks in Hawaii on his return journey in 1958.

Mr. J. P. Lamusse, Assistant Sugar Technologist, spent one week in Réunion in November under the auspices of the Comité de Collaboration Agricole Maurice — Réunion — Madagascar.

Mr. E. Rochecouste, Botanist, visited Rodrigues at the request of Government to advise on weed control.

Finally the Director attended the 3rd Congress of the Pan Indian Ocean Scientific Association (PIOSA) held in Tananarive from the 24th October to 2nd November, and read a paper to the Agronomy section on behalf of Mr. Robert Antoine, pathologist, on the use of tetrazolium salt in the diagnosis of ratoon stunting disease. From the 6th to 13th November, the Director visited Réunion island with other Mauritius delegates for the Annual Conference of the Comité de Collaboration Agricole Maurice — Réunion — Madagascar.

In concluding these introductory notes to the Annual Report of the Research Institute I have once more the pleasure to express my gratitude to all members of the staff for their loyal collaboration during the year.

Director.

31st January, 1958.

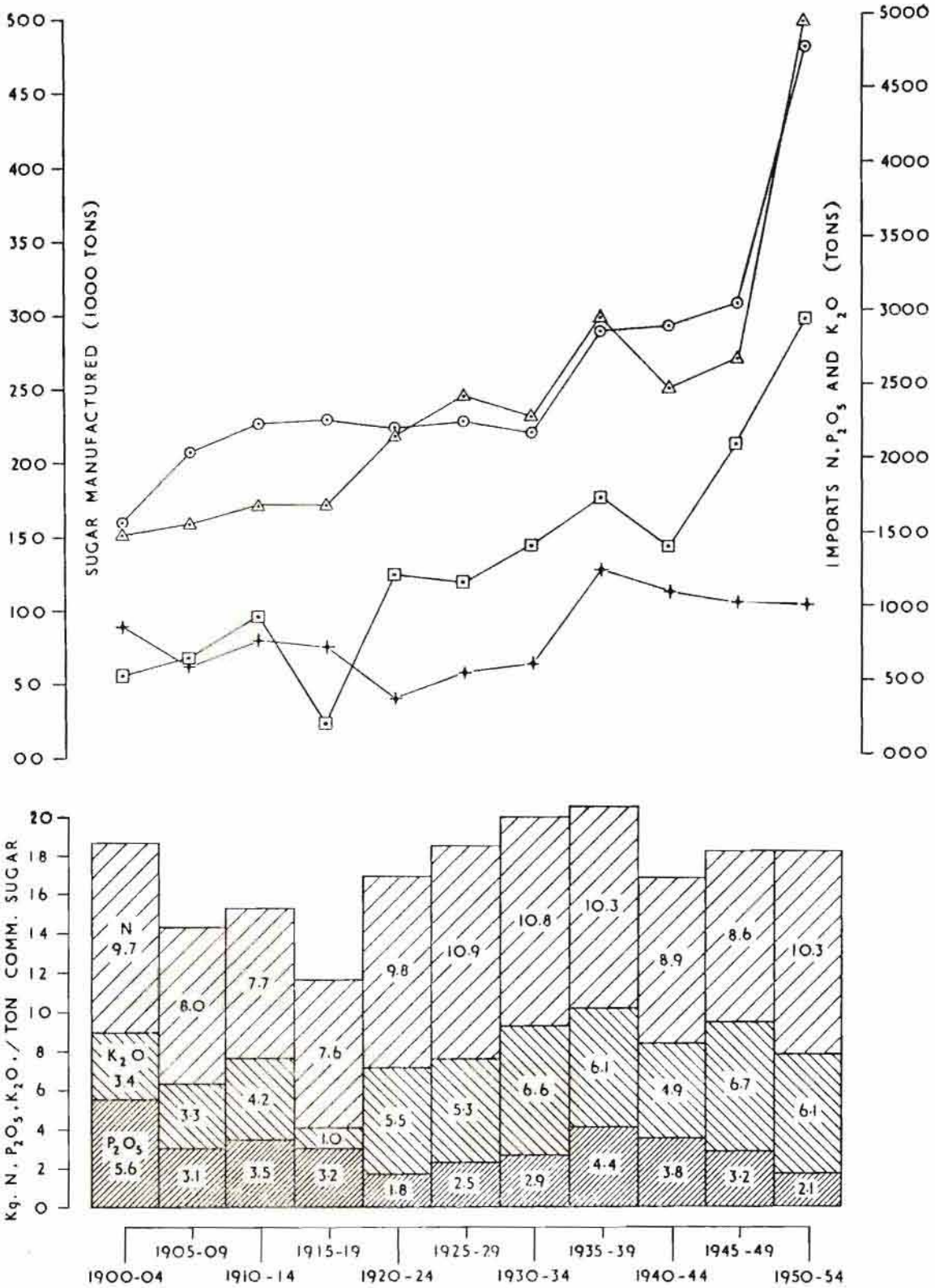

Fig. 10. Importation of fertilizers from 1900 to 1954 expressed as N (triangles) P (crosses) and K (squares). Sugar production is shown by circles. Columns indicate consumption of N PK in ks. per ton sugar produced.

TABLE 1. Important agricultural characteristics of

	M. 134/32 (1)	M. 112/34	M. 147/44	M. 31/45
Agricultural zone for optimum economic yields	Sub-humid to humid	Irrigated	Sub-humid humid irrigated areas	Sub-humid to super-humid
Habit	Semi-erect	Erect	Lodges, tends to produce side shoots	Semi-erect, tends to produce side shoots
Ratooning capacity	Very good	Very good	Excellent	Excellent
Stalk diameter	Medium (3 —4 cms)	Medium	Thin	Thick
Arrowing	Medium	Medium	Low	Shy arrower
Trash	Free trashing	Free trashing	Clinging	Free trashing
Sucrose content	High	Very high	High	High
Maturity	Medium to late	Early to medium	Early to medium	Medium to late
Response to Nitrogen	Ratoons: 40—50 kg. N per arpt for average yields of 30 tons	Not determined	Being determined	Being determined
Fibre	Low	Low	Medium	Medium
Resistance to Drought	Very resistant	Susceptible	Very resistant	Resistant
Resistance to Ratoon Stunting Disease	Highly susceptible	Susceptible	Susceptible	Susceptible
Resistance to Chlorotic Streak	Susceptible	Highly susceptible	Highly susceptible	Moderately susceptible
Resistance to spotted borer (*Proceras sacchariphagus*)	Moderately resistant	Moderately resistant	Moderately resistant	Susceptible

(1) This variety is now declining because of its inferior performance.

(2) Indifferent performance in all regions.

major commercial cane varieties cultivated in 1957.

Ebène 1/37	B. 3337	B. 34104	B. 37161 (2)	B. 37172
Humid and super-humid	Subhumid to superhumid but recommended for sub-normal conditions.	Sub-humid to humid	Humid	Sub-humid, humid, irrigated areas
Semi-erect	Erect	Semi-erect, tends to produce side shoots	Lodges	Erect
Good	Excellent	Good	Medium	Excellent
Thick	Thin	Thin	Thick	Thin
Medium	Shy arrower	Free arrower	Low	Low
Free trashing	Clinging	Free trashing	Free trashing	Free trashing
Very high	Low	High	High	High
Satisfactory at all seasons	Medium to late	Early to medium	Early to medium	Satisfactory at all seasons
Similar to M. 134/32	Much better response than M. 134/32	Similar to M. 134/32	Similar to M. 134/32	Better response than M. 134/32
Low	Very high	Medium	Medium	High
Very susceptible	Very resistant	Resistant	Resistant	Very resistant
Highly resistant	Highly susceptible	Moderately resistant	Moderately resistant	Highly susceptible
Highly susceptible	Susceptible	Moderately susceptible	Moderately susceptible	Highly susceptible
Moderately susceptible	Moderately resistant	Average	Moderately susceptible	Moderately resistant

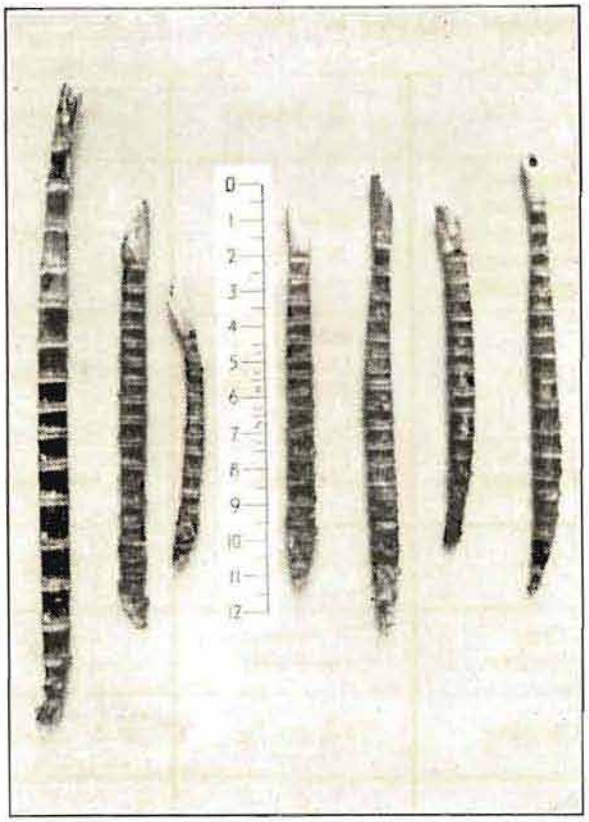

Fig. 11. Random sample of M. 134/32 stalks affected by drought in coastal regions of the north. These canes were collected at the factory yard, and came from a field which produced less than 2 tons per arpent.

Fig. 12. In February, a tornado moving along an approximate SE - NW course caused havoc over a narrow strip of cane lands at Savannah and Benarès Estates. This field of Ebène 1/37 was photographed the following day.

CANE BREEDING

A. de SORNAY

1. ARROWING

As in 1956, intensity of arrowing was estimated from data collected by estates of the five sectors of the island. The method of sampling fields for arrow counts was the same as the one adopted previously. Twenty estates out of 27 replied to the questionnaire, so that the figures summarised in Table 2 are accurate enough for all practical purposes.

Table 2. Arrowing in 1957.

Sector	Arrows %			
	Virgins		Ratoons	Average
	Long season	Short season		
	M. 134/32			
North	13.5	6.1	11.2	10.9
South	6.0	5.6	12.0	11.5
East	6.6	1.3	7.0	6.8
West	—	—	5.2	5.2
Centre	—	—	1.3	1.3
Average	9.4	5.6	9.5	9.3
	Ebène 1/37			
South	13.7	1.1	13.9	12.8
East	12.9	2.7	13.6	12.7
Centre	4.7	2.3	6.1	4.9
Average	10.9	1.8	11.6	10.1

Arrowing was therefore less pronounced than in 1956, the averages for M. 134/32 and Ebène 1/37 being 9.3 and 10.1%, as against 22.5 and 13.1% respectively in 1956. Long season virgins flowered more than short-season canes, while ratoons showed a higher rate of tasseling than virgins in general, these data being correlated with those of the previous year. Again, except for the western sector, arrowing intensity appears to decrease from the coastal regions to the uplands. The relatively lower flowering in the west may be due to a better control of cane growth by irrigation.

The data of the effect of harvesting period on arrow percentage for the period August — November show once more a nearly linear relationship, but the slopes of the regression lines are somewhat different in 1957. When the figures for the years 1956 and 1957 are combined together and plotted, the graphs obtained are illustrated in Fig. 13. Rate of flowering as a function of age appears greater in M. 134/32 than in Ebène 1/37, probably because of the higher growth rate of the latter variety. The effectiveness of the normal photoperiod conducive to arrowing thus appears to depend on the age of the plant, and tends to substantiate the theory postulated by Klebs*, that a plant must have gone through the stage of ripeness-to-flower before flowering can occur.

Arrowing figures for July and December are as yet too scanty for inclusion in Fig. 13, and will be considered when those covering more years become available. It will be interesting to determine whether these months will make any real difference in the order of magnitude of flowering rates, so that a better picture for the whole crop season may be obtained.

* KLEBS, G. S.B. Heidelberg Akad. Wiss., Abt. B., 1913, 3, 47. as quoted by Meirion Thomas Plant Physiology, 4th Edition, 1956.

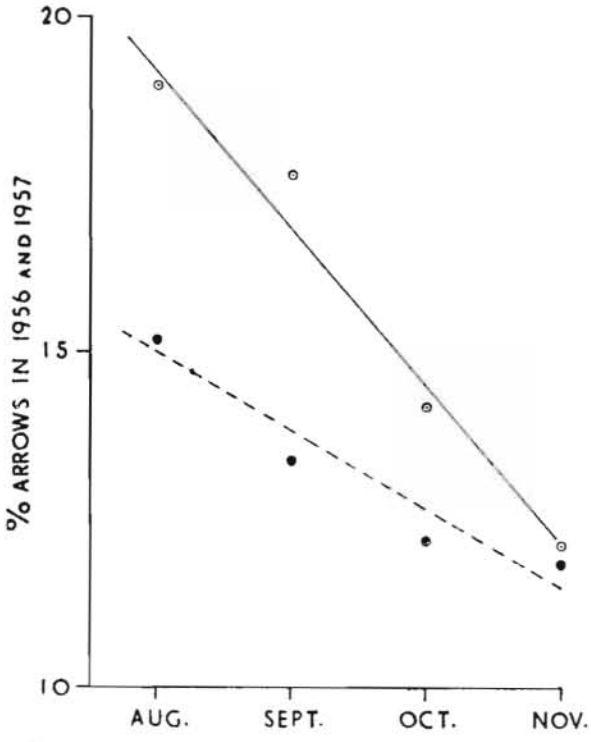

Fig. 13. Relationship between arrowing in ratoon canes and date of reaping. Plain line: M. 134/32; broken line: Ebène 1/37.

As observed previously the cane flowered a little more in the border than in the middle of fields, the difference in arrowing intensity, although small, being, in all probability, significant, large cane samples being dealt with.

Apart from M. 134/32 and Ebène 1/37, other commercial varieties were included in the survey, but their tasseling percentages cannot be given in Table 2, having been estimated from a much smaller number of canes. They are as follows:

Variety	*Arrows %*
M. 112/34	17
M. 147/44	10
M. 31/45	< 1
B. 3337	< 1
B. 34104	15
B. 37161	4
B. 37172	< 1

The above figures confirm field observations made during the past years, namely, that, except B. 34104, the Barbados varieties flower little, and M. 31/45 is also a shy arrower.

2. CROSSING

Although climatic conditions have not been conducive to arrowing in 1957, cross-pollination could be carried out as contemplated, except for a few crosses which could not be attempted due to a disparity in the times of flowering of the parent varieties.

Crosses made at Réduit and Pamplemousses numbered 305, as compared to 390 in 1956 (see Table 3 and Table XIII of Appendix).

The breeding policy centered on the production of improved varieties, particularly for higher sugar content, and of hybrid varieties adapted to sub-normal environment. The various lines of approach to try to bring this policy to a successful end may be summarised as follows:

(a) Bi-parental crosses between promissing parents, home-bred and imported, of commercial and near commercial status, and others.

These crosses comprise, as a side-line, successive matings to the richest parent varieties available to try to increase the frequency of genes conducive to high early sugar. As the inheritance of sucrose like that of many other quantitative traits is probably polygenic, and the genes cummulative in their effect, recombinations giving even richer progeny can be hoped for. Naturally this process will be coupled with that of selection so as to preserve other qualities in the varieties to be synthetised.

(b) Diversification of blood lines, and the breeding of complex hybrids. Some success had already been achieved by this method in the breeding of the varieties M. 147/44 and M. 31/45.

(c) Bi-parental crosses between specific parents exhibiting contrasted pairs of commercial qualities such as heterotic vigour and high sugar, followed by sib-crosses, selfing of selected members of the progeny from these, and back crossing the selfs to the original parents.

(d) Inbreeding : crossing between themselves varieties involving the same blood lines obtained by certain of the previous methods, so as to try to concentrate favourable genes in the same clones.

Following the policy implemented some years ago to introduce new varieties from abroad to provide primarily a broader basis of germ plasm for hybridization, new parental types were available for crossing purposes, namely Co. 779, P. R. 1000, Q. 44 and N : Co. 310, all of which exhibited male sterility at Réduit, and were therefore used as pistilate parents in successive rounds of matings to test as quickly as possible their potential value in breeding. New locally bred parents were Ebène 1/44 and M. 202/46, the former producing no pollen, and the latter being a fairly prolific male. Thus the cross-pollination work continues to suffer from a dearth of strong male parent varieties, while females are abundant. As a result, M. 147/44 had to be used on a larger scale than intended.

Some ten B.H. 10/12 canes showed advanced signs of arrowing in the propagation plot at California Estate, but arrows from only three of these canes could be used in crossing. Some of the canes reverted to the vegetative state and gave rise to the " bunch top " condition. The remainder of the arrows did not protrude at all because of side shoot production. Lantern crosses were made on the spot with Ebène 1/37 and M. 147/44 as male parents.

Sib-crosses have been carried out between selected seedlings of the progeny of the following crosses :

Cross	*Number of crosses*	*No. of seedlings obtained*
B.34104 x M.63/39	1	0
Ebène 1/37 x M.63/39	2	17
" " x M.147/44	1	0
M.134/32 x Ebène 1/37	1	0
" x M 147/44	1	15
M.112/34 x M.63/39	1	0
" x M.147/44	2	370
M.168/53 x M.167/53	2	0

The 402 seedlings from the above sib-crosses have been planted in a separate plot at Pamplemousses for a detailed study in first ratoon in 1959.

The cross M. 112/34 x *Coix lachryma jobi* was made at Réduit with the view to inducing parthenogenesis in the female component, but it failed to produce seedlings. It was thought advisable to use as female a variety producing no pollen at all instead of using a male variety emasculated by the method described at the 9th I.S.S.C.T. Congress. A plot of *Coix lachryma jobi* has been planted at Réduit so that plenty of pollen of this plant may be available for crossing in 1958.

Maleic hydrazide to control flowering was used for the second time, and again gave varying results. This chemical was sprayed on the leaves at the usual rate at the beginning of March, weather conditions being very favourable. It reduced and delayed arrowing in P.O.J. 2878, P.O.J. 2940, Co. 290 (retardation very pronounced) and M. 213/40. The other treated male varieties at Richelieu did not flower at all even in the untreated rows. At Réduit maleic hydrazide had no effect on Co. 421, a very early flowerer, while at Pamplemousses a row of this cane did not respond to the treatment as it had made poor growth through interaction with the neighbouring stronger varieties.

Selfings : Ten arrows from a selfed clone of *Saccharum spontaneum* (Glagah Passoeroean) were selfed and yielded no seedlings. This is the second case of a selfed Glagah seedling proving sterile and giving no F 2 generation. It may be, therefore, that successive selfing leads to complete sterility in so far as the Glagah clones are concerned.

M. 147/44 and Ebène 1/37 were also selfed (one arrow of each) and gave three and zero seedlings respectively. This confirms the view already expressed that, except in the Glagah clones, selfings produce very few or no seedlings in general, and may prove a bar to the success of diallel crossing.

The seed-bearing fuzz was more fertile than in 1956, particularly at Pamplemousses where 29,543 seedlings have been raised from 151 crosses, or nearly 250 seedlings per cross, as against 70 per cross at Réduit. Many experimental crosses gave no seedlings at all, but they will have to be repeated over the years before they can definitely be eliminated from the crossing programme.

The soil used for planting the fuzz was sterilized by means of the equipment described in the 1956 Report. Practically no case of damping-off occured, and the seed pans were generally free of weeds.

Seedlings were transplanted in the field in November and December. All the seedlings at Union Park and Belle Rive were planted singly, while at Réduit and Pamplemousses bunch planting was carried out on a small scale, as the method does not appear promising because of the uncertainty of selecting high-sucrose stalks from the bunch stools.

A summary of the breeding work in 1957 is given in Table 3, and crosses made are listed in alphabetical order in Table XIII of the Appendix.

Table 3. Summary of Breeding Work in 1957.

Experiment Stations	Number of crosses made	Number of seedlings obtained	Number of seedlings transplanted		
			Single	Bunch	Total
Réduit	154	10,932	9,723	2,200	11,923
Pamplemousses	151	29,543	8,977	2,360	11,337
Belle Rive	—	—	5,853	—	5,853
Union Park	—	—	6,184	—	6,184
Total	305	40,475	30,737	4,560	35,297

Fuzz from a number of crosses stored at low temperature will be sown at different periods in 1958 to provide more seeldings for studying the best planting month under super-humid conditions.

3. SELECTION

429 seedlings of the M./55 series have been selected from first ratoon populations and planted in propagation plots at the Experimental Stations. The layout of these plots allows of a fair comparison between the selections and the standard varieties in respect of Brix and vigour of growth, so that a second selection will be performed prior to planting first selection trials in 1958. The figures in Table 4 show how it is necessary to select again from the propagation plot prior to establishing first selection trials.

First selection trials were selected in second ratoon in September, and 44 varieties retained and multiplied at the Experiment Stations prior to testing in variety trials on estates in 1958.

A curious looking seedling of the 1953 series

Table 4. Percentage selection in propagation plots.

Station	Number of varieties in propagation plots	Number of varieties selected	%
Réduit	359	63	18
Pamplemousses	128	35	27
Belle Rive	180	56	31
Union Park	79	35	43
	746	189	25

was selected in 1955 and numbered M. 211/53. It is illustrated in Fig. 14 and was planted in the variety collections at Réduit and Pamplemousses. It has thin stalks, narrow and short leaves, and morphologically appears to be derived from an intergeneric cross between sugarcane and either maize or sorghum.

This variety comes from the cross B. 37161 x Ebène 1/37. A second seedling of similar appearance bred from the cross M. 241/40 x P.O.J. 3016 was found this year. An examination of the genealogy of these varieties shows that they are very likely cases of a reversion to the original Chunnee type, one of their ancestors.

Fig. 14. M. 211/53, a curious looking variety derived from the cross B. 37161 x Ebène 1/37.

4. PRE-RELEASE VARIETY TRIALS

Eleven trials have been planted on estates during the year, their distribution being as follows:

Super-humid zone	4
Humid zone	6
Sub-humid zone (irrigated)	1

The experiment at Trianon (Réunion S.E.) suffered badly from drought and had to be abandoned. As it includes varieties such as H. 37–1933, Ebène 5/40, 24/42 and 50/47, in addition to two promising M varieties, it will be replanted on the same estate in 1958.

The varieties under test in the above mentioned trials comprise many home-bred canes and the foreign varieties B. 41227, N: Co. 310, P. R. 1000 and Q. 44. The varieties M.202/46, M.93/48 and M.253/48 which show considerable promise, have been planted in several of these trials. The standards are: M. 134/32, M. 147/44, M. 31/45 and Ebène 1/37.

Forty-four trials have been harvested in 1957. The results of those including M. 147/44 and M. 31/45 are summarized in Table 5, the data obtained being sufficiently comprehensive for the various climatic zones to be considered separately.

The following main conclusions emerge from the results of these trials repeated over localities and years and reaped in ratcons. The varietal survey carried out on representative estates in 1957 to obtain some idea of the field performance of M. 147/44 and M. 31/45, in comparison with the standard varieties, substantiate these conclusions.

M. 147/44. There is now a sufficiency of data for an appraisal of the potentialities of this variety for commercial growing in the various agro-ecological areas of the colony, except in the super-humid zone where its performance relative to M. 134/32 cannot be a criterion of its suitability for cultivation in these localities due to the regression of the latter variety.

M. 147/44 appears remarkably adapted to the warm irrigated regions of the West where it has led the standard by wide margins because of its high tonnages coupled with a higher sugar content. It is already gaining in impetus in these regions, and is likely to make further inroads into the plantings. In the humid zone too, it proved superior to M. 134/32 owing to its better ratooning capacity. In the drier localities for which, naturally, yield figures do not loom as large as for the humid zone, M. 147/44 appears to be able to yield more cane and sugar per arpent than M. 134/32. It is giving a good account of itself on the black soils of the Black River district.

When M. 147/44 is compared to Ebène 1/37 in the wetter localities, its value for

Table 5. Summarized performance of M. 144/47 and M. 31/45 in ratoons in variety trials.

Varieties	Tons cane/arpent				C. C. S. % canne				C. C. S. per arpent			
	Sub humid	Humid	Super humid	Irrigated	Sub humid	Humid	Super humid	Irrigated	Sub humid	Humid	Super humid	Irrigated
M. 147/44	32.3	39.5	—	39.9	14.9	16.1	—	15.4	4.84	6.37	—	16.15
M. 134/32	28.2	32.6	—	28.7	14.9	16.1	—	15.1	4.26	5.35	—	4.35
Diff.	+4.1	+6.9	—	+11.2	0.0	0.0	—	+0.3	+0.58	+1.02	—	+1.80
Sign. Diff.	5.7	1.9	—	4.5	—	—	—	—	0.84	0.31	—	0.68
M. 31/45	31.1	39.2	—	33.2	15.0	15.4	—	15.0	4.67	6.05	—	4.96
M. 134/32	28.1	32.2	—	28.1	15.0	15.3	—	15.5	4.26	4.94	—	4.36
Diff.	+3.0	+7.0	—	+5.1	0.0	+0.1	—	—0.5	0.41	+1.11	—	+0.60
Sign. Diff.	5.9	2.8	—	4.5	—	—	—	—	0.88	0.43	—	0.68
M. 31/45	—	—	30.8	—	—	—	14.9	—	—	—	4.59	—
Ebène 1/37	—	—	29.2	—	—	—	15.5	—	—	—	4.53	—
Diff.	—	—	+1.6	—	—	—	—0.6	—	—	—	+0.06	—
Sign. Diff.	—	—	3.1	—	—	—	—	—	—	—	0.47	—

cultivation in such localities cannot be assessed due to too meagre data, but there is little doubt that, although it may yield as well as Ebène, the latter variety is the more economical of the two.

M. 31/45. In the humid localities where this cane appears in many trials, it has proved better than M. 134/32 especially in yield of sugar p. a. Data for the low rainfall areas tend to indicate that M. 31/45 is capable of doing better than M. 134/32 in these regions as well.

For reasons already given, it is unnecessary to compare M. 31/45 to M. 134/32 in the super-humid zone. Its performance relative to Ebène 1/37 in eighteen tests in this zone shows that, in general, its yields of cane is nearly on a par with that of Ebène 1/37, but that its sugar content is lower than that of Ebène 1/37, and runs the gamut from average to high values.

As already mentioned, a varietal survey was carried out on some estates to obtain data of the field performance of M. 147/44 and M. 31/45 under estate conditions. These data are generally in agreement with experimental results. Stress should, however, be laid on the fact that the newly released varieties are mostly in the multiplication stage, and that productive figures in ratoons are still lacking.

Milling tests were carried out and despite their obvious shortcomings, due particularly to their low number and to the natural field-to-field variation on estates, their results, on the whole, bear out those of variety trials.

The rate of ripening of M. 147/44 and M. 31/45 relative to M. 134/32, a medium maturer, is given in Table 6 hereunder.

These figures confirm those obtained up to 1956, but are more accurate because of the higher number of tests particularly in ratoon.

It is generally admitted that the coincidence of a very favourable season enhances the value of cane varieties. The period during which the above varieties have been tested includes two excellent maturation years with sugar % cane at record heights. But do all varieties benefit in the same proportion? In other words, is the interaction variety — years

Table 6. Maturity behaviour of M. 147/44 and M. 31/45 as compared to M. 134/32.

Variety	JULY-AUGUST		SEPTEMBER-OCT.		NOVEMBER-DECEMBER	
	No. of harvests	C. C. S.	No. of harvests	C. C. S.	No. of harvests	C. C. S.
M. 147/44	33	+ 0.5	46	— 0.3	29	— 0.2
M. 31/45	46	— 0.1	67	+ 0.2	34	0.0

the same for all varieties? If not, abnormal conditions acting in a positive or negative way may render the interpretation of experimental results more complicated. There is, it will be noted, some discrepancy in the order of magnitude of the maturity figures up to 1955 and up to 1957, which may be due partly, to the differential effect of climate on maturation in different varieties and partly to insufficiency of data up to the end of 1955. However, the main conclusion is that M. 147/44 is very probably an early maturing variety while M. 31/45 is a mid-season cane.

M. 129/43. The results of experiments harvested in 1957 bear out those obtained the previous year, that there is no difference in yields of cane and sugar between this variety and M. 134/32 in the sub-humid and humid zones of this island. On the irrigated lands M. 129/43 has beaten the standard by a small margin, but it is outclassed by M. 147/44 which, in all probability, promises to be a major cane on these lands.

In view of these results it is not considered worth while to recommend M. 129/43 for release.

White and Striped Sports of M. 134/32. The results of tests in ratoons (10 for the white sport and 6 for the striped sport) do not reveal up to now an appreciable difference in yields of cane and sugar from the standard red variety. It is possible that with a much larger body of data this small difference will become significant, but this appears rather doubtful. All three varieties have flowered to the same extent in variety trials.

Other varieties: The following varieties stand as candidates for testing in several pre-release trials under diversified conditions.

M. 202/46 gave promising results compared to Ebène 1/37 at Bagatelle Estate (80'' rainfall), and now appears in six trials laid down in representative climatic zones. It is of the same parentage as M. 147/44.

M. 93/48 performed extremely well in an experiment of the super-humid area and was superior to B. 3337, the control variety, so that it has been decided to include it in several trials under varying conditions. Its sugar content is high but, unfortunately, it appears to germinate unsatisfactorily.

M. 253/48 has given a good account of itself under irrigation at Médine compared to M. 134/32 and has also been planted in other trials.

M. 305/49 outclassed Ebène 1/37 at Riche-en-Eau and has been multiplied so that more trials including it may be laid down in 1958.

Ebène 1/44 also appears promising and has already been planted in four trials repeated over locations.

Planting material of M. 202/46, M. 93/48 and M. 253/48 has been distributed to estates and the Extension Service of the Department of Agriculture for propagation on a small scale. The field data obtained under estate conditions might prove a useful adjunct to those from variety trials, and help in arriving at a better verdict of their suitability for release.

5. IMPORT AND EXPORT OF CANE POLLEN AND CUTTINGS.

Three new varieties have been introduced from U.S.A. in October and planted in the quarantine glasshouse : B. 39246, C. L. 41—70 and C. P. 1. They are immune to ratoon stunting disease and will be used as parents in crossing with the view to incorporating this quality in the progeny.

The varieties imported in 1956 have been released from quarantine at the end of the year, except 30 M. Q. 985 which showed poor growth and will be further studied. Difficulties in obtaining good planting material were encountered in the quarantine glasshouse in the case of the two generations because of side — shoot production. No such difficulties were experienced with previous importations. As most of the varieties in quarantine showed sprouted buds, many of which had developed into lateral shoots, it is believed that there must be a common cause for this phenomenon, which is under investigation. Cultivation methods have remained unchanged in the glasshouse, except that the cane introduced in 1956 have been planted in smaller tubs so that more varieties may be quarantined. An experiment is now in progress to test the effect of planting canes in small versus large containers of standard size in the greenhouse.

Of the varieties introduced in 1954, four, namely, Q. 44, P.R. 1000, H. 37-1933 and N : Co. 310 have already been planted in trials. Other varieties from the same consignment likely to be tested are Q. 47 and B. 4362 of which there will be a sufficiency of cuttings in 1958.

Planting material has been sent to the following countries in 1957 : South Africa, England, Madagascar, Equatorial French Africa Réunion, Kenya, Scotland and Argentina

A sample of sugarcane pollen was despatched by air freight to Dr. A.W. Frankland, Wright-Fleming Institute, St. Mary's Hospital, London, where pollens of the Gramineae are being investigated using gel diffusion methods to study related and specific antigenic components.

6. INDUCTION OF ARROWING

R. P. 8 and B. H. 10/12 canes were marcotted and planted in tins after adequate root production. An aqueous extract of young leaves of freely arrowing varieties was prepared by crushing the leaves in a mortar and adding a little water. The liquid was decanted and administered to the canes by dipping the exposed midribs of leaves, from which the lamina had been removed, into the extract contained in small test tubes suspended to the canes near the growing point. Operations commenced at the end of February and and were repeated at weekly intervals until the middle of March. Neither variety responded to the treatment.

As already mentioned, ten B. H. 10/12 canes showed advanced signs of arrowing at California, three of which were used in crossing. Only one cane flowered at Luchon (St. Félix) but was not used.

7. RATOONING CAPACITY OF NEW VARIETIES

One of the experiments at Pamplemousses for rapidly assessing the ratooning potential of new varieties by growing 3-4 months ratoons, was kept in 7th ratoon and reaped when ten months old, the results being appended in Table 7.

Except for M. 171/30, which has consistently given low yields, and M. 134/32, it would appear that cutting the canes at short intervals has had little effect on the final yield of a ratoon crop of nearly normal age. The cuttings used in this experiment had been treated against ratoon stunting disease, so that the lower yields of M. 134/32 may be due to a loss of stamina and not to R.S.D. The Brix values of all five varieties appear quite normal.

As already reported the traumatic treatment induces high tiller formation, and all plots, particularly those of M. 147/44, consisted of an

Table 7. Results of Pamplemousses Trial in 7th ratoons.

	M. 171/30	M. 134/32	M. 129/43	M. 147/44	M. 31/45
Tons cane per arpent	13.6	15.9	23.3	27.9	24.0
Brix	22.4	22.9	22.8	23.4	23.4

unusually large number of thin stalks.

The trial at Belle Rive had to be discontinued, the varieties M. 171/30, 134/32 and 129/43 having disappeared in nearly all the plots. Could not these results indicate the capacity to survive under such drastic conditions in a sub-normal environment?

At Union Park, however, there was little mortality in these varieties, and in fifth ratoon the yield of M. 147/44 and 31/45 was far better than those of M. 171/30, 134/32 and 129/43.

At Réduit, the results in 4th, 5th and 6th ratoons showed that M. 147/44 and 31/45 are capable of outclassing M. 134/32 in old ratoons.

The results of five trials in many ratoons are now available. Taking a broad view of these results, and not laying too much emphasis on the order of magnitude of the yields of the different varieties, they show good correlation with those obtained in variety trials.

It has already been pointed out that harvesting ratoons at short time intervals has little effect on the yield of the last ratoon crop of normal duration. The routine practice at the Experimental Stations consists in reaping young plant cane seedlings and selecting from the ratoon populations the following year. Up to now there has been no indication that cutting the virgin canes at an early stage has had any effect on the yield of the subsequent ratoon crop. Since the virgin crop is of relatively little importance in Mauritius nowadays, 85% of the canes handled by the factories being derived from ratoons, it has been decided to cut the plant canes in first selection trials a few months after planting and to reap the first ratoons the following year, thus saving one year and excluding data for the virgin crop.

Two more ratooning capacity trials were laid down during the year, one at Pamplemousses to assess the ratooning power of Ms. 202/46, 93/48, and 253/48 in comparison with M. 147/44 under irrigation, and the other at Magenta to test Ms. 147/44 and 31/45 against M. 134/32 and B. 37161. As far as the writer is aware, all the cane varieties cultivated on the black soils of Magenta have displayed low ratooning capacity. It is, therefore, of great importance to gauge the value of the newly released varieties for cultivation in old ratoons on these black soils. Field data obtained from different localities of the Black River district have already given some indication that M. 147/44 seems to be adapted to these soils and may crop well in third ratoons onwards.

8. SAMPLING EXPERIMENTS

Research on the methods of sampling cane for sugar analysis was initiated in 1956 and continued in 1957. Experiments have been designed to give information on: (a) stool versus random stalk sampling; (b) number of stalks to be taken per plot to give a representative sample; (c) whether fractions of canes can be used as a substitute for whole canes in analysis.

Of these only (a) and (c) could be started, and the data obtained, although preliminary, warrant a summary in this report.

Stool versus random sampling: Ten-stalk samples were taken at random from an area equivalent to a plot of a variety trial consisting of two experimental rows of 30 ft. Ten canes were taken from a single stool chosen at random from the same plot. The sampling was repeated until 20 to 25 pairs of 10-stalks samples from different plots were obtained for analysis. The analytical results are summarized in Table 8.

Table 8. Analysis figures of 10—stalk samples from whole stools and random stalks.

Variety	Date of analysis	Sampling method	Brix		Fibre		C. C. S.	
			Mean	C. V.*	Mean	C. V.	Mean	C. V.
B. 3337	9.12.57	Whole stools	20.20	4.2	13.93	11.3	15.62	3.5
		Random stalks	20.30	2.8	13.94	10.1	15.78	5.0
		Significant difference †	0.48		0.96		1.97	
M. 134/32	26.11.56	Whole stools	21.78	2.8	10.42	10.7	17.64	4.5
		Random stalks	21.65	1.9	10.17	12.9	17.46	3.9
		Significant difference	0.30		0.67		0.40	
Ebène 1/37	19.10.57	Whole stools	22.78	2.3	9.07	11.4	18.95	3.2
		Random stalks	22.52	0.5	8.93	9.1	18.65	1.9
		Significant difference	0.29		0.58		0.32	

† *At the 5% level* * *C. V. = Coefficient of variation.*

There is thus no significant difference between the mean Brix, fibre and C. C. S. values for each pair of the above sets of figures. The coefficients of variation of the Brix and C. C. S. are low but a little higher in the case of fibre. The experiments have all been made towards the end of the crushing season, so that higher coefficients may be obtained at the beginning and middle of the crop period. It must be pointed out that the above data show that the coefficient of variation is generally lower for the random stalk samples, particularly that of the Brix, although, perhaps, not significantly so.

It appears, therefore, that the method of sampling canes for analysis from variety trials used by the Institute, and consisting in taking either 30 canes at random from a plot or six bundles of five canes each at approximately equal intervals along the row, is sound. The sample of 30 canes is finally reduced to one equivalent to 10 canes made up of 10 tops, 10 middles and 10 bottoms from different stalks.

Despite the above results, the writer is inclined to believe that stalk sampling is probably better than stool sampling, as the latter may not, in certain cases allow for variation between stalks due to variation in plot fertility. Moreover, random sampling allows for both variation between and within stools, since by taking 30 canes at random from an experimental plot, the odds are very likely that all types of stalks will be represented in the composite sample. In experiments of this kind, one is confronted with the question of whether the data obtained are the consequence of some other cause of variation which may not have been recognized and which may, therefore, confuse the issue in some cases. It is hoped that by replicating the experiments in locations and periods, using different varieties, they may be carried to a more logical conclusion.

Dividing canes into tops, middles and bottoms. Ten 15-stalk samples were divided into three portions of nearly equal length, and each sample of fifteen tops (T),

middles (M) and bottoms (B) analysed separately with the object of determining whether the middle thirds are representative of the entire canes. The data obtained are appended in Table 9.

The ratio of the mean Brix, mean fibre and mean C. C. S. of whole canes (that is the average of tops, middles and bottoms) to that of the middles is remarkably constant for the ten samples of each variety, particularly the ratio of the Brix and C. C. S. The slight variation in the ratio in the case of fibre % cane is, in all probability, due to analytical errors arising from sampling. The mean ratios and their coefficient of variation (for M. 134/32 and M. 147/44), are given in Table 10.

Table 9. Brix, fibre and C.C.S. values for Top, Middle and Bottom thirds of cane stalks.

Variety	Date of analysis	Brix			Fibre			C. C. S.		
		T	M	B	T	M	B	T	M	B
M. 147/44	4.12.56	11.68	18.31	19.83	9.2	10.4	10.9	6.9	15.3	16.8
M. 134/32	10.7.57	16.59	19.60	20.43	8.8	9.4	10.1	10.4	15.5	16.8
Ebène 1/37	11.11.57	22.64	24.46	23.98	9.8	10.3	11.7	17.8	20.5	19.7
M. 112/34	4.12.57	19.62	22.56	22.68	10.0	10.0	11.2	14.9	19.1	19.1

When the different varieties are compared, it is found that, except for M. 147/44, the ratios are nearly the same although the different varieties have been analysed at different periods. The lower ratios for Brix, fibre and C. C. S. obtained with M. 147/44 may be due to the fact that very young immature canes, which looked rather abnormal in growth, have been analysed right at the end of the season.

Table 10.— Ratio of mean Brix, fibre and C. C. S. of whole canes to Brix, fibre and C. C. S. of middle portions.

Variety	Brix		Fibre		C. C. S.	
	Ratio	C. V.	Ratio	C. V.	Ratio	C. V.
M. 147/44	0.90	1.1	1.08	0.9	0.85	3.5
M. 134/32	0.96	2.1	1.00	3.7	0.91	2.2
Ebène 1/37	0.96	—	1.00	—	0.94	—
M. 112/34	0.96	—	1.04	—	0.93	—

Chance alone could not explain adequately the above results, but, needless to emphasize, it is necessary to repeat the experiments with other varieties particularly at the beginning of the crop when canes usually display higher Brix or C. C. S. gradients, these gradients being probably different in different varieties.

Should the ratios be constant, middle portions, 30 in number, equivalent to 30 canes from the analysis standpoint, but equivalent to only 10 canes for shredding, could be sampled for analysis. Futhermore, the error of the C. C S. would be reduced in the proportion of 1 ; $\sqrt{3}$ supposing ten entire stalks be taken for analysis. The reduction in error would, of course, be less if the sample consists of 10 tops, 10 middles and 10 bottoms from different canes. A satisfactory solution, therefore, would

be to take for analysis as many as 40 to 50 middle portions of stalks.

The method could be applied to seedling selection. A number of middle portions of stalks equal to the number of tillers per stool, or less if the number of tillers is too high, would be sampled per seedling and the C.C.S. determined.

Fig. 15. Field day at Belle Rive Experiment Station - June 1957.

NUTRITION AND SOILS

1. THE COMPOSITION OF CANE JUICE

D. H. PARISH

III. A STUDY OF THE ORGANIC ACID CONSTITUENTS OF JUICE*.

A wide variety of aliphatic and aromatic organic acids are contained in plants and one group, known simply as the plant acids, is widely distr buted and important physiologically. These organic acids constitute a variable but always significant proportion of the total soluble nonsugars of sugar cane and are responsible for most of the titratable acidity of the juice.

The best known of these plant constituents are malic, citric, succinic, tartaric and oxalic acids. Less well known are isocitric and aconitic acids. Most of these acids are present in low concentrations in plants as normal metabolic products; however, certain plants have high concentrations of individual acids, thus the sugar cane has an unusually high concentration of aconitic acid. This acid is widely distributed in nature but does not occur in appreciable quantities as frequently as does citric acid to which it is chemically closely related.

Although the occurrence of organic acids has been known for many years, the function of these compounds in the plant was only clarified after the work of Krebs had shown that the plant acids play a central role in cellular respiration.

The initial reaction of the Krebs cycle which shows the changes in acids occurring during respiration involves the production of *cis*-aconitic acid which is then changed into citric or isocitric acid by the enzyme aconitase.

The organic acids present in cane juice are important not only from the physiological points of view but as these acids and their alkali salts are soluble, they have important effects on the reactions of clarification and in limiting the recovery of sugar. Being less stable than the mineral acids and being capable of entering into complex reaction with the sugars and other organic constituents of the juice, they are probable causes of the formation of undesirable mellasigenic substances in the course of the manufacturing process. Oxalic and aconitic acids have been associated with the formation of scale on factory heating surfaces [Martin (1953)].

Aconitic acid has received much study recently due to its commercial exploitation as a chemical synthetic, its value in this respect being due to the unsaturated structure of its molecule and consequent reactivity.

Information in the literature on the occurence of organic acids in the cane juice is not complete and apart from aconitic acid details of content of other acids given before the advent of chromatographic methods are of doubtful value due to the analytical difficulties involved.

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* I. The Amino acid and Nitrogen Content of Cane Juice. Ann. Rep. M. S. I. R. I, 1955.

II. The influence of variety and other factors on level of some ash constituents of juice. Ann. Rep. M. S. I. R. I., 1956.

Chromatographic methods provide the only means of investigating the entire group of trace constituents without resorting to excessively large samples of cane or juice material. Paper chromatography has been applied by Wiggins (1952) for the tentative identification of a number of these acids, preliminary separation and concentration of the anion fraction being effected by ion-exchange treatment of the juice. Qualitative evidence was obtained for the presence of malic, aconitic, citric, glycolic and possibly glyoxylic acids. Roberts and Martin (1954) using direct partition chromatography of the juice on silica gel columns established the presence of all these compounds except glyoxylic acid, and they found in addition mesaconic and fumaric acids.

The study of this important group of substances and of the quantitative variations which may occur with season, variety and age is obviously of value not only from an academic point of view but industrially also. In view of the successful application by Roberts and Martin, loc. cit., of the silica gel columns of Marvel and Rands (1950) to the direct analysis of cane juice, this technique was used in the present studies.

EXPERIMENTAL

The samples of juice used in this work were obtained from the second ratoons of the post-release trials of this Institute planted in June 1954 and harvested as virgins in July, September and November 1955. The ratoon crops were harvested at exactly yearly intervals after the virgin crops thus giving three groups of twelve month old canes harvested at the beginning, the middle and the end of the crushing season respectively.

Two only of the trials were sampled, the one at Bonne Veine (120" rainfall) being taken as typical of the wetter districts of the island, and the other at Bon Espoir (60" rainfall) as typical of the drier districts.

The varieties M. 134/32 and Ebène 1/37 were studied as these two varieties are at present the most important commercially and Ebène 1/37 shows a marked adaptation to humid (greater than 60" rainfall) conditions.

Juice from the samples was obtained by the usual methods employed in this Institute.

250 ml. of juice sub-sample were then evaporated down to 67-70° Brix in a rotary-film evaporator, the evaporator temperature being kept below 35°C in order to avoid the possibility of chemical artefacts of the acids being formed. The concentrated juice was stored at —15° C until required for analysis.

To a known weight of silica gel, dried over phosphorus pentoxide, (about 7 gm. for 4 gm. of juice solids) was added 7 ml. of the concentrated juice, the mass was mixed thoroughly and then dried over phosphorus pentoxide in vacuo.

When the mass was completely dry it was weighed to obtain the weight of cane juice solids and then crushed quickly to a fine powder in a mortar ; 1 ml. of 2N sulphuric acid was added and the whole thoroughly triturated. This material was then added to the top of a prepared chromatography column.

The preparation of the column was as follows : 30 gm. of silica gel, dried over phosphorus pentoxide, were moistened with 20 ml. of 0.5N sulphuric acid and stirred into an homogeneous paste. This paste was made into a slurry with chloroform which had been equilibrated against a solution of the 0.5N acid and the whole transferred to a chromatographic column, fitted with a stopcock at the bottom. With practice a column completely free from air bubbles was obtained.

The column with added cane juice solids was eluted with successive 100 ml. volumes of chloroform-n-butanol in which the n-butanol increased by 5% steps from 0-50% v/v. All solvents were saturated with 0.5N sulphuric acid.

The effluent was collected in approximately 10 ml. fractions with the aid of an automatic fraction collector and the acid content of each fraction was determined by titrating the entire amount with 0.01N sodium hydroxide using phenol red as indicator. The rate of flow of eluent through the column was kept at about 1 ml. per minute. An elution diagram, corrected to volume (10 ml.), for one of the samples together with the total amount of aconitic acid found in all samples examined are given.

A reference sample was also analysed (fig. 16); recovery of aconitic acid was 99%.

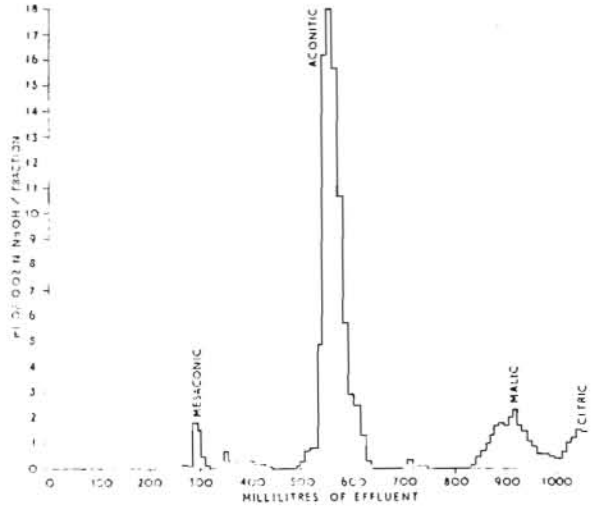

Fig. 16. Elution diagram showing the resolution obtained with a mixture of mesaconic acid (0.0077 grm), aconitic acid (0.0986 grm), malic acid (0.025 grm) and citric acid (0.0165 grm).

Figure 16 shows a typical separation of mesaconic, aconitic, malic and citric acid from a mixture of these acids and sucrose. Recovery of the aconitic acid is 99 % and the resolution is good. Marvel and Rands reported recoveries of 99.3 and 100.7 % for succinic and aconitic acids respectively, whilst Roberts and Martin, loc. cit., found that the recoveries of all the organic acids of sugar cane were essentially quantitative except for oxalic acid which was found to be erratic.

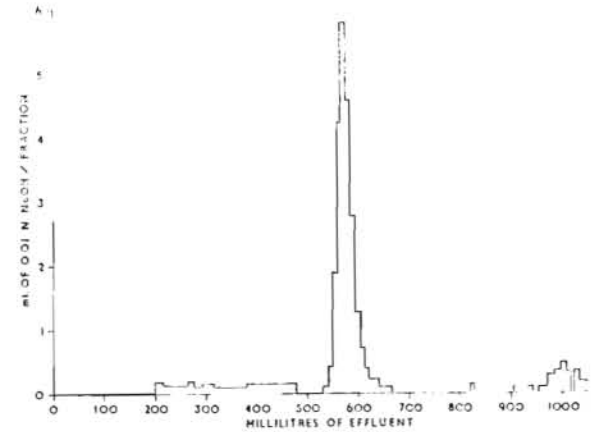

Fig. 17. Elution diagram of juice of M. 134/32 from Bon Espoir trial; mid harvest plots receiving 20 Kgs N per arpent.

From the elution diagrams, of which figure 17 is a typical example, it is seen that the level of aconitic acid is low, and that levels of the other acids are insignificant. The usual method of determination of aconitic acid is by de-carboxylation, which is subject to errors of constant magnitude in the determination of small amounts of carbon dioxide, and is less reliable than chromatography for the analysis of juice samples containing less than 1% aconitic acid on solids (Roberts and Martin).

All the local juices analysed fell below a level of 1% aconitic acid on solids and it is therefore obvious that chromatography on silica gel provides the most reliable method for determining this constituent; figures for local juices obtained by the decarboxylation method will be of dubious value.

From table 11 it will be seen that the average aconitic acid figure, as a percent of dry matter, for typical Mauritian juices is 0.22% and that the lowest and highest values encountered in this work were 0.1% and 0.4% respectively. These levels of aconitic acid are very much lower than the levels encountered in Louisiana which, in the samples analysed by Roberts and Martin, ranged from 0.43% to 2.07% with an average value of 1.26% on dry matter.

The aconitic acid contents of tropical cane are known to be much lower than the contents of Louisiana cane, and the work of Balch, Broeg and Ambler (1945) has shown moreover that the juices obtained from the growing portion of the sugar cane, including the tops, leaf blades and sheaths, contain three to five times as much aconitic acid as the juice from the mature cane stalks. This work suggested the possibility of growing sugar cane entirely for aconitic acid production, the cane to be reaped in an immature condition at least twice a year and crushed with tops and leaves.

A study of table 11 also shows that there is no apparent relationship between aconitic acid content and harvest date, and none with changes in the level of nitrogenous fertilization. Differences in content of this acid between the two varieties in the Bonne Veine samples are insignificant but in the case of the Bon Espoir samples, Ebène 1/37 has, on the whole, higher levels than M. 134/32.

Table 11. Aconitic acid content (percent dry matter).

Locality: Bonne Veine Variety : M. 134/32				Locality : Bon Espoir Variety : M. 134/32			
Harvest / Kg. N. per arpent	Early	Mid.	Late	Harvest / Kg. N. per arpent	Early	Mid.	Late
20	0.23	0.17	0.18	20	0.10	0.12	0.34
40	0.19	0.22	0.15	40	0.18	0.13	0.28
60	0.32	0.31	0.22	60	0.10	0.10	0.22
Variety: Ebène 1/37				Variety : Ebène 1/37			
Harvest / Kg. N. per arpent	Early	Mid.	Late	Harvest / Kg. N. per arpent	Early	Mid.	Late
20	0.34	0.15	0.28	20	0.34	0.16	0.30
40	0.16	0.19	0.14	40	0.21	0.14	0.35
60	0.21	0.22	0.14	60	0.25	0.25	0.41

SUMMARY AND CONCLUSIONS

The method of direct partition chromatography of cane juice solids gives good results for aconitic acid. Using this method the aconitic acid content of juice from Ebène 1/37 and M. 134/32, grown and harvested under different conditions, have been determined.

The levels of this acid occurring in typical samples of local cane juice are less than one quarter of the levels found in Louisiana juice.

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2. CHEMICAL FERTILIZATION

D. H. PARISH AND S. M. FEILLAFÉ

A REVIEW OF THE PRESENT FERTILIZER POSITION IN MAURITIUS

In terms of practical agriculture the most important chemical nutrients applied to growing crops are nitrogen, phosphorus and potassium. Other elements are just as vital for normal plant growth as these three; however, their supply in soils is usually sufficient to meet the needs of the plant and they cannot therefore be considered as important to the economics of agriculture in general; rather deficiencies of the three major nutrients must be completely corrected before the possible limiting effects of other essential nutrients on yields are considered.

The roles of nitrogen, phosphorus and potassium are well delineated for they each have different roles; yet in looking at them separately one must not lose sight of the fact that these functions are co-ordinated and inter-dependent. They affect the same entity, the plant, and the balanced development of the plant is brought about by the interaction of these functions.

Hopkins (1957) in discussing the relationship between the major plant nutrients and fertilization, points out that "a great deal of the misuse of fertilizers is due to applying unbalanced amounts of nutrients so that one function is over-performed whilst the other drags along in a dreary struggle with deficiency".

The role of nitrogen in the nutrition of the plant is well known by all who have ever used fertilizers, a good supply of nitrogen leading to fast growth, increase in leaf area and size of stem and deepening of the green colour. Conversely, symptoms of nitrogen deficiency are easy to recognize, the plants being pale and stunted.

The effect of nitrogen on a growing crop is so marked visually that there has never been the slightest hesitation by agriculturalists in accepting nitrogen as the king-pin of a fertilization programme on land where a response to this nutrient can be expected.

With potassium, the effects of a good nutrient status, and the symptoms of deficiency, are less marked than with nitrogen although, on land which is markedly deficient in this element, increases in crop yields following potash application can be spectacular.

Of these three elements, — nitrogen, potash and phosphorus, — the latter is the least dramatic in its visual effects, and yet in terms of yield it is just as vital as the other two nutrients and can therefore impose, as has already been stated, a limit to yields which no excess of nitrogen or potash can overcome. Routine application of these major nutrients to soils which respond to their application by giving increased crop yields is therefore standard practice throughout the agricultural world.

Expenditure on fertilizers is an addition to the cost of those unavoidable items that must be incurred if cropping is to take place at all. These items are very much more costly to-day than they were even just after the war. The tendency is for them to increase whereas the prices of fertilizers have remained fairly steady and in the case of nitrogen have even tended to fall. If, as a result of investment in fertilizers, increases in crop yield are secured there is more produce to carry the load of total costs, and the supreme criterion of any agricultural budget is not the cost per acre but the cost per ton of produce.

It is against the background of these generally accepted ideas that the fertilizer position operative in Mauritius will now be discussed.

On a national scale, in an island which, apart from those two very useful fertilizing materials, scums and molasses, has no native source of the three major nutrients, the imports of fertilizers give a sound picture of the intensity of fertilizer application. Data obtained from total import figures obviously do not apply to individual areas of the island, rather do they represent a fictitious *average* treatment; within this limit various cane lands will fall above or below the national level in the amount of fertilizer they receive.

The five-yearly averages for imports of the major nutrients, N, P_2O_5 and K_2O, into Mauritius since the turn of the present century, together with the production of sugar, are given in figure 10 (page 25).

The first point of importance appearing in the graph is the close relationship between sugar production and imports of nitrogen. It is apparent that these imports of nitrogen into Mauritius are responsible for a large percentage of the total sugar production and therefore a large part of the prosperity of the island depends on maintaining a high level of imports of synthetic nitrogenous fertilizers.

The second point of importance is that the imports of potassic fertilizers, whilst not at the same level as nitrogenous fertilizers, follow closely the trends in total sugar productions. The foliar diagnosis results obtained by Halais (1957) show that small planters apart, the overall potash status of the cane growing lands of Mauritius is quite good, and one must therefore conclude that despite the debit of potash caused by export of molasses there is an awareness of the importance of this nutrient which is reflected in rising imports and that there is reason for general satisfaction concerning this element

The third important point is that despite the almost phenomenal rise in sugar production between 1949 and 1954, the levels of import of phosphate have, if anything, shown a decline. Halais (1957) has shown, as a result of his study of foliar levels of phosphate, that more than one third of the cane growing lands of Mauritius are deficient in this nutrient.

The Hawaiian islands have similar soils and climatic conditions to those of Mauritius and it is of interest to compare their imports of fertilizers, with the data shown in figure 10.

The actual levels of imports are, of course, very different, but this is not important; what is important is the ratios of N to P_2O_5 and K_2O, the so-called N: P: K ratio, as this ratio indicates the balance of these major nutrients applied to the cane crop.

Imports of fertilizers into Hawaii are extremely variable over the years (H. S. P. A. Exp. Sta. Comt. Annual Report 1952) but it is seen that the N and K_2O curves follow one another closely whilst the P_2O_5 curve shows a very marked decline in the years 1935 - 45. From 1945 onwards, however, the amounts of phosphate imported have been increasing and the 1950 point shows that imports of this nutrient are again at a substantial level. Taking the 1950 levels of imports of N, P_2O_5 and K_2O, the ratio of the nutrients applied by the sugar industry of Hawaii to their crops was approximately 5: 2: 4 whilst for Mauritius the ratio was 5: 1: 3.

Borden (1950) in a recent survey of plantation fertilizer practices in Hawaii gives figures showing that the application rates for phosphate were as follows: 30 % of the land received no phosphate, the level of phosphate in the soil presumably being high enough to permit cropping without application of maintenance doses; average application on the remainder was at a rate of 56 kg. P_2O_5 per acre, the figure being almost ten times the mean annual level of phosphate application in Mauritius, so that the ratio of nutrients applied to land expected to benefit from phosphate application was in fact of the order of 5: 3: 4, in other words the balance of fertilizer nutrients in Hawaii would seem to require almost three times as much phosphate as that found in practice in Mauritius.

By breaking down the amount of nutrient applied in Mauritius per ton of cane produced, and giving costs in terms of fertilizers, we find for the years 1950–54 the following figures:

	Kg. of nutrient /ton of cane	*Cost of nutrient Rs./ton of cane*
N	1.20	2.16
P_2O_5	0.24	0 17
K_2O	0.70	0.42

These figures do not include the substantial amounts of potash added in the form of molasses and phosphate returned as scums, which amount to about 3,000 tons of K_2O and 1,200 tons of P_2O_5 respectively. These returns however do not affect the monetary comparisons which are made.

The ratios of money spent on the nitrogenous, phosphoric and potassic fertilizers are of the following order: 12.5 : 1 : 2.5. This shows that phosphorus fertilization is being neglected not only in the balance of nutrient which is normally applied, but also economically, as there is no reason to spend 2.5 times as much money on potash imports relative to phosphate when deficiencies of the latter nutrient are effecting a larger percentage of the total cane growing area.

The reason for the deterioration in the phosphate position is not difficult to see:

higher yields per acre, the cultivation of marginal lands and the longer ratooning period, together with a widespread awareness of the value of nitrogenous and potassic fertilizers and the lower content of P_2O_5 in marketed guano have all worked together to cause an unfavourable nutrient balance.

It is of interest to note that in the period 1905—09, the nutrient ratio of fertilizers imported into Mauritius was 2 : 1 : 1 and that the ratio now stands at 5 : 1 : 3, showing markedly the undeserved decline in popularity of phosphatic fertilizer.

Those people who consider that in the 'good old days' things were done properly, should ponder on this change as it carries an important lesson ; no gross imbalance of nutrients in those days, no exploitation of the basic fertility of the soil without returning nutrients to it.

Almost the entire importation of phosphates into Mauritius is in the form of "guano phosphaté" which has the overriding benefit of being per unit of P_2O_5 by far the cheapest form available. The level of 1,000 tons of guano imported must be stepped up and it is reasonable to assume that the ratio 5 : 1 : 3 should become something of the order of 5 : 2 : 3. Financially, a transfer of a small percentage of the money spent on nitrogen and potash would achieve this end without increased expenditure, or a slight increase in outlay would be a desirable alternative.

The problem of overcoming the phosphate deficiency resolves itself into two parts. Firstly, the amount of "guano phosphaté" to be applied in the furrow at planting should be assessed by a study of the foliar diagnosis figures for phosphate in the particular section involved. A marked deficiency of phosphate would indicate that guano at the rate of approximately one ton per acre should be applied. Many estates are now applying this amount at planting and results are eminently satisfactory, whilst other areas known to be deficient in P_2O_5 receive as little as 250 kg. of guano and this amount is expected to last for up to eight ratoons.

If the ratoon crops show deficiency of phosphate, the use of some soluble phosphatic fertilizer should be seriously considered. Results of work carried out by the Chemistry division have shown that soluble phosphate applied to ratoon crops can and does enter the plant. These soluble forms of phosphate are expensive, but some are approaching in cost the price of the phosphate in guano.

The use of the cheaper forms of soluble phosphate is indicated for ratoons which are suffering from phosphate deficiency, and the application of 25 - 50 Kgs. of P_2O_5 to the canes is probably a sound investment financially, as this treatment may enable ratooning to be extended to the normal length of time.

The Chemistry division has a considerable research programme under way to study the various soluble phosphates and to find their limitations and advantages when compared with "guano-phosphate". Placement is one problem, for it is necessary to be able to apply as little as 25 kgs of P_2O_5 per arpent and to obtain good uptake by the plant. The use of the small booster doses may prove exceedingly useful and are on the lines of the widely supported theory that a little nutrient applied often, and placed well can give better results than the use of massive doses. In this connection it should be pointed out that the band application of heavy dressings is not the correct method for an insoluble phosphate, such as "guano phosphaté" ; rather should insoluble fertilizer be incorporated into the soil as thoroughly as possible. This procedure assists the plant in obtaining the maximum benefit from the fertilizer. With soluble fertilizers the contrary is the correct procedure, good placement helping to prevent a heavy reversion of the soluble phosphate to forms which are more slowly available to the plant.

From this article it will be seen that phosphatic fertilization is a major fertilizer problem facing the sugar industry, and a considerable amount of experimental work by the Chemistry division is being directed towards obtaining information which will be a guide to the best treatment to adopt.

Nitrogenous fertilization is already at a high level but continued field trials are useful in giving data which enable the most economic level of application of these costly fertilizers to be assessed for the different varieties. Halais (1953) has prepared for the standard variety M 134/32 a table showing the economic level of N to be applied to a crop, after due consideration to the price of sugar, the price of fertilizer N and the normal cane yield of the region. The only criterion to be considered in purchasing nitrogenous fertilizer is the cost per unit of nitrogen. Urea has now shown itself to be a strong competitor

of ammonium sulphate. Field trials and pot experiments have so far shown them to be of equal value. The fear that the slight content of biuret, present in some commercial urea fertilizers, could cause a loss in yields of sugar cane due to its toxicity, is unfounded, even massive doses of biuret having no harmful effect on cane plants when applied to the soil.

In the case of potash the status of the soils of Mauritius on the whole is not such as to cause worry, and even though potash is being exported in the form of molasses, imports of the nutrient are relatively high. The only observation to be made is that applications of small amounts of potassic salts frequently, is a more rational procedure than using heavy dressings infrequently.

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3. FOLIAR AND INTERNODE DIAGNOSIS

PIERRE HALAIS

Foliar diagnosis according to the leaf punch sampling technique run on four to six months old ratoon canes in full vegetative growth is being carried out regularly at the Institute for two main purposes :

(1) as a permanent control of the nutrition of sugar cane grown on estates, large and small planters' fields to disclose P & K deficiencies and to follow up the course of improvement as a result of the fertilizer programmes implemented ;

(2) as a check on all field experimentation with fertilizers, each plot being sampled at least twice during the boom stage, the green weight of the whole 3rd leaf being reckoned in addition to the collecting of leaf punches for N, P & K analysis.

Internode diagnosis on the basal and 8-10 internodes of the cane stalk, as proposed by Burr and Takahashi (1955) of the Hawaiian Sugar Producers' Association Experiment Station has been critically studied by us during the last two campaigns on a number of field trials. It should be mentioned that the Crop-Log system of Clements which makes use of leaf blades or sheaths is being actually followed by 21 out of the 28 Hawaiian sugar plantations.

Improvement of the foliar diagnosis technique has always been one of our chief concerns. Progress achieved in this connection during 1957 is summarized below:

(a) More precise localization of the 5mm diameter punches to be collected right in the centre of the parenchyma of the 3rd leaf, taking length and width into account, in order to eliminate the disturbing influence of differences of composition within the blade.

(b) Provision of other analytical procedures for K determination as a substitute, if circumstances command, of the two methods — colorimetic dipicrylamine and flame photome-

tric — regularly used at the Mauritius Sugar Industry Research Institute which ask for specialized and expensive equipment. Consequently the newly proposed volumetric procedure of Schall (1957) using sodium tetraphenylborate reagent was given special trial after minor modifications involving semi-micro work on H_2O_2 — H_2SO_4 wet digested leaf punches. Attempts were also made to determine by the same occasion the nitrogen content following co-precipitation of NH_3 and K by the reagent in slightly acid medium. A third modification was tried in order to extend the whole procedure to P determination through the NH_3 contained in the yellow molybdate precipitate formed, according to Lorenz. No reliable results have yet been obtained in this connection but the major simplification which would result from N, P and K analysis of leaf punches culminating in the same final volumetric titration is worth further analytical investigations.

Results of comparative routine tests for N and K on five leaf samples are given in table 12.

Table 12. Comparative results of N and K determinations.

N % d. m.		*K_2O % d. m.*	
Colorimetric Nessler	Volumetric TPB (Schall) modified	Colorimetric dipicrylamine	Volumetric TPB (Schall)
1.77	1.71		
1.84	1.77	1.57	1.49
1.93	1.82	1.57	1.59
1.95	1.91	1.11	1.08
2.16	2.09	1.54	1.42
		1.63	1.47
Averages *1.93*	*1.86*	*1.48*	*1.40*

Optimal foliar diagnosis values have been found in collecting data on a series of highly replicated post-release variety trials involving low, medium and high nitrogen fertilization (20, 40 and 60 Kg. N/arpt). They are the first evaluations for ratoons performed on three of our commercial varieties : Ebène 1/37, B 37172 and B. 3337.

The optimal foliar diagnosis for nitrogen is the one associated with no profitable response of ratoons, reaped at 12 months, to the early application of 20 Kg. N/arpent. It has been found by means of proper mathematical treatment of all available data (table 13).

Table 13. Correlation between response to nitrogen and foliar diagnosis.

Variety	*Regression equation*	*t. value*	*Optimal F. D. N % d.m.*
Ebène 1/37	Profitable response in TCCS/arpt = 2.433 — 1.42 x F.D.	2.22	1.71
B. 37172	" = 3.131 — 1.61 x F.D.	2.60*	1.94
B. 3337	" = 2.952 — 1.63 x F.D.	2.85*	1.81

* significant to 5% level.

Practical difficulties in obtaining representative leaf samples throughout the grand period of growth, on an estate scale, seem to constitute the major obstacle against the adoption, for the time being, of those optimal values for advisory work concerning nitrogen fertilization.

In addition, the optimal foliar diagnosis for Phosphate and Potash on leaf punches has also been worked out from the same series of field trials which, of course, included the much studied earlier variety M. 134/32.

	Optimal F.D.	
	P_2O_5 % *d. m.*	K_2O % *d. m*
M. 134/32	0.50	1.50
Ebène 1/37	0.45	1.50
B. 37172	0.47	1.45
B. 3337	0.44	1.40

Comparisons between foliar and internode diagnosis have been subjects of intensive studies in 1956 and 1957 on the already mentioned six post-release variety trials which comprise 648 individual plots.

A summary of some of the results obtained is given in tables 14 and 15. They will be published and commented in full elsewhere. They refer to foliar diagnosis done at the usual age of four to six months and to internode diagnosis carried out at six to eight months.

The main conclusion reached is that the leaf punch sampling technique, which is so convenient in practice, is at the same time perfectly suited to our local needs provided it be handled properly i.e. with sufficient care, replication and continuity.

The third leaf blade selected is a fully developed organ, at the peak of its physiological activity, which precedes the elongation of the internode. Once its growth completed, this internode is subjected to gradual senescence accompanied by migration of the nutrients towards the actively growing tissues of the cane top.

Table 14. Relation between foliar and stalk diagnosis for NPK at different levels of N fertilization.

Kg. N/arpt.	*20*	*40*	*60*
TCCS/arpt.	4.88	5.19	5.10
Green leaf wt. in grs	22.4	23.8	24.5
	N % d. m.		
F. D.	1.62	1.74	1.81
Basal Int. D.	0.14	0.18	0.23
8-10 Int. D.	0.14	0.17	0.19
	P_2O_5 % d. m.		
F. D.	0.43	0.44	0.44
Basal Int. D.	0.102	0.086	0 071
8-10 Int. D.	0.105	0.093	0.076
	K_2O % d. m.		
F. D.	1.41	1.43	1.47
Basal Int. D.	0.41	0.41	0.41
8-10 Int. D.	0.83	0.82	0.80

Table 15. Relation between foliar and stalk diagnosis for NPK, from different localities (average of 1st and 2nd ratoons).

Location	*N* % *d.m.*		P_2O_5 % *d.m.*		K_2O % *d.m.*	
	F. D.	*B. I. D.*	*F. D.*	*B. I. D.*	*F. D.*	*B.I. D.*
Mount	1.65	0.155	0.50	0.164	1.60	0.650
Bon Espoir	1.65	0 155	0.47	0.124	1.32	0.390
Beau Vallon	1.73	0.200	0.44	0.065	1.37	0.290
Eau Bleue	1.79	0.220	0.46	0.089	1.45	0.320
Union Flacq	1.85	0.230	0.45	0.065	1.39	0.400
Bonne Veine	2.03	0.230	0.47	0.057	1.36	0.360

The conspicuous drop in the P_2O_5 content of internodes as a result of nitrogen fertilization is in conflict with the stability of the P_2O_5 in the leaf punches collected on the same canes. What seems to be the normal course is a depletion of the stem in P_2O_5 to keep up the P_2O_5 content of the enlarged leaf system at the highest possible level. The cane plant will only suffer in its growth and final yield if the P_2O_5 content in the physiologically active leaves does not succeed in reaching the critical or optimal level desired, a drop in P_2O_5 content of the stalk under those conditions does not imply, *per se*, that the plant is suffering from increased phosphate deficiency.

Consequently, stalk analysis, whether made on basal, 8 - 10 internodes (and *a fortiori*, the inorganic P_2O_5 content of the juice) is not a simple and unfailing test of the phosphorus welfare of the growing cane as the figures obtained are almost as dependent on the nitrogen nutrition of the plant as on the phosphate supplying power of the soil. Furthermore, intrisic varietal differences in P_2O_5 content have to be taken into account. Comparison of the results from Bon Espoir and Bonne Veine are particularly instructive in this connection.

There is no need for special comments concerning N and K_2O contents of leaves and internodes.

Samuels and others (1957) of the Agricultural Experiment Station of the University of Puerto Rico have recently reported the results of their comparative studies on the different leaf sampling procedures proposed for sugar cane in Mauritius, Jamaica, British Guiana on the one hand and in Puerto Rico and Hawaii on the other. Their conclusion is that when proper adjustments are made, the optimal values are similar regardless of country. Such conformity in the results speaks high for the fundamental background lying behind foliar diagnosis as the best means available for solving in a practical way the question of the economic use of fertilizers for the benefit of sugar cane agriculture at large.

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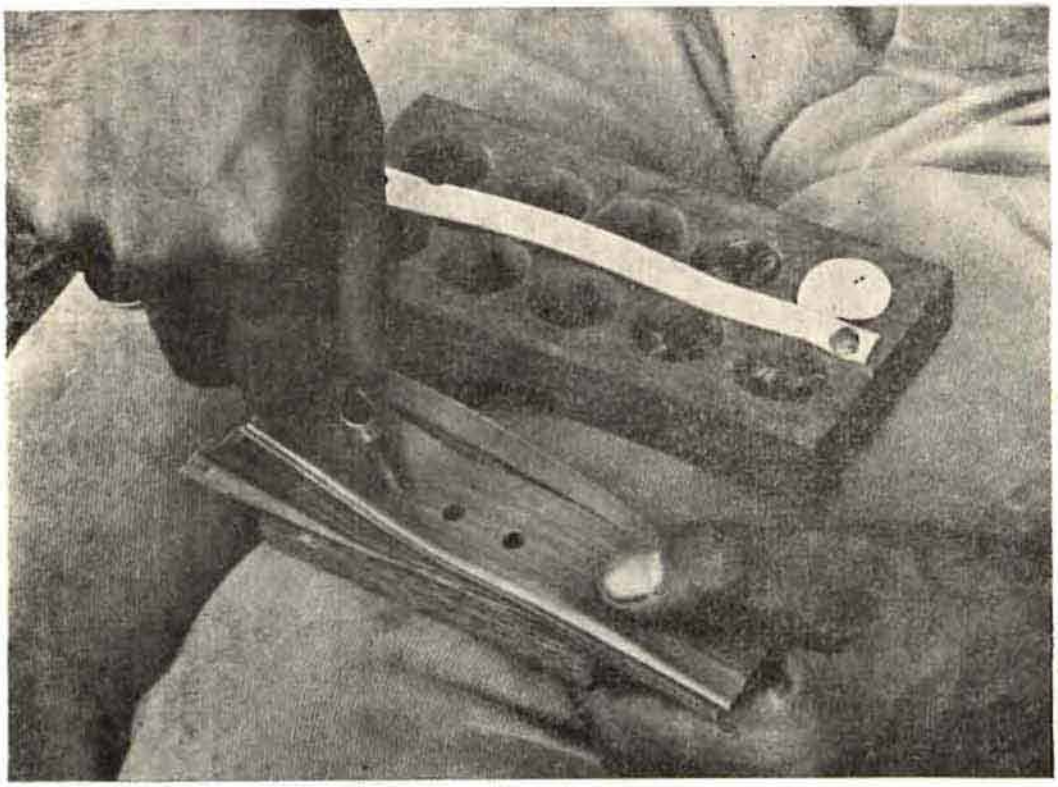
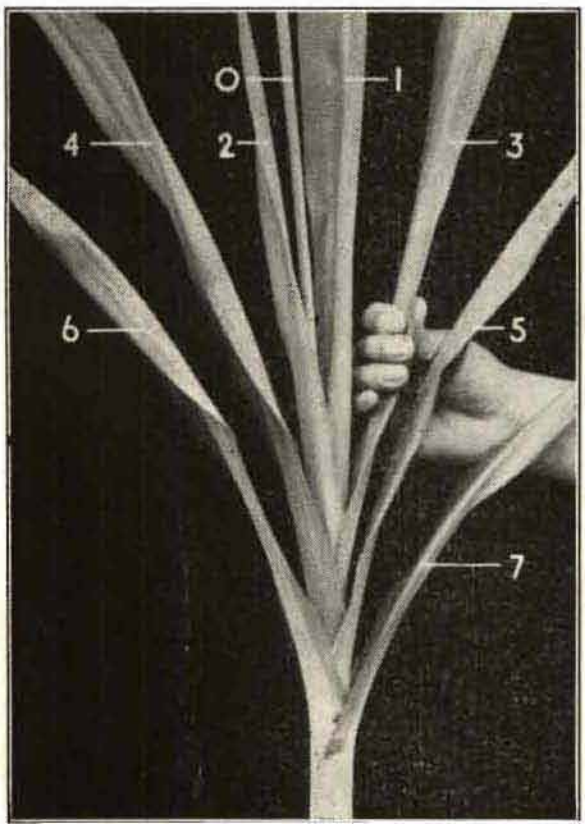
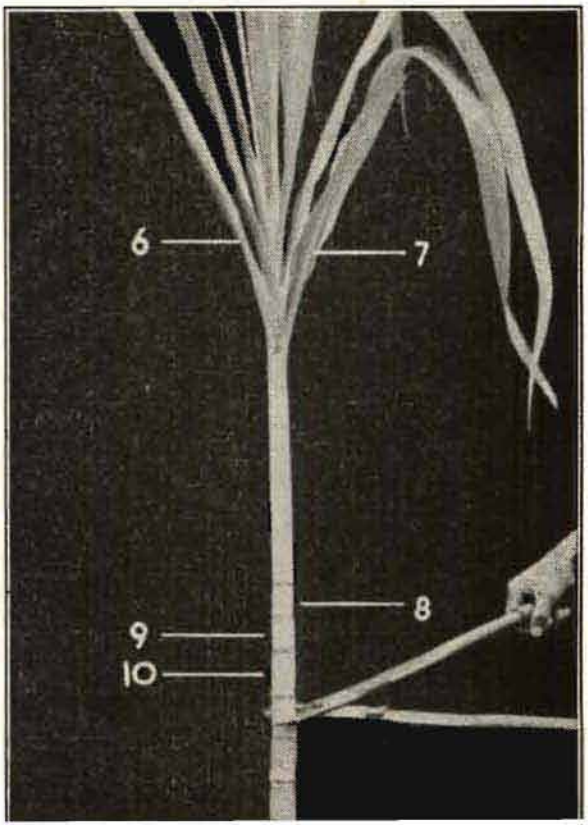


Fig. 18. Punching cane leaves for foliar diagnosis.





CANE DISEASES

ROBERT ANTOINE

1. CHLOROTIC STREAK

A. INVESTIGATIONS ON THE OCCURRENCE OF THE PATHOGEN IN CANES OF DRY LOCALITIES.

CHLOROTIC streak prevalent in the super-humid zone is not encountered in sub-humid areas except locally on ill-drained irrigated soils. Experiments were conducted in order to determine whether canes growing in a dry locality possess the disease in a latent form. To test the above assumption two trials were laid down, one in the sub-humid and the other in the super-humid area. Heat treated and diseased material was planted with cuttings originating from symptomless cane growing in the apparently disease-free zone. The cuttings, all taken from variety Ebène 1/37, were planted in randomized blocks with the three treatments mentioned above randomized 10 times. Each plot consisted of two rows with 20 cuttings. The results are summarized in table 16. Furthermore, individual stools were mapped and observations on presence of leaf symptoms recorded at intervals. The results are expressed graphically in figs. 21 and 22.

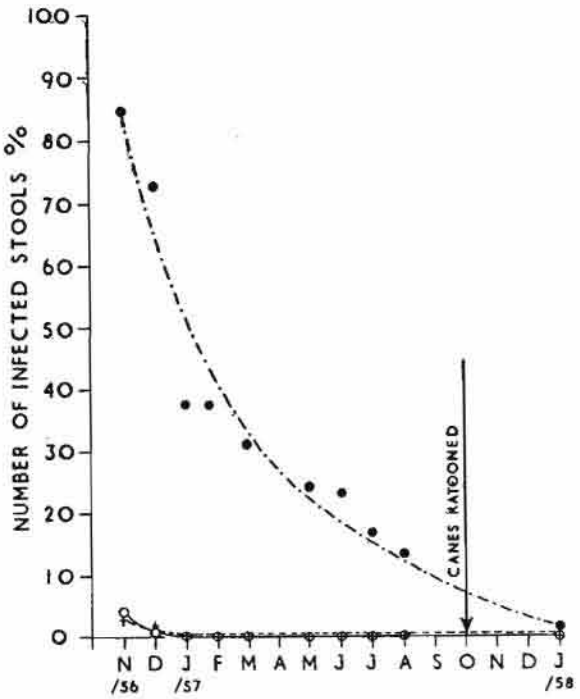


Fig. 21. Loss of foliar symptoms in a sub-humid locality. Plain line: cuttings originating from an apparently disease-free locality; broken line: hot water treated cuttings; broken and dots: diseased cuttings.

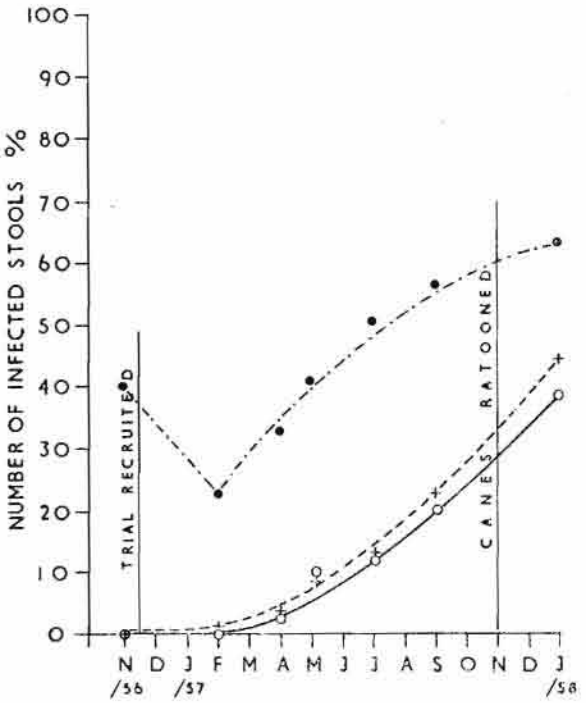


Fig. 22. Acquisition of foliar symptoms in a super-humid locality. Plain line: hot water treated cuttings; broken line: cuttings originating from an apparently disease-free locality; broken and dots: diseased cuttings.

Table 16. Acquisition and loss of chlorotic streak symptoms in different localities.

Locality / Nature of Cuttings	Super-humid zone			Sub-humid zone		
	Germination failures	Stools finally established	Yield in tons / acre	Germination failures	Stools finally established	Yield in tons / acre
Diseased ; originating from super-humid area	80%	58%	5.0	50%	48% *	22.2
Apparently healthy ; originating from symptomless canes from sub-humid area	32%	77%	15.6	18%	83%	36.2
Heat treated	26%	79%	18.6	14%	88%	37.6

* No recruiting carried out in order to have comparable yield figures.

It will be observed that cuttings originating from a dry locality have given rise to stools which have reacted in the same way as those derived from heat treated cuttings, at the two experimental sites, whether germination failures, expression of symptoms or yield are taken into account. It is therefore logical to assume that symptomless canes in dry areas are free from the disease organism.

It will also be noted that there is a gradual disappearance of symptoms in originally infected stools in a dry locality. As a corollary to the experiments, it was necessary to establish whether such loss of symptoms meant an actual or apparent disappearance of the disease from the plant. Cuttings taken from originally infected stools which had lost disease symptoms were planted with infected and heat treated material for comparison in a diseased locality. Four months after planting, all stools derived from heat treated material or from cuttings taken from stools having lost disease symptoms were still healthy. It should be pointed out, however, that disease incidence has been very low so far in stools derived from infected cuttings, only 7%. It appears that loss of symptoms means an actual disappearance of the disease from the plant.

Another important observation is the serious reduction in yield caused by the disease on Ebène 1/37 ; 73 % in the super-humid zone as compared to heat treated cuttings and 41 % in the sub-humid area (Fig. 23). It should however be pointed out that the diseased plots were planted and recruited with cuttings obtained from cane showing pronounced leaf symptoms. It is therefore difficult to conceive how the prevalence of Ebène 1/37 would have arisen in the high rainfall area without the heat treatment.

Fig. 23. Chlorotic streak trial. Diseased plots: foreground and top right; healthy plot; top left.

B. INFLUENCE OF TIME OF PLANTING ON RATE OF NATURAL INFECTION.

Final results obtained in the 6 x 6 latin square two-year experiments described in the 1956 report are expressed graphically in figs. 24 and 25. It will be observed that time of planting has an important influence on the rate of natural infection by chlorotic streak. The highest incidence is observed in the November plantings; then, there is a gradual decrease to the lowest figure for the July plantings followed by a recrudescence in September. The observations hold good both for virgin and first ratoon cane. The fact that the plant contracts infections more readily when plantations are made during the hot months may have contributed to the failure of summer plantings and led to the establishment of cane plantations during the cooler months in the super-humid zone.

It appears also from figs. 24 and 25 that the cane contracts infection in young virgins and particularly during the summer months. The same trend seems to take place during the first year of ratoon growth.

It follows from the evidence obtained that in areas where chlorotic streak prevails, a reasonable disease-escape measure, at least in virgins and early ratoons, would be the proper timing of plantations.

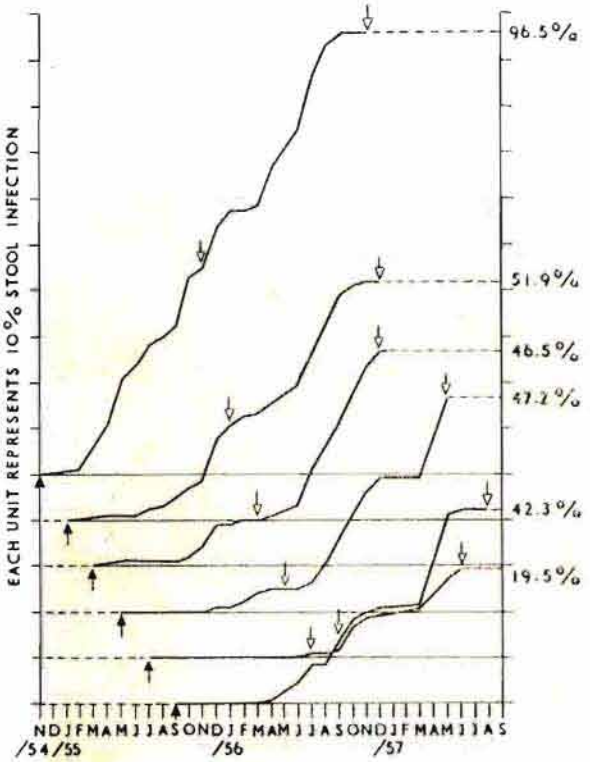


Fig. 24. Rate of natural infection by chlorotic streak in plantings made at two months interval.
↑ : Time of planting ; ↓ : Time of harvest.

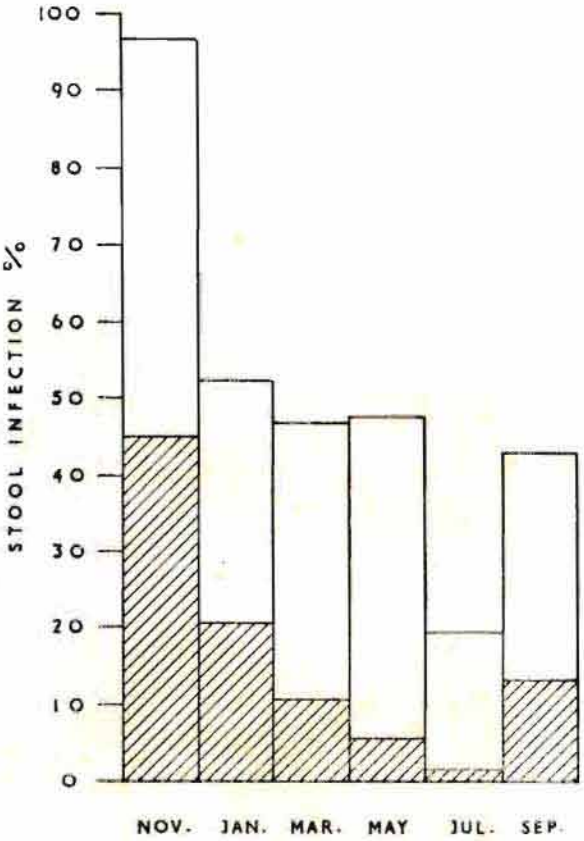


Fig. 25. Influence of time of planting on natural infection by chlorotic streak at the end of virgin (shaded) and first ratoon growth.

C. TRANSMISSION STUDIES.

(a). *Soil.* A trial was established in 1956 at Union Park Experiment Station in order to investigate whether natural infection takes place in the soil. Ebène 1/37, a variety highly susceptible to chlorotic streak, was selected. Cuttings derived from stools showing obvious leaf symptoms and hot water treated cuttings were planted in drums in sterilized and unsterilized soil from a disease-free and a diseased locality.

The results obtained showed that stools derived from hot water treated cuttings, planted in soil whether sterilized or unsterilized from a disease-free as well as diseased locality, did not show any disease symptoms, while almost 100 % of the plants derived from diseased cuttings exhibited the typical leaf streaks. It should be noted that no aerial transmission occurred although with randomized treatments and drums close together there was an intermingling of diseased and healthy leaves.

Although no evidence of soil transmission was obtained in the experiment, the design was modified in 1957 in order to investigate more closely whether such transmission occurred.

Two stools derived from hot water treated cuttings contracted infection. In the first case, a treated cutting planted in unsterilized soil from a diseased area gave rise to an infected stool. In the second case, when a diseased plant derived from an infected cutting planted in sterilized soil was uprooted and replaced by a heat treated cutting, the latter gave rise to an infected stool. These are indications that the disease may be transmitted through the soil. Observations are being continued.

(*b*). *Parasitic phanerogam.* Research on experimental transmission of the chlorotic streak virus was continued during the year. Attempts at bridging two sugar cane plants by an organic connection afforded by a parasitic phanerogam, mentioned in the 1956 report, were pursued. The partial parasite, *Cassytha filiformis*, proved unsuitable as it was impossible to maintain a good growth at Réduit, the natural habitat of the plant being coastal areas. Various methods were tested in order to try and establish on sugar canes the two species of the complete parasite *Cuscuta* present in Mauritius. After several failures, one of the species, namely *Cuscuta chinensis*, when vigorously growing on a suitable " mother plant " (*Asystasia gangetica*) was successfully established on the leaves and sheaths of young sugar cane plants (fig. 26). The parasite is being used in an attempt to transmit the disease from diseased to healthy plants growing in sterilized soil.

Fig. 26. *Cuscuta chinensis* on young sugar cane plants.

(*c*). *Roots.* Another method under experimentation is illustrated in fig. 27. Sugar cane plants derived from single eyes were made to grow on sett roots only, in order to be able to induce moisture transfer through their intertwined root systems. The " recipient plants " grew on single and the " donor plants " on double sett root systems. The former plant developed in the top container only and the latter in both containers. After the root systems of the two types of plants had been well established, the top container received no more water while the donor plant in the bottom container was watered daily.

Fig. 27. Induction of moisture transfer between roots of sugar cane plants.

The experiment is being conducted with diseased plants as donors and healthy plants as recipients in order to study the possible passage of the disease through moisture transfer between the plants. These grow in sterilized soil and the paired containers in groups of three stand in large trays surrounded by an oil seal. The experiment is being conducted in the greenhouse.

2. RATOON STUNTING DISEASE

The severe drought which occurred during the second half of 1956 and in 1957 had serious effects on plantations made in the sub-humid area where irrigation cannot be resorted to. As no drought had prevailed in the island for several years past, the effect of such unfavourable conditions on ratoon stunting had been imperfectly assessed. Observations and experimentation had led to the conclusion that the disease was at its worst in the super-humid zone, where the sub-normal growth conditions were brought about by excessive soil moisture. However, that conception on the distribution of the disease in the island had to be revised as a result of the behaviour of sugar cane plantations under the dry conditions that prevailed. Although the localized, though at times severe, effects of root disease cannot be overlooked, there is no doubt that ratoon stunting disease has been an important factor which has considerably intensified the effects of drought in sugar cane plantations along the coastal areas of the nothern and eastern sectors of the island.

It follows that the effects of ratoon stunting disease are accentuated by any unfavourable condition in the sugar cane environment. Such detrimental influences may be a severe drought or excessive soil moisture. The two factors would affect to an appreciable extent the normal physiological process of the plant thus leading to an intensification of the effects of the disease. *Per contra*, when the plant is growing under ideal conditions, it is not always easy to distinguish between healthy and infected plots.

Infected cuttings derived from severely stunted canes growing under conditions of excessive soil moisture were planted with heat treated cuttings in the sub-humid zone. During the first two generations good environmental conditions prevailed leading to almost no difference in growth between healthy and diseased cane. The third year however, the effects of a drought were observed in the diseased plots. The results are expressed in table 17.

Table 17. Effect of ratoon stunting on M.134/32 in 2nd ratoons under droughty conditions in the sub-humid area.

	No. of canes	Total length of canes (inches)	Average length per cane (inches)	Yield in tons per acre
Healthy	483	37,650	78	39.5
Diseased	300	19,050	63	14.0
% Reduction	38	49	19	65

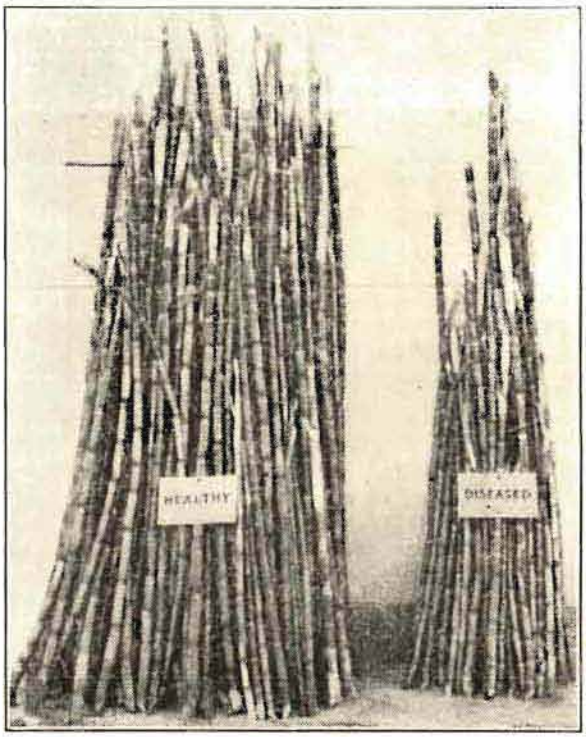


Fig. 28. Left: cane yield in plots derived from heat treated cuttings. Right: yield in diseased plots derived from cuttings infected with ratoon stunting disease.

It will be observed that a reduction in yield as high as 65 % was obtained (fig. 28). In a similar experiment established in the super-humid zone, the drop was 39 %. It would appear that the effects of the disease are intensified more by a deficit in soil moisture than by an excess. The observations are of particular significance when it is considered that M. 134/32 is still the dominant variety in the nothern sector of the island.

It is also interesting to note that the effect of the disease is observable not only on the length of cane, but also on the number produced per stool.

Experiments conducted to determine the effect of the disease on M. 134/32 have shown that reductions of up to 27 % in yield could be obtained in virgins under unfavourable conditions. Diseased Co. 419 yielded 6 % less than heat treated cane in virgins.

No significant difference in yield was obtained in the trial established to study the effect of the disease on commercial varieties. Although stunting was observed on several varieties in inoculated plots, the effects of the heat treatment itself, namely reduced germination and retarded growth, were responsible for the large variations observed in plot yields. New trials have been established using planting material taken from cane derived from healthy stock and inoculated cuttings. The effect of the heat treatment has thus been eliminated and a preliminary observation made is that the virus appears to have an effect on germination of cuttings. All plots were planted with three-eyed cuttings and the results are given in table 18.

Table 18. Effect of ratoon stunting on the germination and early establishment of commercial varieties.

Variety	No. of primary shoots		% reduction
	Healthy	Diseased	
M. 134/32	549	362	34
M. 112/34	574	458	11
M. 147/44	667	505	25
M. 31/45	666	467	30
Ebène 1/37	453	363	20
B. 34104	558	437	22
B. 3337	655	446	32
B. 37161	544	245	55
B. 37172	655	610	7

All varieties have shown reduced germination varying between 7 % and 55 %. Such observation is made for the first time, erratic germination resulting from heat treated material having so far masked that particular effect of the virus.

Promising seedlings and breeding canes have been included in a ratoon stunting resistance trial. Two hundred and ten varieties have so far been established. An assessment of their reaction to the disease may help in the breeding work for resistance along specific blood lines. Three varieties claimed to be immune or highly resistant to the virus have been imported from the United States and are now undergoing quarantine.

As a result of recommendations made by the Institute, a central hot water treatment plant is being installed for the Sugar Producers' Association at Belle Rive Experiment Station and will begin to operate in April 1958. It is contemplated to treat a total of 6,500 tons of cane annually for estates and large planters. The treated material will serve for the establishment of nurseries in each factory area. It is estimated that the amount of healthy cuttings derived from the nurseries will be sufficient to provide disease-free material for planting the total area of virgin canes the following year.

Two hot water tanks will operate at the central treatment plant. The dimensions of each tank will be 10′ x 8′ x 5′ with a capacity of 2,000 gallons of water and $1\frac{1}{2}$ ton of cuttings ; hence, a water: cane ratio of 6: 1. Electrical heating will be provided by means of 45 elements of 5 Kw housed in the bottom of the tanks. A chokeless centrifugal pump driven by an individual electric motor of 15 h.p. capable of maintaining an output of 20,000 gallons per hour, will be connected to each tank. The circulation cycle will thus be 6 minutes. Incoming water will be forced through outlet holes made into 2″ pipes situated on the two longer sides at the top of the tank. Circulation water will return to the pump by means of a 4″ draw-off pipe along the long middle line at the bottom of the tank and above the heating elements. Cuttings will be treated in iron baskets, 18″ x $14\frac{1}{2}$″ x 18″, covered with wire netting. The capacity of each basket will be approximately 100 lb of cuttings. Loading of each tank will be made in two metal cages, each containing 18 baskets. The cages will be lifted by means of an electric winch travelling on a gantry. The tanks will be insulated and will be provided with control instruments, such as : thermostat and recording thermometer mounted on individual panels; the operation of the two units will thus be completely independent. A fungicide tank large enough to accommodate one cage will serve for the treatment of cuttings as they come out of the heat treatment tank. The dip will provide a a desirable immediate cooling effect on the

cuttings and a protection against attacks by soil fungi.

The station is entirely financed and administered by the Sugar Producers' Association, the Institute acting in an advisory capacity.

A similar scheme is being implemented for small planters by the Sugar Planters' Rehabilitation Fund, after recommendations were made by the Institute to the Extension Service of the Department of Agriculture, which is responsible for technical advice to small planters. A nursery is being established with planting material treated in the hot water tank of the Institute at Réduit.

The short hot water treatment, 52° C for 20 minutes, will have to be given to planting material derived from nurseries established in regions where chlorotic streak prevails. A concern of this Institute has been the possible large scale contamination by the ratoon stunting virus, the source being the few diseased plants that could be present in nurseries. Experimentation has indicated that no such contamination takes place. Cuttings infected with the ratoon stunting virus were heat treated at 52° C for 20 minutes with healthy cuttings, and then planted separately. The results are given in table 19.

Table 19. Infection by the ratoon stunting virus after heat treatment against chlorotic streak.

Origin of stools	% diseased stools
Diseased cuttings, not treated	88
Diseased cuttings, treated at 52° C/20 mins. with healthy cuttings	73
Healthy cuttings, treated at 52° C/20 mins. with diseased cuttings	0

Several disease-free plots have been established in various localities with material treated in the hot water tank of the Institute. It will be noted that when adequate precautions are taken in the preparation of cuttings and good conditions are given at planting time a very reasonable to excellent stand can be expected.

3. HISTO-CHEMICAL DIAGNOSIS OF RATOON STUNTING DISEASE

Tetrazolium salt, 2, 3, 5 - triphenyl tetrazolium chloride, was used in a colour test in order to detect the presence of the ratoon stunting virus in sugar cane. The change in colour is from the water soluble colourless tetrazolium to a red insoluble substance, triphenyl formazan, through reduction. The reaction being photochemical, the test has to be carried out under carefully controlled conditions.

The following technique was found to give reliable results. Plugs of cane tissue were taken from the second and third nodes, starting from ground level, of mature sugar cane stalks, at the level of the leaf scar, boring vertically into the lower internode. Slices, 0.5 mm thick, were prepared by means of a hand microtome and the six sections immediately above the level of the leaf trace bundles, at each node, were selected (fig. 29). The twelve sections obtained were kept together in juice squeezed from the corresponding internodes. They were then blotted dry and placed in a 0.5% solution of 2, 3, 5 - triphenyl tetrazolium chloride and kept in an incubator, in darkness, at 35°C. The reaction was allowed to proceed for various lengths of time, the insoluble formazan produced was extracted with hot acetone and the colour intensity determined by means of a Lumetron colorimeter. The colour change was found to be more rapid with virus-infected than with virus-free tissues **(fig. 30).**

The results are expressed graphically in fig. 31. It will be noted that although the colour difference can be observed after 2 hours when the reaction takes place in darkness, the best difference is obtained after approximately 9 hours and is still very marked after 20 hours

When the cane tissue is sampled in the internode, a minimum reaction is obtained with both diseased and healthy tissue. When sections are taken at the level of the leaf trace bundles both infected and disease-free tissue stain too deeply.

The best zone for sampling, in order to have a maximum difference in colour change between

diseased and healthy material, is just above the level of the leaf trace bundles (fig. 29).

When young canes were sampled they reacted in the same way as young portions of mature cane with the result that a good colour differentiation was not obtained A more exhaustive study on all commercial varieties at various ages is under way.

Other tetrazolium salts, namely 3, 3-dianisole-bis-4, 4-(3, 5-diphenyl)-tetrazolium chloride and 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride, were experimented with but did not show promise as colour indicators.

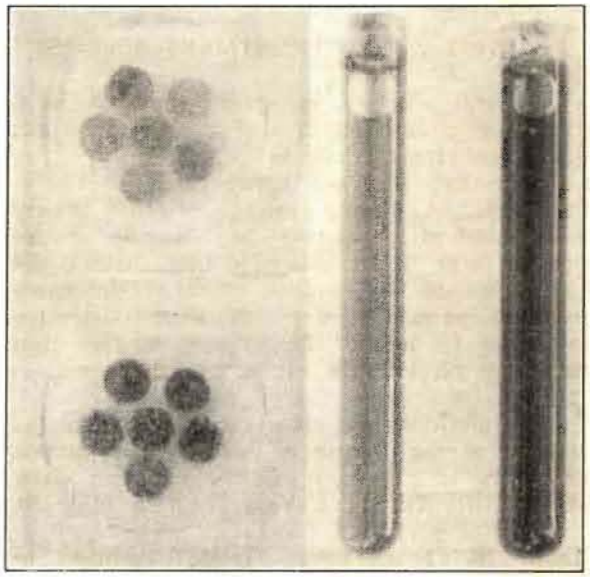


Fig. 30. Left, colour development in slices after 20 hours in darkness: healty, above; diseased, below. Right, acetone extract: healthy, left; diseased, right.

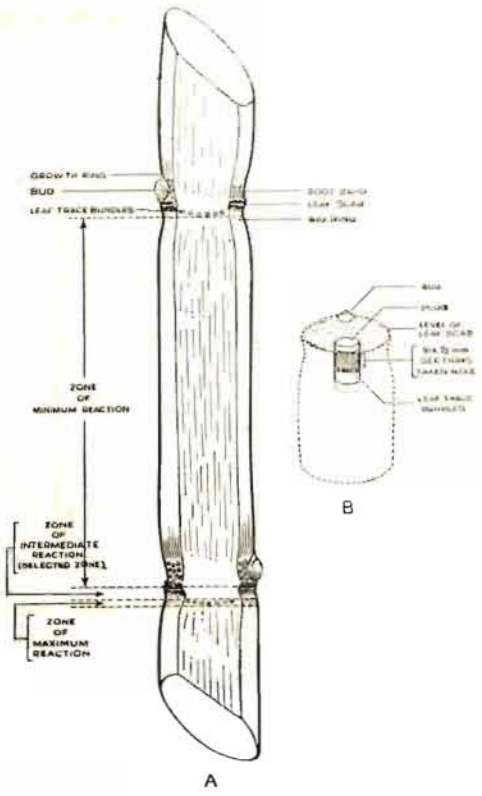


Fig. 29. A. Colour reaction in node and internode. B. Sampling procedure.

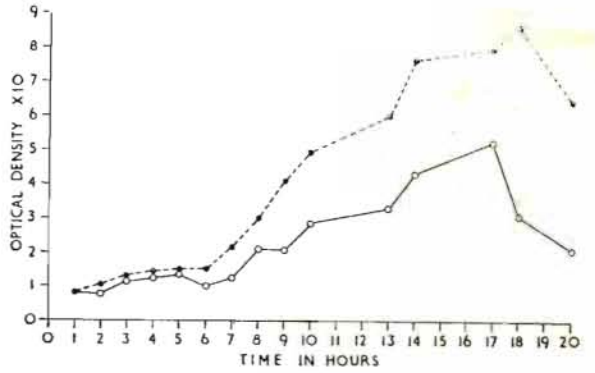


Fig. 31. Optical density of acetone extract. Plain line healthy, broken line: diseased.

4. HEAT THERAPY.

(A). HOT WATER TREATMENT AGAINST CHLOROTIC STREAK (52°C FOR 20 MINUTES).

Several foci of infection appeared in a plantation established in the super-humid zone, with heat treated cuttings of Ebène 1/37, in an area that had not borne cane for thirty-five years. As some cuttings of that variety in a random population are usually exceptionally large, it was assumed that these could have escaped the curative effect of the treatment. Experiments were therefore conducted in order to assess the efficacy of the heat treatment on cuttings of various diameters.

Results obtained this year on temperatures reached at the centre of cuttings of various diameters at the end of treatment in water at 52° C for 20 minutes are given in table 20.

Table 20. Temperatures inside cuttings of various diameters at the end of the short hot water treatment (52°C for 20 minutes)

Diam. of cutting (cms)	Temperature at centre of cutting after 20 mins. (°C)
2.5	52.0
3.5	50.3
4.0	47.6
4.8	42.0

Cuttings were grouped according to diameter into five classes :

Class	A :	diameter	3.0 — 3.5 cm.
"	B :	"	3.5 — 4.0 "
"	C :	"	4.0 — 4.5 "
"	D :	"	4.5 — 5.0 "
"	E :	"	5.0 — 5.5 "

All cuttings were treated at 52° C for 20 minutes and planted with diseased cuttings as controls. The disease was not cured in class E only, i. e. in cuttings above 5 cm. in diameter.

As a corollary to the experiment, thin nodal cylinders taken from diseased stalks including the bud and root primordia only, were treated in water at various temperatures for 20 minutes. There were 36 cylinders in each treatment. These were planted in tins containing wet sawdust, in the greenhouse, after the heat treatment. There were 12 cylinders per tin. The plants were examined at intervals for the presence of disease symptoms. Results are expressed in table 21.

Table 21. Effect of temperature on the chlorotic streak virus.

Temperature °C (for 20 mins.)	Ungerminated cuttings	Dead plants	Plants with leaves showing chlorotic streak symptoms	Healthy plants
38	17	7	7	5
40	12	4	7	13
42	5	8	7	16
44	15	3	0	18
46	23	3	0	10
48	19	0	0	17
50	33	0	0	3
52	33	1	0	2

It appears from the results that temperatures above 44° C inactivate the pathogen *in vivo*.

B. HOT WATER TREATMENT AGAINST RATOON STUNTING DISEASE (50°C FOR 2 HOURS).

Temperature determinations inside cuttings, by means of a thermocouple attached to a potentiometer, during the hot water treatment, have indicated that the temperature at the centre of the cutting, at the end of the two-hour treatment is constantly a quarter of a degree Centigrade below that of the surrounding water. A typical curve for a cutting, 4.5 cm in diameter, is illustrated in fig 32. During the experiments conducted to determine the effect of fibre content on temperature distribution inside cuttings the bath temperature was kept at 50.5° C and the time taken to reach an internal temperature of 50.° C recorded. Three varieties were selected M.134/32 and Ebène 1/37 with a low fibre content ranging from 7.0–12.0, and B. 3337 with a high fibre content 10.0–16.0. Cuttings were selected in order to have uniformity in diameter. Experimental data are expressed graphically in fig. 33. It can be inferred that fibre content has no influence on the efficacy of the heat treatment.

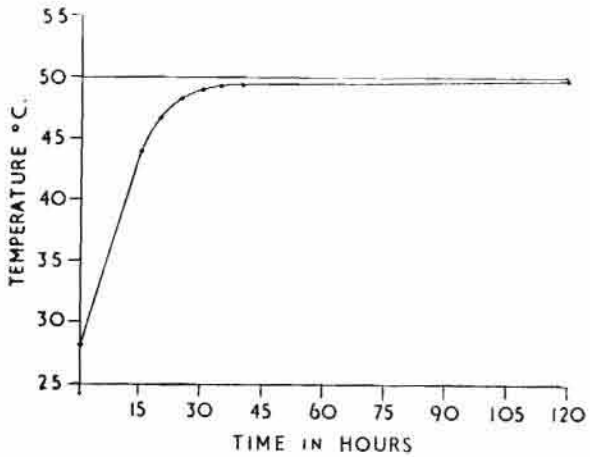


Fig. 32. Temperatures at the centre of a cutting, 4.5 cm. in diameter, during treatment in water at 50° C for 2 hours.

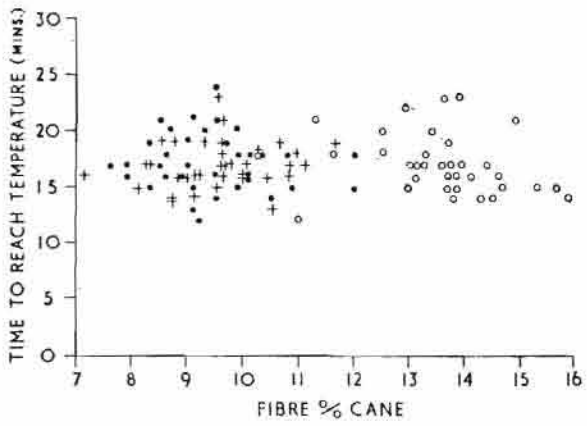


Fig. 33. Relation between fibre content and time to reach temperature of 50° C in hot water at centre of cutting.

5. PINEAPPLE DISEASE

Six organo-mercurials and one tin organic fungicide were tested, at concentrations recommended by the manufacturers in the control of pineapple disease in two localities where different climatic conditions prevail. Cuttings were rigorously selected in order to have homogeneous planting material and all furrows were watered with a spore suspension of the pathogenic fungus, *Ceratostomella paradoxa*. The results are given in tables 22 and 23.

It will be observed from results obtained in the two trials that all fungicides at suitable concentrations have significantly improved germination of the setts. It is interesting to note that the tin organic fungicide, included in one of the trials, has proved to be just as effective as the mercurials. Another result has confirmed observations already made locally that one of the fungicides, namely Aretan, should not be used at concentrations below 1% of the commercial product.

Table 22. Pineapple disease trial at Union Park Experiment Station. Results expressed as per cent of controls.

FUNGICIDE		Cuttings affected by pineapple disease	Germinated shoots	Green weight of shoots
Name	Conc. %			
Phenyl mercury urea (1.8% Hg)	0.5	50	160	250
Phelam (3% Hg)	0.1 0 25 0.5	41 70 37	178 147 193	208 194 200
Aardisan (3% Hg)	0.5 1.0 1.5	65 48 30	164 145 230	206 169 294
Solusanigran (3.5% Hg)	0.5 1.0 1.5	59 39 48	170 145 151	200 119 172
Aretan (3% Hg)	0.5 1.0 1.5	59 56 61	122 186 163	125 275 174
Phenyl mercury acetate (3% Hg)	0.1 0.25 0.5	48 35 35	155 183 184	144 258 239
Brestan (20% Sn)	0.5 1.5 2.5	56 72 48	149 154 179	203 219 175
Significant Diff.		± 29	± 39	± 92

Cuttings affected by disease in control plots : 38 %.

Table 23. Pineapple disease trial at Réduit Experiment Station. Results expressed as per cent of controls.

FUNGICIDE		Cuttings affected by pineapple disease	Germinated shoots	Green weight of shoots
Name	Conc. %			
Phenyl mercury urea (1.8% Hg)	0.5 1.0 1.5	69 32 82	175 266 209	165 260 190
Phelam (3% Hg)	0.1 0.25 0.5	47 50 60	267 273 236	254 183 156
Aardisan (3% Hg)	0.5 1.0 1.5	76 68 50	202 286 343	167 234 303
Solusanigran (3.5% Hg)	0.5 1.0 1.5	45 24 16	304 359 387	331 406 473
Aretan (3% Hg)	0.5 1.0 1.5	105 85 69	161 200 234	170 150 183
Phenyl mercury acetate (3% Hg)	0.1 0.25 0.5	102 76 35	154 232 370	153 210 312
Significant Diff.		± 24.6	± 92	± 191

Cuttings affected by disease in control plots : 52%.

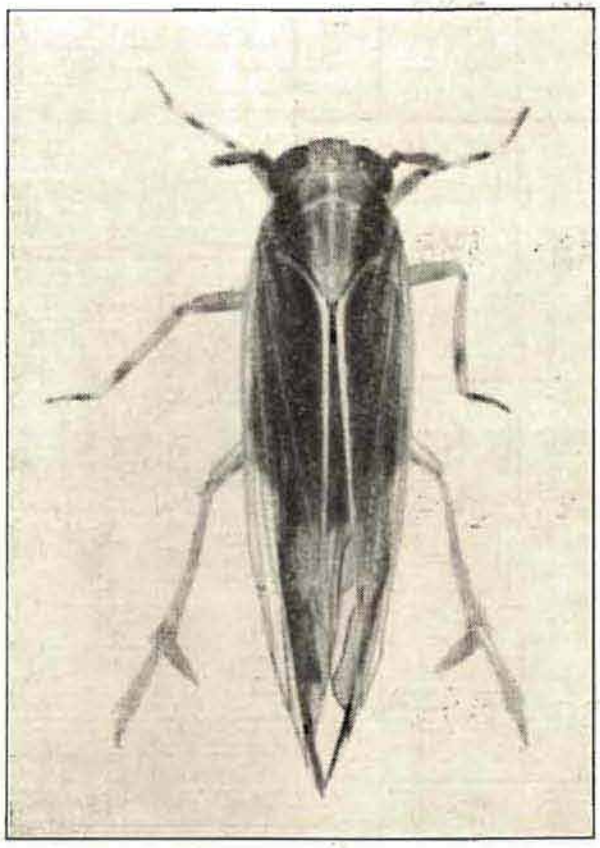


Fig. 34. The vector of Fiji Disease of sugarcane, *Perkinsiella saccharicida* Kirkaldy, x 18.

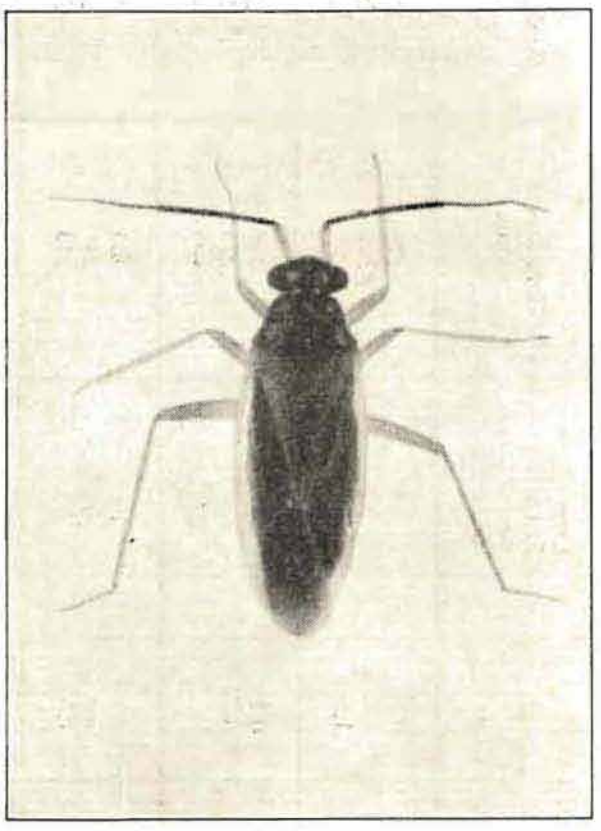


Fig. 35. *Tytthus mundulus* (Bredd.), the recently introduced predator of *Perkinsiella* eggs, x 18.

CANE PESTS

J. R. WILLIAMS

1. INSECTICIDAL CONTROL OF CLEMORA SMITHI (Arr.)

A new approach to the control of the cane white grub, *Clemora smithi*, has been offered by the development of synthetic insecticides capable of retaining their toxicity for long periods after incorporation in the soil. The control of *Clemora* has hitherto, and with partial success, centered upon the introduction and encouragement of parasitic insects, notably Scoliid wasps, but infestation of cane growing soils remains chronic in some regions of the humid zone and is a contributory cause of poor growth, particularly in ratoon cane. Acute infestations, which cause considerable and obvious loss are fortunately of sporadic occurence only. The development of a simple and cheap insecticidal treatment to prevent acute attack and to ameliorate chronic infestation has been envisaged for some time and during 1948 - 51 the Department of Agriculture made experiments with BHC. Although application of this insecticide was effective to a certain extent, it became evident that a satisfactory control technique was not in sight and the work was discontinued.

In 1954 the Department of Agriculture, in collaboration with this Institute, began to experiment with Chlordane and subsequently with Aldrin. This work has now been much extended and the present article summarises investigations in progress and the results so far obtained.

It is worth noting at this point that the application of Chlordane in particular, and of other of the more recent insecticides, to cane soils has been reported in Louisiana (Dugas, 1957; Mathes *et al*, in press) and in India (Siddiqui & Agarwal, in press) to stimulate growth and increase yield quite apart from any control exerted by them over obviously harmful insects such as white grubs. This, it is suggested, is due to the action of the insecticides upon minute soil insects and other arthropods which injure cane roots and whose phytophagous activities have not been fully appreciated.

THE LIFE CYCLE OF CLEMORA

Clemora has one generation each year. The adults are active and laying eggs during the hot months, December—January. The larvae have three stages of development and are fully grown by September—October when they begin to pupate. The most injurious stages, the 2nd and early 3rd larval stages, are found in April—August and are concentrated in and under the cane stools.

EXPERIMENTAL

The randomised block layout with a plot size of five cane rows forty feet long and with either eight or ten replications for each treatment has been used for all trials. One cane row or a strip two feet wide separated the plots.

Two preliminary trials with Chlordane were laid down in 1954 and another in 1955 (trials 1, 2 and 6 below). The results from these were so promising that the work has now been extended and a total of 18 trials are now

in progress, 11 of them having been laid down in 1957. The recent trials include Aldrin as well as Chlordane treatments. The trials are located in different localities to allow for possible variation of results due to different soil types and rainfall.

The following methods were used to apply the insecticides :

Virgin cane
- (a) Water-emulsion to the furrows before addition of fertilizer and setts.
- (b) Water-emulsion to surface along rows of recently germinated cane.
- (c) Insecticide-fertilizer mixture to the furrows before insertion of setts.

Ratoon cane
- (d) Water-emulsion to the soil surface along the rows after harvest.

The emulsions were of miscible insecticide oil in water at the rate of 400 or 200 gall/arpent, the latter amount being used in all recent trials. Watering-cans were used to apply the emulsions primarily to avoid spray drift over the plots but it appears that even for applications on a larger scale the method may prove superior to the use of sprayers for it is both quicker and enables the emulsion to be properly placed where it is wanted, i. e. into the furrow when planting or in band over the soil surface along the rows of germinated virgin cane or harvested ratoon cane. The large drops also probably aid penetration of the insecticides into the soil. The insecticide-fertilizer mixtures used in some trials consisted of dispersible insecticide powders mixed with phosphatic guano and they were distributed in the furrows by hand in the manner normally used for the application of guano.

The above methods would seem to exhaust the practical methods of application permitted by cane cultivation practices in Mauritius. It might be noted that owing to the general absence of mechanical cultivation in fields after planting, it is not possible to insert insecticide into the soil after the cane is estabished although the operation of hilling-up, if done after insecticide application, helps to mix in the insecticide a little. Owing to this difficulty of properly incorporating surface—applied insecticide into the soil, the use of dust formulations with established cane is not favoured as it is thought that better penetration and positioning of insecticide is achieved with emulsions.

RESULTS

The results obtained to date are expressed in table 24 in a condensed form and they are derived, of course, only from the trials laid down before 1957. The grub infestation within plots was assessed by uprooting ten feet of cane row near the middle of each plot in May—June—July when the grubs are large and congregated about the main roots. The counts are expressed as number of larvae per arpent of cane row to the nearest 500. The figures in brackets express the populations in the treatment plots as percentages of those in the untreated plots.

Table 24.

Trial 1. **Chlordane emulsion to the furrows before planting at 3 lb and 6 lb a. i. / arp. in November, 1954.**

	Untreated	*3 lb Chlordane*	*6 lb Chlordane*	*Lowest Significant Diff. ($P=0.01$)*
1955	6,000	1,500 (25)	500 (8)	3,500
1956	23,500	10,000 (43)	4,500 (19)	7,500
1957	26,000	12,500 (48)	10,000 (39)	13,500

Table 24 (*continued*).

Trial 2. **Chlordane emulsion at 4 lb a. i. / arp. to (a) furrows before plainting in Aug , 1955, and to (b) the rows after germination in Nov., 1955.**

	Untreated	*Furrow Application*	*Row Application*	*L.S.D. (P=0.01)*
1956	12,000	1,000 (9)	3,000 (25)	5,000
1957	42,000	5,500 (13)	11,000 (26)	18,000

Trial 3. **Chlordane emulsion to the rows shortly after germination at 4 lb., 6 lb., and 8 lb., a. i. / arp. in March, 1956.**

	Untreated	*4lb Chlordane*	*6lb Chlordane*	*8lb Chlordane*	*L.S.D. (P=0.01)*
1957	39,000	12,500 (32)	6,500 (17)	5,000 (13)	19,000

Trial 4. **Chlordane emulsion at 4 lb. and 8 lb. a. i. / arp., Aldrin emulsion at 2 lb. and 4 lb. a. i. / arp. to furrows before planting in May, 1956.**

	Untreated	*4lb Chlordane*	*8lb Chlordane*	*2lb Aldrin*	*4lb Aldrin*	*L.S.D. (P=0.01)*
1957	14,500	1,500 (10)	500 (4)	2,500 (17)	500 (4)	4,500

Trial 5. **Chlordane and Aldrin emulsions at 2 lb. and 4 lb. a. i. / arp. to furrows before planting in Aug., 1956.**

	Untreated	*2 lb. Chlordane*	*4 lb. Chlordane*	*2 lb. Aldrin*	*4 lb. Aldrin*	*L.S.D. (P=0.01)*
1957	7,000	0	1,000 (14)	0	0	3,500

Trial 6. **Chlordane emulsion to the rows of ratoon cane after harvest at 3 lb. and 6 lb. a. i. / arp. in November, 1954.**

	Untreated	*3 lb. Chlordane*	*6 lb. Chlordane*	*L.S.D. (P=0.01)*
1955	90,000	54,000 (60)	37,500 (41)	12,500

(Field replanted, 1955, and trial terminated)

Table 24 (*continued*).

Trial 7. **Chlordane and Aldrin emulsions at 2 lb. and 4 lb. a. i. / arp. to rows of ratoon cane after harvest in November, 1956.**

	Untreated	*2 lb. Chlordane*	*4 lb. Chlordane*	*2 lb. Aldrin*	*4 lb. Aldrin*	*L.S.D. (P=0.01)*
1957	59,000	24,000 (41)	22,000 (37)	17,000 (29)	10,000 (17)	7,000

Trial 8. **As above ; application in September, 1956.**

	Untreated	*2 lb. Chlordane*	*4 lb. Chlordane*	*2 lb. Aldrin*	*4lb. Aldrin*	*L.S.D. (P=0.01)*
1957	20,500	9,000 (44)	9,000 (44)	6,500 (32)	6,500 (32)	9,500

It is to be concluded from the above data that both Chlordane and Aldrin are highly effective against *Clemora* when applied in emulsion form in the furrows when planting, along the rows after germination, or along the rows of ratoon cane after harvest. In all trials, infestation in the treated plots in the year following application was very appreciably lower than in the control plots, the differences being significant at the 1 % probability level.

It is also evident that Chlordane retains its toxicity in the soil, and is able to give a high degree of protection against infestation, for several years. Thus, in Trial 1, grub infestation in the three successive years following the year of application (i.e. for three successive generations) was reduced by 92%, 81% and 61%, respectively, by application of 6 lb a. i. Chlordane in the furrows when planting. Aldrin has been used only in the more recent trials and for this reason, although it is highly effective in the year following application (Trials 4, 5, 7, 8), it is not possible to state if it has a similarly prolonged residual effect.

Application to the soil surface along the rows of recently germinated cane appears to be less effective than application to the open furrows during planting (Trial 2 ; Trial 3 compared with Trials 1, 4, 5). This is to be expected for with the latter method the insecticide is placed with the setts and immediately covered and mixed to a certain degree with the soil. With ratoon cane the insecticide is unavoidably placed on the surface but can be mixed a little into the soil during hilling-up after harvest. A good degree of protection has resulted with application to ratoon cane (Trial 6, 7, 8) but it does not seem comparable with the protection given when the insecticides are applied to the furrows when planting.

Examination of the relation between dosage rates and degree of infestation show that weight for weight Aldrin is superior to Chlordane. Thus, 2 lb a. i. Aldrin appears equivalent to 4-6 lb Chlordane. At current prices this has an important bearing upon cost of treatments, Aldrin being the cheaper. However, a final comparison of the two insecticides must await data upon the duration of the residual action of Aldrin. The outstanding feature of the trials so far is the high and prolonged residual toxicity of Chlordane in the soil.

The insecticide treatments had no adverse effect upon cane growth.

The yield of cane at harvest was assessed in all trials except the first but statistically significant differences were not apparent as a result of the different treatments although in Trial 3 the treated plots yielded 3 — 4 tons/arpent more than the untreated. It should, however, be pointed out that the infestations in the trials were usually well below the level where appreciable loss of yield would be expected. It is generally taken that an infestation of over 50,000 grubs per arpent of cane row is required to affect cane yield although the critical degree of infestation must vary appreciably depending upon such factors as cane variety, number of ratoons taken, soil fertility, climate, and standard of cultivation. Only in

Trial 6 did a heavy infestation occur and this cane, which was 4th ratoon, had apparently been ravaged by grub infestations in previous years. The untreated plots yielded less than 10 tons cane per arpent and the treated plots were only slightly and non-significantly better.

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2. THE INTRODUCTION OF TYTTHUS MUNDULUS (Bredd.) *

The establishment of Fiji Disease of Sugarcane along the east coast of Madagascar constitutes a serious threat to the sugar industry of Mauritius, particularly while the reaction of some of the island's commercial cane varieties to the disease is still insufficiently known. Much attention, therefore, has been given recently to the sugarcane leafhopper *Perkinsiella saccharicida* Kirk. (Delphacidae), a known vector of the disease (Fig. 34) which was first recorded from Mauritius in 1926.

Perkinsiella has numerous natural enemies in Mauritius and although very common, it is not generally abundant. However, owing to its potental importance it was decided to increase, if possible, the existing degree of natural control by introducing *Tytthus mundulus* (Breddin), the predacious Mirid which provided such an effective control for *Perkinsiella* in Hawaii.

Tytthus mundulus is a delicate insect about 3 mm long (Fig. 35) which destroys the eggs of various leafhoppers, among them *Perkinsiella*, by piercing them with its proboscis and sucking out their contents. It is known to exist naturally in Australia, Fiji, Java and the Philippines, and it was purposely introduced into Hawaii in 1920.

The Experiment Station of the Hawaiian Sugar Planters Association generously consented to send consignments of *T. mundulus* and between March, 1956, and June, 1957 eleven consignments were received by air. The insects were sent as eggs in maize midribs and most hatched in transit giving rise to about 24,000 young stages, which were released in various parts of the island.

Search made in the various localities where the insects were released indicate that most of the colonies were too small for survival and they appear to have died out. The ant *Paratrechina longicornis* Latr. has been seen to carry off some of the small nymphs and another species, *Technomyrmex detorquens* Wlk., sometimes mutilates them.

At one locality in Flacq, however, where the substantial number of 15,000 was released in June, the young stages and adults have been repeatedly recovered and here the insect appears to be established and multiplying. It is anticipated that dispersion from this locality will now gradually occur.

* The work briefly recounted was carried out by the Department of Agriculture until March and thereafter by the Mauritius Sugar Industry Research Institute.

WEED CONTROL

E. ROCHECOUSTE.

1. FURTHER INVESTIGATIONS ON THE SUBSTITUTED UREAS.

FOUR trials were initiated in 1956 to investigate the herbicidal value of the substituted ureas CMU–N–(4–chlorophenyl) N′, –N′–dimethyl urea and DCMU–N–(3–4 dichlorophenyl) N′, N′–dimethyl urea and also to obtain some information on the effects of these compounds on cane yield and sucrose content throughout a crop cycle. This year another trial was laid down at Bénares, a locality of the humid zone thus bringing to five the number of experiments of this kind in progress. In these trials CMU and DCMU were applied at rates 2, 3, 4, 5, 6, 8 and 10 lb per arpent. Further the treatments 4, 6, and 8 consisted of two series: one in which these rates were used in one single application and the other in which half of these rates were used in two applications at two months intervals. Herbicide application was made before weed emergence.

As originally planned out two weed surveys were to be made in these experiments: one two months after herbicides application the other four months later in order to determine whether split application treatments at rates 4, 6 and 8 lb per arpent would not give a better weed kill than single application treatments. In plant canes this procedure was followed but in ratoon canes it was found that a second weed survey could not be carried out owing to the fact that at the time observations had to be made on the weed population, the canes had completely closed the interlines.

(a). *Effects on weeds.* In the Valetta, Rose Belle, Solitude and Magenta trials weed assessment made two months after herbicide application has this year shown no great difference between 'control' and 'treated' plots at all rates of application. It must be pointed out, however, that the drought period experienced before and after herbicide application might have affected to some extent the herbicide activity of these weed killers. In general it may be said that DCMU was more effective than CMU in Valetta, Rose Belle and Magenta trials while in the Solitude trial the reverse was true. With regard to weed infestation apart from *Cyperus rotundus* which occurred in varying abundance in all trials irrespective of application rates only few other species were recorded in the different experimental plots of which the following may be mentioned:

Solitude :	Argemone mexicana; Euphorbia hirta; Amaranthus spinosus; Siegesbeckia orientalis.
Magenta :	Sida acuta; Euphorbia hirta; Cardiospermum halicacabum.
Valetta :	Oxalis latifolia; Oxalis debilis; Lobelia cliffortiana; Colocasia antiquorum; Digitaria timorensis; Ageratum conyzoides.
Rose Belle :	Digitaria horizontalis; Colocasia antiquorum.

In Bénares trial which was in plant cane in 1957 observations made on the weed flora two and four months after herbicide application gave results comparable to those obtained in 1956 in the four trials mentioned above. As indicated in tables 25 and 26 it was found that:

(i) DCMU was in general more effective than CMU.

(ii) Split application treatments at 4, 6, 8 lb rate gave a better weed kill than the single application treatments.

Table 25 Effects of CMU and DCMU on weed growth. Weed infestation in % Control.

Rate in lb/arp.	2 months after spraying		4 months after spraying	
	CMU	DCMU	CMU	DCMU
2	54	49	67	65
4	64	45	57	68
5	63	40	54	58
6	38	40	49	40
8	46	40	54	35
10	37	32	47	28

Table 26 Effects of CMU and DCMU on weed growth. Single application v/s split application. Weed infestation in % Control 4 months after spraying.

Rate in lb/arp.	Single application		Split application	
	CMU	DCMU	CMU	DCMU
4	57	68	34	23
6	49	40	33	22
8	54	35	22	15

It is interesting to note that *Cyperus rotundus* was also present in varying abundance irrespective of application rates. Of the other species occurring the following may be mentioned : *Oxalis latifolia; Oxalis debilis; Euphorbia hirta*; *Lobelia cliffortiana; Setaria barbata; Sonchus asper; Cardiospermum halicacabum* and *Solanum nigrum.*

(b). Effects on yield and sucrose content. Four out of the five trials above described were harvested in plant cane in 1957; the results obtained did not show any marked effect of the substituted ureas on cane yield and sucrose content.

2. EFFECTS OF NEW HERBICIDES ON CANE GROWTH

Two trials were laid down with a view to determining the effects of some new herbicides on cane growth. These experiments were established at Réduit and Belle-Rive Experiment Stations situated in the humid and super humid localities respectively.

EXPERIMENTAL

The following herbicides were used in these trials :

CMU–N–(4–chlorophenyl)–N′, N′–dimethyl urea

DCMU–N–(3, 4 dichlorophenyl)–N′, N′–dimethyl urea

Amizol–3–amino–1, 2, 4–triazole

Dalapon–Sodium 2, 2–dichloropropionic acid.

They were applied at rates 2, 4, 6, 8, and 10 lb per arpent after planting but before cane emergence. Each experimental plot consisted of a 10—foot cane row of 10 three-eyed cuttings which were pretreated against Chlorotic Streak disease by the short hot water treatment. The treatments were randomised with fourfold replications and all sprayings made with an Oxford Precision sprayer, the spray solution being kept at the standard rate of 30 gallons per arpent at 30 lb pressure. Observations on germination were made and cane growth measured at three-monthly intervals.

RESULTS AND CONCLUSIONS

Data obtained in these experiments are presented in tables 27 and 28.

The following information emerged from the results obtained.

(a) In Belle Rive trial no adverse effect on germination and subsequent growth was observed at all rates of application.

(b) In the Réduit trial germination in general was not affected except in the 12 lb treatment of Dalapon and Amizol. Dalapon at rates 10 and 12 lb depresses significantly cane growth.

Table 27. Effects of herbicides on cane growth, Réduit Trial.

Rate in lb/arpent	Total shoot length in cms per ten—3-eyed cuttings at 3 monthly intervals											
	CMU			DCMU			DALAPON			AMIZOL		
	3	6	9	3	6	9	3	6	9	3	6	9
2	265	1082	1584	338	1612	1932	422	1489	2080	385	1253	1768
4	360	1367	1521	362	1381	1818	430	1630	2008	329	1180	1477
6	336	1473	1822	343	1640	2098	440	1862	2330	438	1564	1574
8	301	1187	1966	458	1627	1942	368	1359	1662	314	1238	1462
10	347	1409	1744	454	1356	1769	374	1359	1531*	322	1295	1608
12	270	1269	1487	325	1435	1721	257*	1169*	1410*	283*	1510	1584
Control	352	1324	1820	364	1669	1997	599	1627	2406	446	1224	1489

* Significant at 5% level.

Table 28. Effects of herbicides on cane growth, Belle Rive Trial.

Rate in lb/arpent	Total shoot length in cms per ten—3-eyed cuttings at 3 monthly intervals											
	CMU			DCMU			DALAPON			AMIZOL		
	3	6	9	3	6	9	3	6	9	3	6	9
2	104	988	1118	154*	1005	1781*	104	933	1418	157	1287	1610
4	116	1031	1136	93	986	1417	128	1196	1511	146	1282	1376
6	152	1261	1518	81	819	1240	117	1133	1453	170	1260	1694
8	159	1131	1402	115	1030	1584	101	986	1373	183	1274	1626
10	100	789	1173	91	802	1339	138	1219	1410	127	898	1700
Control	106	974	1379	69	912	1088	139	955	1509	125	1288	1468

* Significant at 5% level.

3. OTHER INVESTIGATIONS

(a) *"Herbe Sifflette"* (Paspalidium geminatum). Experimental work on the control of this grass was continued this year. Two series of trials were carried out: one to obtain further information on the effectiveness of the treatment TCA — Dalapon in different localities, the other to investigate whether a critical level of TCA is required for the combination Dalapon — TCA to exercise its full phytotoxic effect.

EXPERIMENT I.

The combination TCA—Dalapon was applied on pure swards of the grass about 12 inches high in the following four localities: Magenta, Baie du Cap, Bel Ombre and Constance. Apart from Magenta trial where the treatment was made on a three acre plot in the other three localities plot size was about 900 sq. ft. The herbicides were applied in about 160 gallons of water per arpent.

RESULTS

Observations made in these trials are summarized in table 29.

The following conclusions can be drawn from the above data.

1. The treatment 100 lb TCA plus 40 lb Dalapon failed to give satisfactory results at Magenta and Baie du Cap, but at Bel Ombre and Constance results comparable to those obtained in 1956 were recorded.
2. When the rate of TCA was lowered to 60 lb in the combination TCA — Dalapon good results were obtained on the control of the weed, but the treatment TCA 100 lb and Dalapon 20 lb proved ineffective unless a second spraying was made a few months later.
3. A second application made two or four months after the first does not seem to intensify the effectiveness of the treatment and does not appear to be an economical proposition.
4. Control of the grass by the mixture TCA 100 lb plus Dalapon 40 lb can only be recommended tentatively at present.

Table 29. Effects of TCA — Dalapon on Paspalidium geminatum.

Treatment per arpent	Localities	1st Spraying (Month)	2nd Spraying (Month)	% Regrowth in December
TCA 100 lb + Dalapon 40 lb	Magenta	July	October	Complete regrowth
	Baie du Cap	May	September	"
	Bel Ombre	May	—	5
	Constance	May	—	5
	"	May	August	5
	"	May	September	8
TCA 60 lb + Dalapon 40 lb	Constance	May	—	5
	"	May	August	15
	"	May	September	Nil
TCA 100 lb + Dalapon 20 lb	Constance	May	—	60
	"	May	August	10
	"	May	September	Nil

EXPERIMENT II.

An experiment was laid down at Constance this year with a view to investigating further, observations made in 1956 which indicated that in the combination TCA— Dalapon a certain critical level of TCA was required for this mixture to be fully effective against "herbe sifflette". In this trial plot size was 400 sq. ft. and herbicide application was made in May. Regrowth incidence recorded six months after spraying are presented below.

Treatment				*% Regrowth*
TCA	100 lb	+ Dalapon	20 lb	60
"	60	"	20	30
"	40	"	20	10
"	100	"	40	5
"	60	"	40	5
"	40	"	40	35
"	20	"	40	25

The above data indicate that:

(a) For a particular level of TCA there is a corresponding critical level of Dalapon which, from an economic view point, will prove the best combination.

(b) Although there are indications that TCA at 60 and 40 lb is more effective when mixed with Dalapon at 40 and 20 lb respectively, yet, at this stage, definite conclusions can hardly be drawn on the critical levels of the two chemicals that are required to obtain maximum efficacy.

b. *"Herbe Bleue"* **(Heliotropium amplexicaulé).** This weed described as a species of *Verbena* in the 1956 Annual Report has recently been identified as being *Heliotropium amplexicaule* a species native of tropical South America. Experiments on its control were continued this year and results obtained are summarized below.

Two plots of about 1/5 arpent each, on which the weed had made good growth were sprayed with U46 Special (butyl glycol ester of 2, 4–D and 2, 4, 5–T) at rates of 1.5 and 3 lb a. e. per arpent.

Treated plants showed symptoms of gradual poisoning about a fortnight later and most of the overground parts were killed in the 3 lb treatment. Growth, however, was resumed about 2 to 3 months after herbicide application. Adventitious buds were produced either at the base of the stout root stock or from the secondary roots that were relatively shallow seated in the soil. A second and even a third spraying on the regrowth at three monthly intervals failed to eradicate the weed completely.

In a second experiment Sodium Chlorate was used on pure stands of "herbe bleue" at rates of 100, 75, 50 and 25 lb per arpent. Observations made three and six months after treatment gave the following data :

Treatment	*% Regrowth*	
	3 months after	6 months after
100 lb	5	20
75 lb	20	40
50 lb	40	75
25 lb	60	100

From the above results it will observed that Sodium Chlorate gave satifactory control at the 100 lb rate but further experimentation is needed before final recommendations are made to planters.

c. *"Liane lingue"* **(Paederia foetida).** Eradication of "Liane lingue" in stone walls has always proved difficult owing to the slow translocation of the toxic material through the abundant mass of rhizomes occurring in the walls. Investigations carried out during the year on the control of "liane lingue" in stone walls with U46 Special, a formulation containing the butyl glycol ester of 2, 4, D and 2, 4, 5—T, have given very promising results. Regrowth incidence has been only of the order of 5—10% — 5 to 6 months after treatment with this herbicide. It must be observed, however, that satisfactory control is only obtained when regrowths are systematically sprayed at about four-monthly intervals.

CULTIVATION

1. HIGHLIGHTS OF POST-RELEASE VARIETY TRIALS

PIERRE HALAIS & GUY ROUILLARD

with the collaboration of F. Mayer, P. Noël & M. Hardy

EXPERIMENTATION, carried out during the last ten years and culminating in highly replicated post-release variety and fertilizer trials established under normal field conditions on sugar estates at six locations: Beau Vallon, Bon Espoir, Mount, Union Flacq, Eau Bleue and Bonne Veine, has shown conclusively the outstanding merits of two cane varieties: Ebène 1/37 for the wetter regions and B. 37172 for the drier ones.

This statement is supported by the figures quoted in the annexed table which is a summary of data obtained on 12 months old first and second ratoons reaped in 1956 and 1957. For each variety the favourable locations only, out of the six tried, have been kept in calculating the mean results reported.

In the brief notes which follow, the results of these trials are used to solve the following pertinent questions:

(1) Which are the best varieties to plant in relation to climate and soil?

(2) What are the months most suited for their harvesting?

(3) How much nitrogenous fertilizer should be applied for maximum profit when phosphate and potash are not limiting?

It should be noted that these experiments have also provided to the various divisions of the Institute much information on the juice properties, disease reactions, borer susceptibility, foliar and internode diagnosis of the six varieties studied. For instance, the amino and other organic acids, nitrogen and ash constituents of juices have already been critically studied (cf. Ann. Rep. M. S. I. R. I. 1955, 1956, 1957).

M. 134/32 has been outclassed by a wide margin everywhere, which means that it has lost its previous position as the leading or standard variety in Mauritius. Its main defect lies in low cane yields produced. Considerable time may take place before all M. 134/32 ratoons now in existence will be uprooted, in the meantime, however, better profits will arise if they are reaped during the middle months of the grinding season.

Ebène 1/37 is a good ratooner and the richest commercial variety available at present. Its weak points are: known susceptibility to chlorotic streak which leads to poor germination and growth unless the cuttings are hot water treated before plantation and probable low resistance to cyclone damage. The lower rainfall limit where it can be grown with advantage seems to vary with the water holding capacity of the soil: approximately 65 inches per annum for deep free soils of the Réduit type and 75 inches for the gravelly soils of the Plaisance type. Ebène 1/37 shows similar response to nitrogen than M. 134/32 and should receive anything between 30 and 50 kg. of N per arpent for ratoons. Ebène 1/37 can be harvested all along the grinding season.

Table 30. Summarized results of six post-release trials reaped in 1st and 2nd ratoons.

Variety	Altitude range (feet)	Annual Rainfall range (inches)	Number of trials	Number of expt. plots weighed & analysed	Sugar Production compared to M. 134/32		Period of harvesting difference from means TCCS/Arpent (compared to six varieties)			Response to N fert. (60 compared to 20 kg. N per Arp.)		General Remarks
					TCCS/Arp.	CCS%C	Early	Middle	Late	TCCS/A	CCS%C	
M. 134/32	50—1500	60—130	6	216	—	—	+0.09	+0.09	—0.18	+0.34	—0.66	Has lost its position of standard variety.
Ebène 1/37	300—1500	70—130	4	144	+1.00(+21%)	+0.60	+0.09	—0.03	—0.06	+0.25	—0.52	Recommended, a very rich cane.
B. 3337	50—1500	60—130	6	216	+0.81(+17%)	—1.22	—0.26	+0.09	+0.17	+0.76	+0.15	Heavy ratooner but too low sucrose content.
B. 34104	50— 300	60— 70	2	72	+0.70(+16%)	+0.30	+0.02	—0.15	+0.13	+0.10	—0.28	Acceptable, low range of adaptation.
B. 37161	50—1500	60—130	6	216	+0.18(+ 4%)	—0.15	+0.12	—0.01	—0.11	0.00	—0.23	Has no special merits.
B. 37172	50— 600	60— 80	4	144	+0.66(+13%)	—0.17	—0.06	+0.04	+0.02	+0.69	—0.26	Recommended.

B. 37172 is also a good ratooner in the drier regions. Its erect habit may result in poor coverage by young canes. As far as sucrose content is concerned, it is slighly inferior to M. 134/32 ; it is more fibrous but the juices are richer in P_2O_5 than the latter variety, a characteristic which may be an advantage from the manufacturing point of view. B. 37172 shows good response to Nitrogen and ratoons should receive between 40 and 60 kg. N per arpent. The variety can be reaped throughout the crushing season.

B. 3337 has a very wide range of adaptation and is the strongest ratooner amongst the commercial varieties of the moment. It has a major defect: too low sucrose content coupled with high fibre. B. 3337 shows the unusual characteristic of its sucrose content being unaltered by heavy nitrogenous fertilization. Ratoons of this variety can give profitable returns to 50 or even 70 kg. of N per arpent. Its extension is not recommended except for marginal lands until a richer substitute is found. B. 3337 should be harvested during the middle and end of the grinding season.

B. 34104 has only been successful in two driest locations tried in the post-release experiments.

B. 37161 has most often trailed behind specially in ratoons where it offers no real advantage over M. 134/32.

Eight new post-release variety and fertilizer trials have been planted during 1957 with four varieties: Ebène 1/37 and B. 37172, the best from previous post-release trials M. 147/44 and M. 31/45, two outstanding newly released varieties. The locations selected have been: St. André and Clarens (irrigated), Bon Espoir, Terracine, Etoile, Henrietta, Valetta and Union Park.

Full information concerning the comparative merits of these four varieties cannot be expected before the end of 1960, when the results of 1st and 2nd ratoon reapings will be known.

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2. THE RECLAMATION OF "PLAINE DES ROCHES" FOR CANE CULTIVATION

S. M. FEILLAFÉ & D. H. PARISH

During the last decade nearly 40,000 arpents of new land have been brought under cane cultivation in Mauritius.

Part of this area includes poor marginal lands which, owing to more stable sugar prices can now be cultivated at a profit. The greater part, however, is of an extremely rocky and stony nature and would never have been cultivated had it not been for the availability of heavy mechanical equipment for field operations.

In reclamation work, it is natural that the worst type of land should be tackled last, and it is not surprising therefore that only recently has interest been centred on the Plaine des Roches as potential cane land.

The reclamation of land flooded by lava is probably unique to Mauritius ; this paper describes the physiography of the Plaine des Roches area, the nature of soils encountered and the reclamation work to which it is subjected.

The Plaine des Roches is formed by a series of more or less unweathered lava flows on the north east of the island and stretches from Mare d'Australia to the sea (fig. 35). The northern boundary follows roughly the Riviere du Rempart, Amaury village, Belle Vue — an annexe of Mon Loisir S. E. —, and joins the sea some distance north of Roche Noire. The southern boundary passes about half a mile north of Bon Accueil and the Pamplemousses—Flacq Road and proceeds eastward to Bras d'Eau to join the sea near Bras de Mer Belcourt. The area thus covered approximates 11,500 arpents.

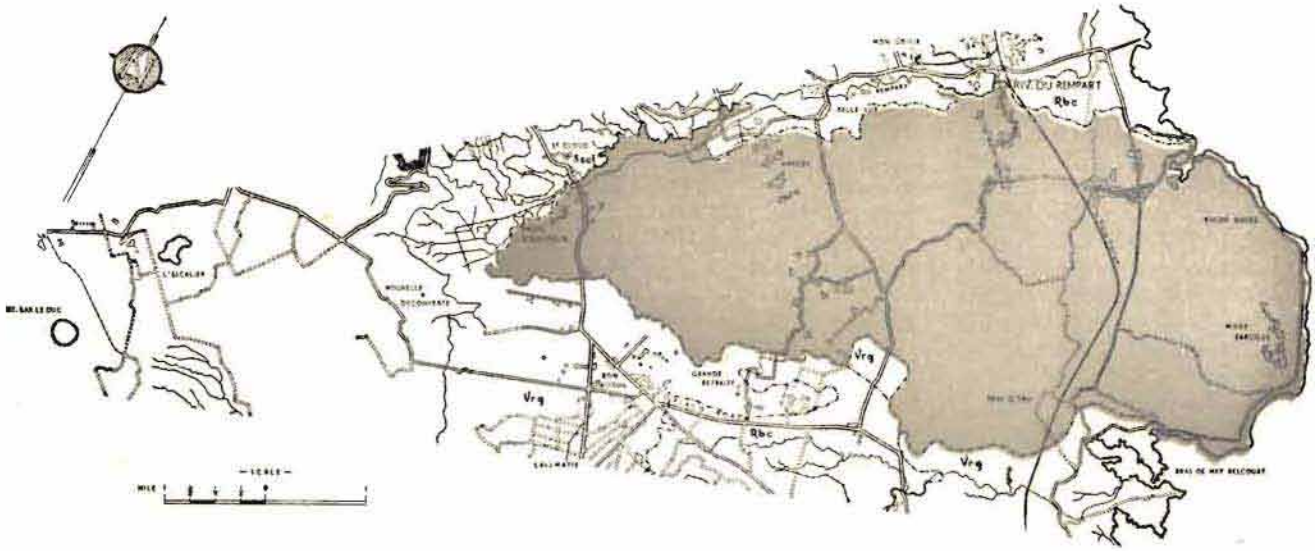

Fig. 36. Map of Plaine des Roches.

It is not certain which of the two extinct craters, Bar le Duc or l'Escalier, gave rise to the Plaine des Roches. The vicinity of the craters makes the issue more difficult; but stereoscopic study of the aerial photographs of the area suggests that it is from the latter that the Plaine des Roches originated.

The very fluid magma poured out from the crater, 1700 feet above sea level and flowed rapidly down the steep slope around Nouvelle Découverte mountain towards Mare d'Australia four miles away and at about 600 feet altitude. Thence, the magma, owing to a more level topography, flooded the countryside until it was diverted by such obstacles as rivers and hillocks on its way towards the sea, approximately eight miles distant.

The Plaine des Roches consists of numerous flows of doleritic basalt of variable thickness, the variation in depth depending mainly on the volume of magma emitted, and also on topography. Between the few last flows of lava there are sandwiched layers of soil up to about one inch in thickness. These layers are probably fossil soils of shallow depth swamped by the later lava flows, although some of the soil could be due to *in situ* weathering of the lava blocks by seepage water.

The superficial flows of the Plaine des Roches were of an extremely fluid type similar to the " pahoehoe " type of lava of the Hawaiian Islands [Simpson (1951)]. One of the main characteristics of this type of lava is a rather smooth surface which breaks in slab during cooling.

The general aspect of the Plaine des Roches is a gently sloping plain where the smooth surface bedrock outcrops count for nearly half of the area. Parts of the area are, however, cavernous due to surface solidification of deep lava flows and subsequent drainage of the liquid lava underneath. In many places these lava tunnels have collapsed giving a broken or hummocky appearance.

The Plaine des Roches is geologically speaking very recent and therefore little weathering of the rocks has taken place.

A certain amount of weathered rock material however is found in cracks and crevices. This soil permits plant growth to establish itself and gain access to the underlying weathered lava or to the fossil soil which provides a foothold for plants. Some weathered material, mixed with much organic matter may also collect in depressions giving thin layers of soil.

The soils of Plaine des Roches fall in the Lithosol great soil group of the American classification [Cline (1955)]. As is the case with other azonal soils, they show little or no development of genetic profile on account of young age except for a certain accumulation of organic matter in the uppermost layer.

The soils of this group are best mapped as land types. The whole of Plaine des Roches

proper falls in the Rockland type characterized by areas of almost bare rock outcrop insufficiently weathered to carry a soil of appreciable thickness.

The land type can be further differentiated according to the weathered soil material which collects in depressions and crevices. These soils are either silt loams or silty clay loams containing on the average 25% of organic matter. In spite of the high content of organic matter, they are not organic soils because they have not been formed under the special conditions necessary for accumulation of organic matter; the accumulation in this case being only relative owing to the small amount of soil material.

The soils are slightly to moderately acid, show high N content and a wide C/N ratio. The base exchange capacity is high and averages 65 m.e. % gm.; the organic fraction being responsible for 70 — 80% of this figure. The combined water is on the low side, less than 10, indicating that weathering is still at its initial stage.

A sample of fossil soil collected under a slab showed on the other hand a high combined water (17.8); higher acidity (pH 5.4); and a low base saturation : 11% compared to 70% for the other soils of the region.

Craig (1937) has studied the soils occurring on the south west end of Plaine des Roches in the Lallmatie and Bon Accueil area. Though their chemical characteristics are very similar to those of the Plaine des Roches, yet from a pedological point of view they are different in that they possess a top soil averaging 8" over a thin B horizon. This area will therefore be classified as a very rocky phase of a yet unclassified type of soil.

Other soil types adjoining Plaine des Roches comprise the Réduit series at Haute Rive on the lower part of the area and the Sans Souci type further inland where rainfall is higher. There is no doubt that these soil types occupied the whole region at one time and were covered by the lava flows now forming the Plaine des Roches. In fact where the lava layer becomes thinner, i.e. near the sea, in certain places when pits are dug, a profile is obtained showing a lava sheet about two feet in thickness covering a typical Réduit soil (fig. 37).

This account of rocks and soils of Plaine des Roches brings us to the interest shown by Constance and Mon Loisir S. E. in reclaiming this type of land for cane cultivation. Constance estate started reclamation work on the southern limit of Plaine des Roches near Grande Retraite in 1955. Mon Loisir in 1956 experimented on about 6 arpents

Fig. 37. Profile at Bras d'Eau showing two feet of lava overlying Réduit houldery clay.

on the northern part of the area near Amaury village where two Barbados varieties B. 37161 and B. 37172 were planted with normal fertilization. A crop of 26 tons of cane per arpent was obtained after one year. The results were considered of sufficient interest to warrant work on a larger scale in 1957. This is shown in its various stages in fig. 38. Among the machinery available is a 160 h.p. bulldozer with rock rake and another of 260 h p. with ripper.

Lines are marked at intervals of 200 feet across the field and lying perpendicular to the road. Along this line are pushed all the loose stones lying on the surface of the ground. The bulldozer is sent between these lines to break the lava. Where the lava is not very thick, the weight of the bulldozer itself is sufficient to break the superficial layer, but in most cases, the use of the ripper permits a more efficient work in breaking one or more rock layers.

These broken slabs are then pushed on each side of the wall which is built up to about 10 feet high on a base 40 feet wide A second ripping is then done. Stones from this operation are piled up by hand on alternative interlines again covering the whole length of the field. These walls can be as high as two and a half feet.

The amount of stones thus piled up on the field represents between 50,000 and 65,000 c.ft. per arpent.

Examination of the area after the walls have been lined up reveal an average of 4–5'' of soil, being a mixture of surface soil and the small amount of fossil soil found between successive layers. This represents about 400 tons of soil per arpent, a very small amount indeed at the disposal of the cane plant but the numerous cracks in the lava below provide satisfactory anchorage for the plant.

The land where the reclamation work is carried out lies in an area where a rainfall of 60″ can be expected annually. The drier coastal areas are not being reclaimed owing to the much lower rainfall and therefore to the possibilities of drought.

The soil with its high organic matter content has a very good water holding capacity and no doubt good crops may be expected, but to cover the high expenses incurred in the reclamation of the land, the good results obtained in plant cane must be maintained in the following ratoons.

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Fig. 38. Reclamation work at Plaine des Roches :

1. Four inch thick superficial lava exposed after removal of one slab.
2. General aspect of Plaine des Roches.
3. Breaking the superficial rock layer with a 160 h.p. bulldozer and ripper.
4. The accumulation of slabs after ripping.
5. Lining up of stones by means of a 260 h.p. bulldozer.
6. Stones from the first ripping have been lined up in the background. Those in the foreground have been exposed by a second ripping.
7. The field ready for planting.
8. Young cane plantation.

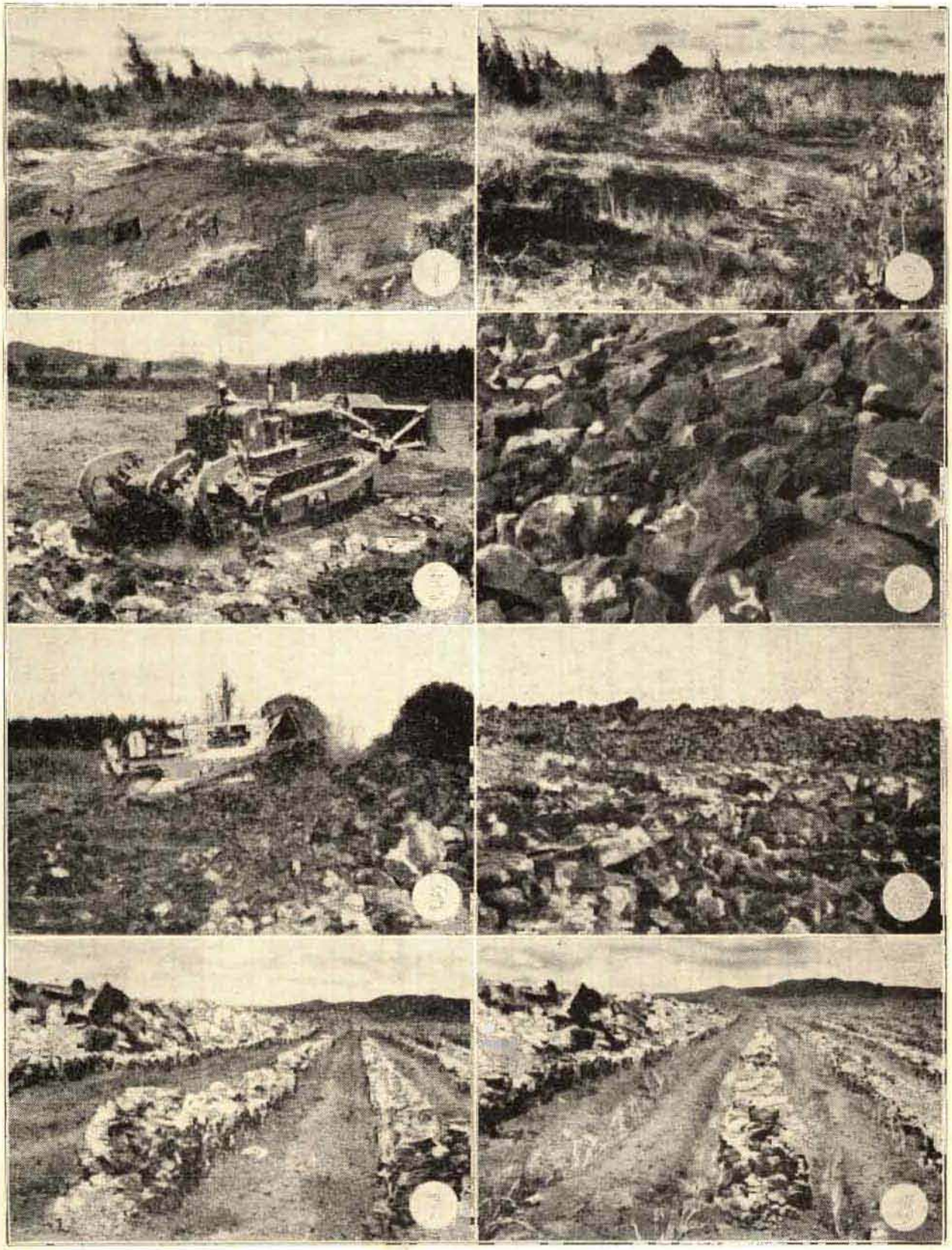

Fig. 32. Reclamation work at Plaine des Roches.

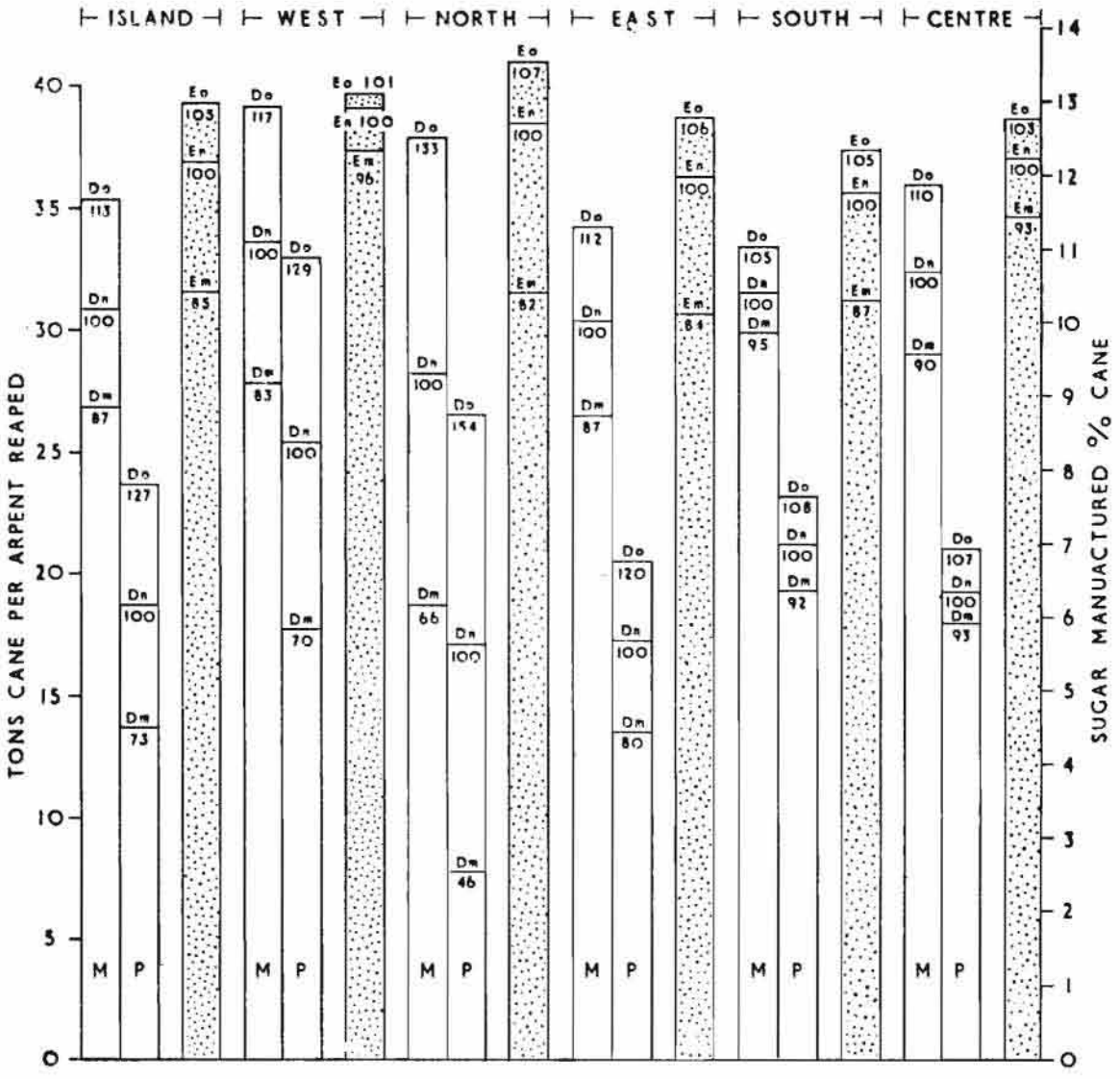

Fig. 39. Normal yields of cane, (M: estates, P: planters) and sugar manufactured % cane (shaded), are shown at Dn and En. Fluctuations therefrom are indicated at Do and Eo (no deficit or excess of rainfall) and at Dm and Em (maximum deficit and excess of rainfall).

CANE AND SUGAR YIELDS OF DIFFERENT SECTORS IN RELATION TO RAINFALL

PIERRE HALAIS

PREVIOUS studies on related subjects published in the Annual Reports of this Institute for 1954 and 1956, have shown the dominant influence of monthly rainfall distribution on the annual sugar production of the island as a whole and on that of the five sugar sectors in particular. High sums of monthly deficits, D, reckoned from November to June lead to low cane yields in the field and high excesses, E, during July to October favour low sugar content and recovery of the canes delivered to the factory. Low deficits and low excesses are both conducive to high cane yields and sucrose content.

In the first study, only global figures for deficits and excesses were used, based on monthly rainfall data averaged over the whole sugar cane area of the island. Subsequently, it has been found desirable to calculate and interpret separately both D and E for each sugar sector on the basis of its own monthly rainfall records. Although there is a very close mathematical correlation between monthly rainfall of the various sectors on such a small island as Mauritius, there may be in any given year significant variations in rainfall between sectors especially the leeward western one and the others.

Consequently, for the whole period of eleven years, running from 1947 to 1957, during which no winds of cyclonic strength were recorded, new regression equations for each sugar sector have been worked out featuring November-June deficits and cane yield on the one hand, and July-October excesses and sugar manufactured % cane on the other.

The results obtained are shown in table 31 in which M refers to plantations run by mill owners, P by planters and T for the island as a whole.

The regression coefficient b, which means either the loss of cane production expressed in tons per arpent, following one inch of deficit D or the loss in cane quality, expressed as sugar manufactured % cane, following one inch of excess E, may be useful for the better understanding of at least three problems relating to the sugar industry.

A. OBJECTIVE FORECAST OF CANE PRODUCTION.

In years without destructive cyclones, it should be possible to estimate cane production with fair accuracy before the grinding season begins. On the other hand the forecast of sugar manufactured % cane, which bears so much weight on the total sugar output, is not possible, even after crushing has started since this figure depends largely on the rainfall conditions which will prevail during the coming months.

Table 31. Correlation and regression coefficients between cane yield, sucrose content, and rainfall deficits and excesses.

	ISLAND			WEST			NORTH		
	M	P	T	M	P	T	M	P	T
Tons cane per arpent (mean 1947/57)	30.9	19.5	25.0	32.9	23.6	26.3	30.1	19.8	23.3
Rainfall Deficit November—June (mean 1947/57)			13.4			10.0			13.3
Correl. coefficient, r	–0.873	–0.907	–0.915	–0.678	–0.633	–0.627	–0.835	–0.870	–0.882
Reg. coefficient, b	0.272	0.333	0.312	0.510	0.665	0.668	0.647	0.635	0.640
Sugar manufactured % cane (mean 1947/57)			12.11			12.48			12.67
Rainfall Excess July—October (mean 1947/57)			2.02			0.64			0.84
Correl. coefficient, r			–0.917			–0.478			–0.935
Reg. coefficient, b			0.267			0.211			0.860

	EAST			SOUTH			CENTRE		
	M	P	T	M	P	T	M	P	T
Tons cane per arpent (mean 1947/57)	31.7	18.2	23.1	30.9	20.0	27.1	30.4	19.3	25.7
Rainfall Deficit November—June (mean 1947/57)			12.6			16.4			14.7
Corrl. coefficient, r	–0.710	–0.795	–0.817	–0.569	–0.502	–0.504	–0.561	–0.527	–0.526
Reg. coefficient, b	0.270	0.241	0.228	0.092	0.100	0.092	0.222	0.093	0.163
Sugar manufactured % cane (mean 1947/57)			11.83			11.73			12.38
Rainfall Excess July—October (mean 1947/57)			4.35			2.25			2.77
Correl. coefficient, r			–0.777			–0.877			–0.762
Reg. coefficient, b			0.140			0.206			0.105

Note : All correlation coefficients above 0.602 pass the 5% level of significance
and above 0.735 pass the 1% " " "

B. NORMAL VALUES FOR CANE YIELD AND SUGAR MANUFACTURED % CANE.

By eliminating fluctuations caused by rainfall it is possible to calculate normal values for cane yields and sugar manufactured % cane. These values form a sound basis of comparison to assess quantitatively the trend in cane and sugar yields. Apart from human intervention, the total sugar output is largely dependent on rainfall variations as indicated above. Fig. 39 shows the normals referring to the years 1956 and 1957, as well as the extremes which would result from exceedingly good (D = o and E = o) or excessively bad (D = maximum and E = maximum) rainfall in terms of cane yields per arpent and sugar manufactured % cane for each sector.

The calculated regression coefficient b, being of the same magnitude in the case of high yielding plantations run by mill owners, as of the lower yields recorded by planters, the percentage of variation in cane production accruing from yearly fluctuations of rainfall distribution is much smaller in the former case than in the latter. In other words, greater stability accompanies higher agricultural level.

As expected from the general climatology of the sectors, the north shows the highest potential variations in both cane production and quality, while the south and centre are remarkably stable. It is interesting to note that, in spite of irrigation practised in the west, the influence of rainfall is still predominant.

Data for 1947-48, 1952-53 and 1956-57 are given in tables 32 and 33 and record the progress achieved during the past eleven years. All figures quoted for tons of cane per arpent, sugar manufactured % cane, or sugar production per arpent, have been corrected by using the appropriate regression coefficients which take into account the normal rainfall, and the calculated deficits and excesses.

The outstanding facts emerging from these data are summarized below but it should be clearly stated that the reasons behind the changes are multiple and complex and should leave much food for thought.

(1) The area reaped has not increased appreciably after 1953.

(2) Cane yields have shown a remarkable increase in the west, from 1947 to 1953, and in the south and centre after 1952–53. The cane yields in the north and east are, for the moment at least, declining.

(3) Sugar manufactured % cane has progressed on the whole, especially after 1952–53.

(4) Tons of sugar made per arpent harvested show the largest increase in the west, south and centre.

(5) Tons of cane crushed per week have increased regularly throughout the whole period under study.

(6) The length of crushing for a crop of normal size has decreased mostly after 1952-53 particularly in the north.

(7) Sugar output is still rising in the south, west and centre.

It is worth noticing that the length of crushing for a crop of normal size, a figure proposed for the first time, appears to constitute a valuable index in integrating the ever changing rates of agricultural and manufacturing progress. Lengthening of the period means that the agricultural side is comparatively ahead while the factory is lagging behind. Shortening of the period, as it now stands, is conducive to the opposite conclusion.

C. ASSESSING THE RETURN FROM IRRIGATION.

The regression coefficients found can be used to give a fair idea of the average response in tons of cane per arpent to be expected as a result of irrigation when there is rainfall deficit. The highest average response, reaching nearly two thirds of a ton of cane per inch of water applied, refers to the north where annual rainfall averages 55 inches. The west, which only receives about 45 inches of rain on the whole, should respond even more to irrigation.

Table 32. Normal cane yields and sugar manufactured % cane in different sectors of the island 1947—1957.

	1000 Arpt. reaped			*Normal T. C. A.*			*Normal S.M. % cane*			*Normal T.S.M/Arpt.*		
	1947 — 1948	*1952 — 1953*	*1956 — 1957*	*1947 — 1948*	*1952 — 1953*	*1956 — 1957*	*1947 — 1948*	*1952 — 1953*	*1956 — 1957*	*1947 — 1948*	*1952 — 1953*	*1956 — 1957*
Island	133.5	166.2	168.6	24.6	24.7	24.9	11.80	12.14	12.33	2.90	3.00	3.07
West	6.6	8.1	8.8	20.0	28.0	27.3	12.51	12.03	12.94	2.50	3.37	3.53
North	36.5	47.2	48.2	22.8	23.0	21.0	12.41	12.42	12.86	2.83	2.86	2.70
East	28.7	36.9	37.2	22.8	24.1	22.6	11.62	11.65	12.19	2.65	2.81	2.75
South	43.5	52.3	53.6	26.2	26.6	28.1	11.49	11.70	11.92	3.01	3.11	3.35
Centre	18.1	21.8	22.0	25.4	24.8	27.5	12.46	12.40	12.59	3.16	3.07	3.46

Table 33. Normal duration of crop and sugar production from 1947 to 1957.

	1000 tons cane crushed weekly			*Length in days of a normal crushing season*			*Normal sugar production in 1000 tons*		
	1947 — 1948	*1952 — 1953*	*1956 — 1957*	*1947 — 1948*	*1952 — 1953*	*1956 — 1957*	*1947 — 1948*	*1952 — 1953*	*1956 — 1957*
Island	159.9	199.1	232.4	146	146	129	387	499	518
West	6.9	10.8	13.0	134	150	132	16	27	31
North	39.2	54.1	65.5	151	143	110	103	135	130
East	32.0	41.3	43.2	146	153	133	76	104	99
South	58.9	64.7	77.4	140	151	138	131	163	180
Centre	23.8	28.0	33.4	137	137	129	57	67	76

SUGAR MANUFACTURE

1. SYNOPSIS OF CHEMICAL CONTROL FIGURES 1957 CROP

J. D. DE R. DE SAINT ANTOINE & J. P. LAMUSSE.

GENERAL

THE striking feature of the 1957 crop is its similarity with that of 1956. The 26 mills in operation crushed 4,344 thousand tons of cane which yielded 561,6 thousand tons of sugar, a shortfall of only about eleven thousand tons as compared with the 1956 record sugar production. Had not a severe drought prevailed in the North of the island from November to May, a new record would doubtless have been set this year. Further, most of the chemical control figures for 1957 are almost identical with those obtained in 1956, as will be seen below.

CANE QUALITY

Sucrose per cent cane averaged 14.59 this year as against 14.62 last year. However the sucrose content of the cane in the northern section of the island was much higher this year than last; in the East and West it was a little lower whereas in the Centre and South very similar figures were obtained, as shown in table 34 below in which the figures for 1955 are also included for comparative purposes.

Table 34. Average Sucrose % cane, 1955—1957.

Crop Year	Island	West	North	East	South	Centre
1955	14.24	15.05	14.82	14.00	13.87	14.17
1956	14.62	15.06	15.19	14.51	14.20	14.35
1957	14.59	14.87	15.53	14.33	14.16	14.33

Two factories of the North, Labourdonnais and Belle Vue, averaged 16.47 and 16.44 sucrose per cent cane respectively this year, spectacular figures which had apparently never yet been attained in Mauritius. It is interesting to note that average weekly sucrose per cent cane figures of 17.75 have been obtained at those two factories during the peak of the 1957 maturity period.

The Clerget purity of the 1st expressed juice was slightly better this year, averaging 90.1 against 89.9 in 1956. The mixed juice showed the same increase in purity. It is

interesting to note that for several weeks during this crop some factories had difficulties with their juice analyses and the Clerget purity of juices was consistently lower than the apparent purity. On the other hand the fibre content of the cane was a little higher, 11.86 against 11.67 last year, due in part to the fact that more Barbados canes of high fibre content were reaped this year.

MILLING.

A synopsis of crushing data and milling figures is given in Table 35 below.

Table 35

	1954	1955	1956	1957
Number of factories	27	26	26	26
,, ,, crushing days	119	113	109	105
Tons cane/hour/factory	67.8	69.5	74.7	76.1
, fibre/ ,, / ,,	7.51	8.04	8.72	9.03
Imbibition % fibre	—	—	222	231
Sucrose % bagasse	2.71	2.68	2.63	2.63
Moisture % ,,	47.4	47.4	47.8	47.5
Reduced Mill Extraction	94.8	94.8	95.4	95.3
Extraction Ratio	40.2	38.0	36.8	37.1

As may be seen from the above figures, the average crushing rate has been going up slowly but steadily during the past four years. Union Flacq, the biggest factory of the island, averaged 186.4 metric tons per hour, crushing at times over 200 tons / hour with six mills (4 mills 71 x 34, one of 75 x 38 and one of 71 x 38) and still averaging 94.4 reduced mill extraction for the crop.

The number of crushing days has reached a low figure of 105 this year, mainly because of the drought which prevailed in the North, thus enabling six factories to complete their crop in less than 90 days — a performance attained by no factory last crop. St. Antoine factory, which lies in the region most affected by the drought, completed its crop in only 68 days. Rose Belle factory, on the other hand, which harvested a record crop this year, crushed during 141 days.

So far as milling efficiency is concerned, there is no marked difference between the 1957 and 1956 figures. However the percentage increase in tons of fibre crushed per hour has been greater than the percentage increase in tons of cane crushed per hour, due to the higher fibre content of the cane this year, as shown in Fig. 40.

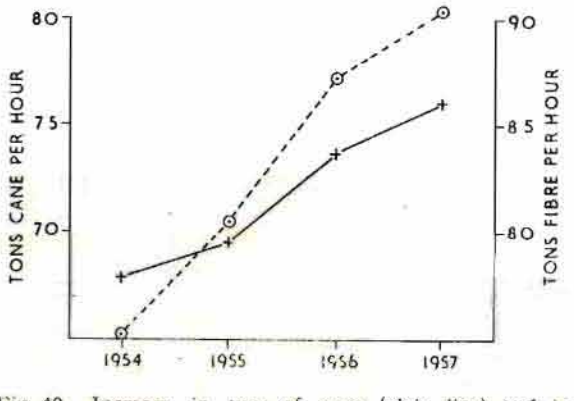

Fig. 40. Increase in tons of cane (plain line) and in tons of fibre (dotted line) crushed per hour from 1954 to 1957.

Thus, with almost the same equipment, it was possible to average this year practically the same milling efficiency as last year whilst crushing 3.5 per cent more fibre per hour. This has doubtless been achieved as a result of stricter mill control, better mill settings and lower final bagasse moisture. In this connection, Dr. H. W. Kerr's two months visit of the island has been most valuable, not only for the new ideas he brought along about milling, but also for the keen interest

he has aroused in our mill technologists and for the incentive he has created by claiming that our mills can achieve still better efficiencies with their present equipment.

One of the "tricks" that Dr. Kerr gave us is the use of "woolly" top rolls. A picture of such a roll is given in fig. 41, whereas fig. 42, represents a juice-grooved roll which had to be temporarily used as top roll and the grooves of which had been welded round. The welds, however, were not entirely impervious, with the result that jets of juice blew from the tiny cracks in the welds whilst the roller was turning round, as may be seen from the picture. This picture thus illustrates the considerable pressure which is exerted on the juice in a cane mill.

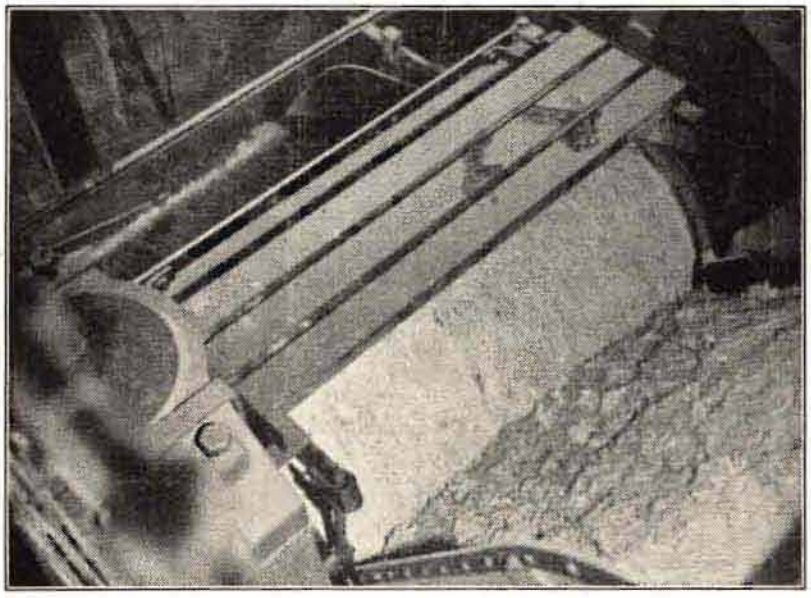

Fig. 41. "Woolly" top roll.

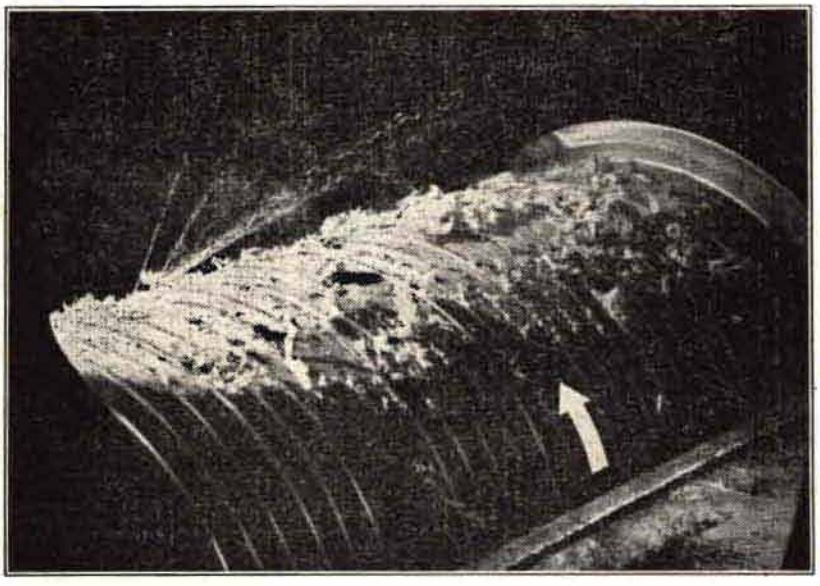

Fig. 42. "Squirting" top roll.

The "woolly" roll shown in fig. 39 is the top roll of the last mill of Labourdonnais factory. The moisture content of the final bagasse at this factory averaged 45.9 percent before the top roll was "woolled up" whilst the figure came down to as low as 42.8 per cent after the roll was made woolly, with the result that Labourdonnais averaged 43.4 per cent moisture in final bagasse for the crop.

In other cases it was not possible to make bagasse adhere to the top roll of the last mill, although that could be done in the other mills. Such was the case at Union—St. Aubin factory, apparently with very good results, since this factory achieved the second best mill extraction of the island this year whilst last year it ranked twelth on the basis of reduced mill extraction. The best milling work for the present crop was achieved by Mon Loisir factory which averaged 31.3 extraction ratio and 96.1 reduced mill extraction.

LIMING AND pH CONTROL

St. Antoine factory used imported lime throughout the crop whilst other factories employed it on a trial basis. From the information gathered, particularly at St. Antoine and at the Mount factories, very good results were obtained. Not only does the imported lime have a higher CaO content than that manufactured locally from coral, but it is much finer and seems to be more active, with the result that the amount of CaO used per ton of cane is appreciably reduced. Further, local lime often contains unburnt particles and grit which cause more wear of the limed juice pumps and, in the case of St. Antoine factory, used to break the glass electrode of the pH. controller.

Two factories. St. Antoine and Riche en Eau, have used pH controllers this crop with very good results. Charts recorded with and without these controllers are reproduced in fig. 43 to 46.

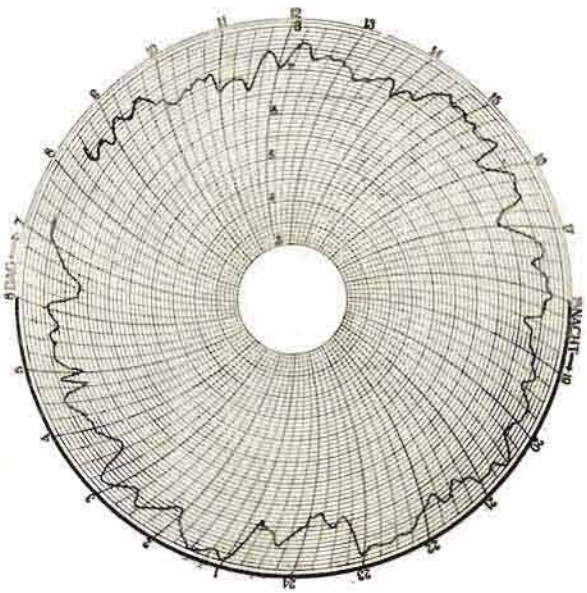

Fig. 43. pH of limed juice without automatic control (Factory A)

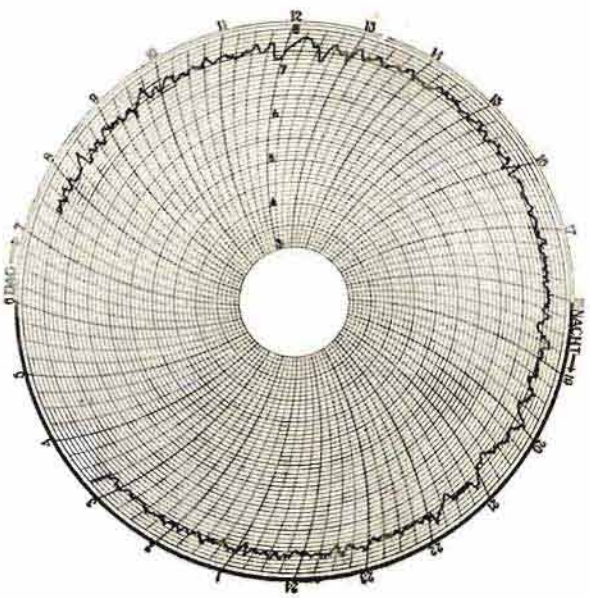

Fig. 44. pH of limed juice with automatic control (Factory A)

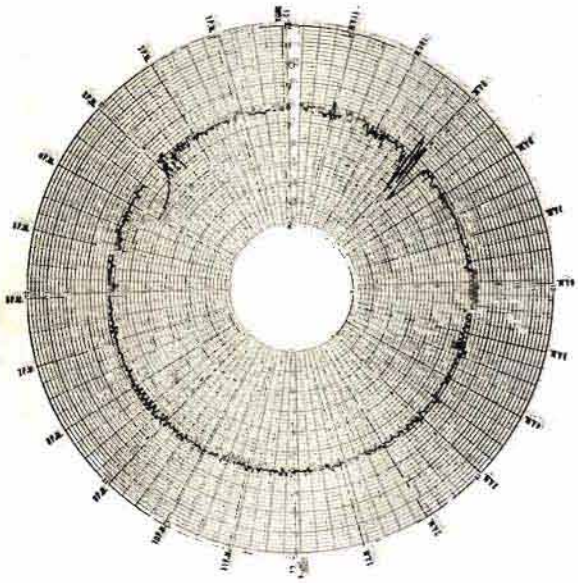

Fig. 45. pH of limed juice with automatic control (Factory B)

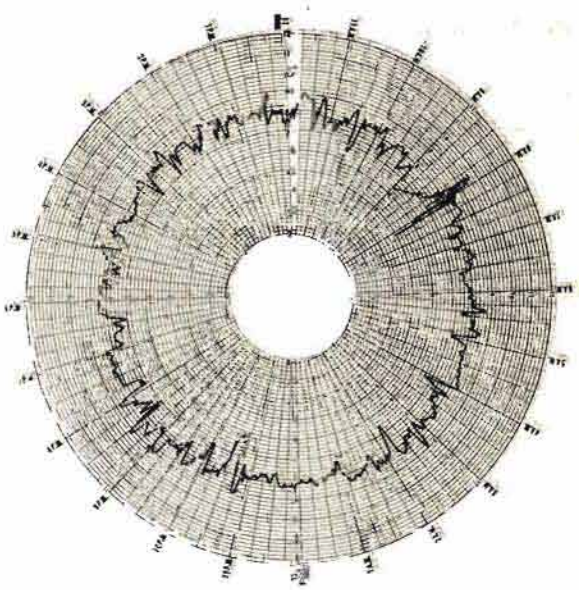

Fig. 46. pH of limed juice without automatic control (Factory B)

CLARIFICATION

Juices have generally been more difficult to clarify this year than last year, several factories having even experienced serious clarification difficulties. It has not been possible to assess the cause of the difficulties, but it is believed that they are mostly due to climatic conditions, particularly to the dry spell that prevailed throughout most of the crop.

In a few factories, particularly at Mon Tresor, clarification difficulties were rather spectacularly overcome with the help of krilium which was added in the flash tank in the form of a slurry at the rate of 1 gram per ton of cane.

FILTRATION

There has been a marked improvement in filtration this year as compared with 1956, pol. per cent cake having averaged 5.57 as against 6.14 last year, whilst the quantity of cake has not varied appreciably from one year to the other. The improvement is due mainly to better operation of the rotary vacuum filters in 1957, as shown in table 36 below.

Table 36.

	1956		1957	
	F. Presses	Rotary Filters	F. Presses	Rotary Filters
Pol. per cent cake	7.92	3.30	7.80	2.55
" " average	6.14		5.57	
Cake per cent cane	2.15		2.12	
Pol. lost in cake per cent cane	0.13		0.09	

One more rotary filter was installed this year, bringing up the number to 10, leaving 16 factories with filter presses. It should be pointed out that the average pol of the cake from rotary filters can still be profitably reduced by about one unit, and that would mean a gain of about 0.5 on sucrose recovered per cent cane.

BOILING HOUSE

There was no appreciable difference with last year in boiling house work as shown by table 37.

The final molasses purity was slightly higher in 1957 than in 1956 but this was compensated by a lower percentage of molasses so that the sucrose lost in molasses % cane is almost the same for both years.

The undetermined losses have gone up from 0.19 in 1956 to 0.23 in 1957. This may be due partly to the difficulties encountered in clarifying the juices this year and partly to better chemical control. More factories have started weighing their molasses and scums this crop so that the undetermined losses that they report is more accurate. For raw sugar production twenty-two of the factories use the same massecuite system: graining on a mixture of syrup and molasses and using C sugar magma as footing for the A and B strike. All the factories except one do some boiling back of A molasses on the A strike. Four factories bag their C sugar.

Table 37.

	A Massecuite Purity	B Massecuite Purity	C Massecuite Purity	A Massecuite Purity Drop	B Massecuite Purity Drop	C Massecuite Purity Drop	A Molasses App. Purity	B Molasses App. Purity	C Molasses App. Purity	Red. Boiling House Recovery	Final Molasses Clerget Purity	Mol. % cane	Sucrose lost in Molasses % cane
1956	79.6	68.2	55.2	20.4	20.9	21.6	50.0	39.7	32.5	89.0	37.2	2.62	0.92
1957	79.6	68.4	55.6	20.7	21.1	22.3	50.4	40.0	33.4	89.0	37.7	2.45	0.90

SUGAR

The average polarization of the sugar has dropped from 98.57 in 1956 to 98.45 in 1957 although a slightly higher proportion of white sugar was made in 1957. This is due to the low polarization (96 to 98) sugar of which 24,624 tons were made this year for export to Japan. This is the first time for many years that sugar polarising below 98 has been made in Mauritius. The Dilution Indicator of the sugar produced has shown a slight improvement from 38.8 in 1956 to 37.2 in 1957, but in both years only 18 factories reported the moisture content of their sugar. In many factories no importance seems to be attached to the moisture content of the sugar and no regular control is exercised over it.

2. PERFORMANCE OF A NEW TYPE OF CENTRIFUGAL LININGS

J. D. DE R. DE SAINT ANTOINE & J. P. LAMUSSE

During the 1955 crop a few sugar centrifugals of the island were equipped with new types of screens and backings manufactured by the French firm Krieg and Zivy. Encouraging results having been obtained, a large number of centrifugals were equipped with the new linings during the 1956 and 1957 crops. Prior to the 1957 crop it was therefore decided to make a comparative study of these new linings with a view to assessing their advantages and disadvantages over the standard centrifugal linings for the curing of C massecuites.

The Krieg and Zivy linings are made up of (a) a special outer backing, (b) a sandwich lining and (c) a slotted screen as illustrated in fig. 47. *

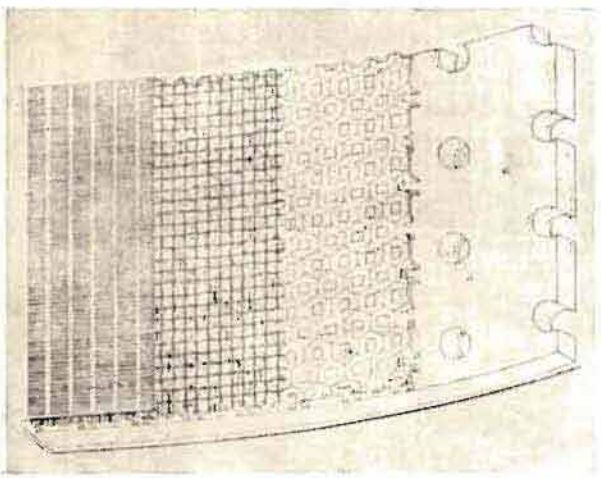

Fig. 47. Cross section of centrifugal basket equipped with Krieg and Zivy linings.

The outer backing, called N 606, is either of brass or of a special strong alloy known under the trade name "Arcap". Its inner surface which rests against the centrifugal basket consists of a hexagonal network of supporting lines offering minimum obstruction to the flow of molasses towards the hole in the basket, and its outer surface bears a conical hole at the centre of each hexagon. It is accurately machined so that its thickness is uniform throughout, and hence it makes a perfect end-to-end fit. It has a draining capacity of 23 per cent.

The sandwich lining is of brass, 9 mesh, with 0 6 mm. threads woven in such a way that the undulations of the threads are of the same amplitude in the warp as in the weft, thus ensuring more uniform backing of the screen.

The screen is perforated with conical slots 0.25 or 0.35 mm. wide by 4 mm. long. It is made of brass 0.45 or 0.70, or of "arcap" 0.50 mm. thick. The latter material offers the advantage that under the action of the plough the screen of a 42 inch basket will elongate with use by about $\frac{3}{4}$ in. only, whilst brass and copper screens elongate by about $1\frac{1}{2}$ and 3 in. respectively. The screen is accurately machined so that the width and length of the slots are uniform throughout. Further, in the case of "arcap" material, the slots are not distorted through use. The draining capacity of the screen with 0.35 mm slots is 28 per cent.

Krieg and Zivy claim the following advantages for their linings:

(a) the design of the outer backing is such that it increases the life of the screen,

(b) the use of the sandwich lining further increases the life of the screen,

(c) it is possible to use thin brass screens 0.45 mm. thick in centrifugals fitted with Fives-Lille ploughs when the centrifugals are equipped with Krieg and Zivy outer backings and sandwich linings, in which case the life of the screen is satisfactory.

It must be pointed out here that although it was not possible during the present study to compare the durability of the new linings

* Reprinted from trade literature.

to that of standard ones, it would appear from the information gathered on several factories that the life of the Krieg and Zivy linings, especially that of the "arcap" backing and screen is far longer than that of standard linings.

Further, many of the engineers who have tried the new linings during the recent crop claim that these linings offer the following advantages:

(a) increase in capacity of the centrifugal station,

(b) higher pol. of sugar,

(c) lower pol. of molasses.

Since the most important sugar losses of a factory occur in final molasses, and since a a decrease of only one degree in the purity of molasses would mean an approximate gain of eight hundred thousand rupees annually to the sugar industry of the island, it was decided, as mentioned above, to find out whether the new linings offer definite advantages over the conventional ones, especially with reference to the purity of the final molasses and the polarisation of the C sugar.

Comparative tests were accordingly made under carefully controlled conditions in four factories equipped with high speed modern centrifugals. Special attention was devoted to the obtention of massecuite temperatures as uniform as possible as it is believed that such tests cannot be of great value if the temperature of the massecuite fed into one centrifugal differs appreciably from that of the massecuite fed into the other. Hence the reason why the results obtained at Saint Antoine factory, where massecuite temperatures differed very little, are tabulated separately from those obtained in the three other factories.

In each of the factories where comparisons were made, either one of the centrifugals was fitted with Krieg and Zivy linings in a battery equipped with standard linings, or one machine was fitted with standard linings in a battery equipped with Krieg and Zivy linings. Thus, whenever possible, the tests were made by comparing the centrifugal under test with each of the two neighbouring centrifugals in turn.

The procedure adopted for the tests was as follows: Every time that one of the two centrifugals was being charged, the temperature of the massecuite was noted and a sample collected. After the test, which lasted 45 - 60 minutes and which generally comprised five cycles, the composite sample was thoroughly mixed, sub-sampled, analysed for apparent purity and inspected for grain size and regularity.

The sugar was sampled separately from each centrifugal by boring through the cake with a 2 - inch diameter borer at the end of each cycle. Care was taken to bore at the same height in both baskets in order to eliminate sources of error due to differences in the thickness of the film of molasses adhering to the sugar surface as this film is thinner towards the top than towards the bottom of the basket.

At the end of the test the sugar samples were sub-sampled and analysed for pol. The thickness of sugar in the basket was measured after each cycle by boring through the cake with a metal scale and averaging the results for the test.

Throughout the test, molasses was sampled at one minute intervals from each centrifugal, and the two samples thus obtained were thoroughly mixed separately, sub-sampled, analysed for Clerget purity and examined under the microscope for the presence of crystals. All the samples thus examined were found to contain sugar crystals of different sizes.

For each test the two centrifugals were timed so as to give cycles of exactly the same duration, and the number of r.p.m. of each machine was checked.

Details of the centrifugals and linings used for the comparisons, and the results of the tests are tabulated hereunder (tables 38, 39, 40.)

It appears from these results that Kreig and Zivy linings are not superior to standard slotted linnings so far as the polarization of the C sugar and the purity of the final molasses are concerned. At Saint Antoine factory Kreig and Zivy linings yielded on the average slightly lower pol sugars than standard linings did (80.7 versus 81.5) whilst the reverse was true for the three other factories taken together (84.9 for Kreig and Zivy versus 84.2 for standard linings). If the results obtained on all four factories are averaged, a polarization of 82.8 is arrived at for both types of linings. It will also be noted that both at Saint Antoine and at the three other factories slightly higher purity molasses were obtained on the average with Kreig and Zivy linings than with standard

Table 38.

Name of Factory	Type of Centrifugal	Type of Lining					
		Backing		Sandwich		Screen	
		Krieg & Zivy	Standard	Krieg & Zivy	Standard	Krieg & Zivy	Standard
A. Saint Antoine	Electric Broadbent 42″ x 24″ 1500 r.p.m.	N. 606 arcap	4 mesh brass	9 mesh brass	7 mesh brass	0.35 x 4.0 x 0.45 arcap	0.40 x 2.6 x 0.90 copper
B. Belle Vue	Electric Fives-Lille 42″ x 24″ 1500 r.p.m.	N. 606 arcap	4 mesh brass	9 mesh brass	7 mesh brass	0.25 x 4.0 x 0.45 brass	0.35 x 4.0 x 0.85 copper
C. Mon Désert	Electric Fives-Lille 42″ x 24″ 1500 r.p.m.	N. 606 arcap	4 mesh brass	9 mesh brass	8 mesh brass	0.35 x 4.0 x 0.50 arcap	0.35 x 4.0 x 0.85 copper
D. Labourdonnais	Hydraulic Watson Laidlow 42″ x 20″ 1500 r.p.m.	N. 606 arcap	4 mesh brass	9 mesh brass	7 mesh brass	0.35 x 4.0 x 0.5 arcap on No. 1 centrifugal & 0.25 x 4.0 x 0.45 brass on No. 3 centrifugal	0.35 x 4.0 x 0.90 copper

Table 39.

Factory	Date of Test	Type of linings	Fugal No.	Massecuite				Sugar		Final Molasses
				Quality	Av. grain size, mm.	Av. Temp. °C	App. Purity	Pol.	Av. Thickness in.	Clerget Purity
A	20.8.57	Ordinary	4	Good	0.30	42.2	55.6	77.9	2	33.6
,,	,,	K & Z	5	,,	,,	42.0	,,	79.7	2	34.4
,,	20.8 57	Ordinary	4	Very good	0.30	41.1	54.4	86.6	2 1/8	34.8
,,	,,	K & Z	5	,,	,,	41.0	,,	81.4	2 1/8	34.1
,,	27.8.57	Ordinary	4	Good	0.30	40.0	56.5	86.0	2	34.1
,,	,,	K & Z	5	,,	,,	40.0	,,	85.0	2	35.6
,,	27.8.57	Ordinary	4	Average	0.25	40.6	56.2	84.6	2	31.5
,,	,,	K & Z	5	,,	,,	40.6	,,	83.2	2	35.4
,,	3.9.57	Ordinary	4	Bad*	0.10–0.40	43 5	56.7	84.0	2 1/8	36.5
,,	,,	K & Z	5	,,	,,	43.5	,,	85.0	2 1/8	34.2
,,	3.9.57	Ordinary	4	Bad*	0.10–0.40	41.5	56.2	82.5	2 1/2	34.3
,,	,,	K & Z	5	,,	,,	41.5	,,	84.0	2 1/4	34.8
,,	18.9.57	Ordinary	4	Good	0.30	41.1	58.2	75.2	2 1/8	35.2
,,	,,	K & Z	5	,,	,,	41.4	,,	71.0	2 1/4	34.7
,,	18.9.57	Ordinary	4	Good	0.30	42.0	59.5	77.8	2 1/4	35.5
,,	,,	K & Z	3	,,	,,	42.1	,,	77.3	2 3/8	35.3
,,	20.9.57	Ordinary	4	Average	0.30	41.1	60.0	80.8	2 3/8	37.6
,,	,,	K & Z	3	,,	,,	41.0	,,	82.0	2 3/8	36.6
,,	20.9.57	Ordinary	4	Average	0.30	40.6	58.8	79.5	2 5/8	36.5
,,	,,	K & Z	3	,,	,,	40.4	,,	78.6	2 5/8	36.7
,,	Average	Ordinary	—	—	—	41.3	57.2	81.5	—	35.0
,,	,,	K & Z	—	—	—	41.3	,,	80.7	—	35.2

* Fine grain present.

Table 40.

Factory	Date of test	Type of linings	Fugal No.	Massecuite				Sugar		Final molasses
				Quality	Av. grain size mm.	Av. temp. °C	App. purity	Pol.	Av. Thickness in.	Clerget purity
B	27.9.57	Ordinary	1	Average	0.30	37.2	54.8	79.2	1 3/4	36.5
,,	,,	K & Z	2	,,	,,	38.3	,,	79.4	1 3/4	35.3
,,	2.10.57	Ordinary	1	Bad*	0.35–0.40	43.2	58.8	84.5	2 1/4	40.0
,,	,,	K & Z	2	,,	,,	41.3	,,	83.0	2 1/8	37.8
,,	2.10.57	Ordinary	1	Good	0.30	42.5	58.0	82.3	2 1/8	37.8
,,	,,	K & Z	2	,,	,,	40.0	,,	82.0	2 1/4	37.8
,,	12.10.57	Ordinary	1	Bad*	0.30	43.0	61.9	90.4	2 3/8	38.7
,,	,,	K & Z	2	,,	,,	45.8	,,	90.8	2 1/4	39.4
,,	12.10.57	Ordinary	1	Good	0.33	42.4	61.5	87.3	2 1/2	40.1
,,	,,	K & Z	2	,,	,,	45.6	,,	90.2	2 1/4	41.7
C	11.9.57	Ordinary	3	Bad*	0.35	32.8	53 5	78.3	1 1/4	34.7
,,	,,	K & Z	2	,,	,,	34.2	,,	78.6	1 1/4	34.2
,,	16.9.57	Ordinary	3	Good	0.40	39.1	57.8	84.6	2	35.7
,,	,,	K & Z	2	,,	,,	40.9	,,	86.8	2	37.3
D	25.10.57	Ordinary	2	Good	0.30	44.1	56.2	82.8	3 1/8	34.1
,,	,,	K & Z	3	,,	,,	42.1	,,	81.5	2 3/4	33.1
,,	28.10.57	Ordinary	2	Average	0.35	43.4	56.2	84.5	2 3/4	34 0
,,	,,	K & Z	1	,,	,,	45.4	,,	88.3	2 3/4	35.2
,,	29.10.57	Ordinary	2	Very good	0.40	43.6	59.2	88.0	3 3/8	35.5
,,	,,	K & Z	3	,,	,,	42.7	,,	88.4	3 1/4	38.3
,,	Average	Ordinary	—	—	—	41.1	57.8	84.2	—	36.7
,,	,,	K & Z	—	—	—	41.6	,,	84.9	—	37.0

* Fine grain present

ones. The difference, however is not significant enough for allowing one to claim that the standard linings yield lower purity molasses than the new ones.

On the other hand, it was observed, throughout the tests that with Kreig and Zivy screens there is less adhesion of sugar which consequently drops much more easily than with standard screens. Hence the ploughing time of centrifugals fitted with the former screens is shorter, while the screens need fewer cleanings with hot water.

Finally, it was not possible to ascertain whether the new linings caused an increase in capacity of the centrifugal station, due to faster elimination of molasses, since it was necessary to run cycles of exactly the same duration and since the amount of molasses centrifuged from each basket could not be collected and weighed separately. Such, however, does not appear to have been the case as the new linings did not yield, on the average, C sugars of higher polarization.

Table II. Area under sugar cane in thousand arpents(1), 1953 — 1957. The first column gives the total area under sugar cane, the others the area reaped for milling.

Year	Island	Area reaped					
		Island	West	North	East	South	Centre
1953	176.88	167.10	8.41	47.10	37.19	52.70	21.70
1954	178.82	168.44	8.55	48.06	37.37	52.40	22.06
1955	180.05	168.59	8.82	47.80	36.90	52.78	21.86
1956	181.21	167.90	8.74	48.16	35.95	53.17	21.88
1957(2)	182.00	169.31	8.95	48.25	35.86	54.14	22.11

NOTE : (1) To convert into acres multiply by 1.043
,, ,, ,, hectares ,, ,, 0.422

(2) Provisional figures.

Table III. Sugar production in thousand metric tons(1) 1953 — 1957.

Crop Year	No. of factories operating	Av. Pol	Island	West	North	East	South	Centre
1953	27	98.6	512.1	31.09	150.09	104.98	158.25	67.64
1954	27	98.6	498.6	28.12	140.29	98.05	163.31	68.83
1955	26	98.6	533.3	31.52	148.39	103.40	173.96	76.07
1956	26	98.6	572.5	31.06	167.14	110.22	187.60	76.47
1957(2)	26	98.5	561.6	36.02	141.09	103.04	199.08	82.44

NOTE : (1) To convert into long tons multiply by 0.984
,, ,, short ,, ,, 1.102

(2) Provisional figures.

Table IV. Yield of cane metric tons per arpent(1) 1953 — 1957.

	1953	1954	1955	1956	1957(2)
ISLAND					
Millers	32.5	31.0	31.0	32.0	32.2
Planters	23.1	20.4	19.7	21.0	18.9
Average	27.8	25.4	25.1	26.3	25.6
WEST					
Millers	37.1	32.2	34.3	32.2	35.9
Planters	30.0	25.4	24.3	24.1	27.8
Average	32.4	27.7	27.8	27.0	30.8
NORTH					
Millers	34.9	30.9	29.0	32.2	29.2
Planters	26.3	21.4	20.5	22.2	16.9
Average	29.1	24.6	23.5	25.5	21.1
EAST					
Millers	34.1	29.9	31.8	31.6	31.4
Planters	22.2	18.4	17.3	19.2	17.0
Average	26.3	22.6	22.5	23.9	22.8
SOUTH					
Millers	30.9	31.1	30.7	31.7	32.7
Planters	20.5	20.4	19.7	20.9	22.7
Average	27.3	27.5	27.2	28.3	28.8
CENTRE					
Millers	30.9	31.5	32.4	32.7	34.1
Planters	21.2	19.4	19.7	19.0	21.0
Average	26.7	26.2	27.1	27.1	29.0

NOTE : (1) *to convert in metric tons/acre x 0.959*
,, long tons/acre x 0.945
,, short tons/acre x 1.058
,, metric tons/hectare x 2.370

(2) *Provisional figures*

Table V. Average sugar manufactured % cane(1) 1953—1957.

Crop year	Island	West	North	East	South	Centre
1953	11.03	11.39	10.93	10.74	10.99	11.77
1954	11.65	11.87	11.88	11.62	11.35	11.89
1955	12.61	12.85	13.22	12.43	12.11	12.83
1956	12.95	13.17	13.59	12.84	12.47	12.89
1957(2)	12.93	13.06	13.85	12.61	12.51	12.87

NOTE: (1) *To convert into tons cane per ton sugar manufactured: divide 100 by above percentage.*

(2) *Provisional figures.*

Table VI. Tons sugar manufactured per arpent reaped, 1953—1957.

	Island	West	North	East	South	Centre
1953	3.06	3.70	3.19	2.82	3.00	3.12
1954	2.96	3.29	2.92	2.62	3.12	3.12
1955	3.17	3.57	3.10	2.80	3.30	3.48
1956	3.41	3.56	3.47	3.07	3.53	3.49
1957(1)	3.31	4.02	2.92	2.88	3.60	3.73

NOTE: (1) *Provisional figures.*

Table VII. Monthly rainfall in inches. Average over whole sugarcane area of Mauritius.

	GROWTH PERIOD: deficient months in italics								NOV. - JUNE (sum of monthly deficits)	MATURATION PERIOD: excess months in italics				JULY - OCT. (sum of monthly excesses)
Crop Year	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE		JULY	AUG.	SEPT.	OCT.	
Normals 1875—1949	3.77	7.09	11.04	11.06	12.09	9.50	6.91	4.96	15.00	4.59	4.15	2.90	2.81	2.50
Extremes :	0.52—13.18	1.74—39.92	2.69—32.46	3.07—36.04	3.35—38.98	1.45—27.60	1.62—21.41	0.97—16.49	2.20—29.20	1.62—10.23	0.60—12.52	0.69—6.41	0.76—9.83	0.00—9.40
1947	10.36	*3.42*	*8.06*	*6.83*	*4.26*	9.69	*3.50*	5.66	22.57	2.76	3.91	2.20	1.24	0.00
1948	*2.52*	*6.83*	*8.23*	*5.10*	*8.04*	12.13	*2.61*	*1.80*	21.79	4.12	2.84	*3.34*	*2.98*	0.61
1949	4.01	*5.48*	*4.81*	16.71	*8.86*	*7.01*	*3.30*	10.09	17.17	4.11	1.91	1.39	1.39	0.00
1950	*3.34*	*3.42*	*10.20*	*5.21*	23.18	11.39	*2.98*	7.02	14.72	4.47	*5.02*	2.80	2.35	0.87
1951	*3.15*	*5.86*	11.65	*8.20*	*10.89*	*7.98*	7.00	7.26	7.43	*4.91*	*5.41*	*4.16*	*3.84*	3.87
1952	4.08	*2.22*	*5.26*	11.17	16.88	10.11	*5.69*	*4.86*	12.31	*8.22*	*5.20*	*3.47*	*3.13*	5.61
1953	6.06	18.05	11.65	*6.59*	*10.57*	*8.35*	11.95	12.75	7.14	*10.10*	*4.72*	*3.07*	2.68	6.25
1954	*3.76*	11.47	*5.00*	*7.96*	14.89	*6.20*	*6.49*	6.06	12.88	*6.44*	*5.04*	*4.11*	1.53	3.76
1955	4.81	*5.19*	*4.50*	23.28	19.60	10.97	8.83	7.73	8.44	*4.66*	3.85	*3.68*	1.12	0.85
1956	*3.03*	7.70	12.02	13.59	*10.60*	*4.14*	*5.93*	*4.90*	8.63	2.94	2.82	1.68	1.40	0.00
1957	*2.08*	8.11	*7.80*	*6.98*	*8.93*	10.66	*6.14*	*3.66*	14.24	3.55	2.54	*3.32*	0.96	0.42

NOTE: To convert into millimetres, multiply by 2.54

Table VIII. Highest wind speed during one hour in miles(1). Average over Mauritius.

Crop Year	1949	1950	1951	1952	1953	1954	1955	1956	1957
NOVEMBER	—	21	17	24	18	18	14	16	12
DECEMBER	18	16	24	21	15	16	15	17	13
JANUARY	27	26	21	22	18	28	13	20	20
FEBRUARY	20	24	20	25	15	15	*34*(2)	16	19
MARCH	20	17	18	25	15	15	29	19	18
APRIL	18	21	17	22	20	16	16	17	16
MAY	20	19	20	24	22	22	19	18	15
JUNE	24	20	23	25	23	20	22	17	13
JULY	21	23	21	20	24	16	17	15	12
AUGUST	18	19	24	25	24	23	20	14	17
SEPTEMBER	20	21	21	21	20	19	19	17	17
OCTOBER	18	19	20	20	19	20	14	18	15

NOTE : (1) To convert into : knots multiply by 0.87.
kilometres/hr. multiply by 1.61.
metres/sec. multiply by 0.45.

(2) Cyclonic wind above 30 miles per hour.

Table IX. Variety trend in Mauritius 1930 — 1956.

% Area Cultivated

	Tannas	M. P. seedlings 55 and 131	Demerara seedlings DK/74, D 109 D 130, RP/6 RP/8	POJ. 2878	BH. 10/12	M. 134/32	Other M. seedlings	Ebène 1/37	B. 3337, 34104, 37161, 37172
1930	57	10	16	—	2	—	—	—	—
1935	48	7	16	1	15	—	—	—	—
1940	29	1	1	5	40	2	5	—	—
1944	5	—	—	2	27	37	7	—	—
1950	—	—	—	—	—	91	6	—	—
1953	—	—	—	—	—	83	5	8	—
1954	—	—	—	—	—	83	5	10	2
1955	—	—	—	—	—	74	5	15	6
1956	—	—	—	—	—	66	8	17	9

Table X. Percentage annual plantations under different cane varieties on sugar estates, 1954 to 1957.

Years / varieties	Island				West				North				East				South				Centre			
	1954	1955	1956	1957	1954	1955	1956	1957	1954	1955	1956	1957	1954	1955	1956	1957	1954	1955	1956	1957	1954	1955	1956	1957
M 134/32	50.0	28.5	16.3	4.2	16.7	3.9	—	—	89.5	76.3	49.4	12.6	62.2	20.0	7.4	1.7	41.1	24.3	14.7	4.3	20.0	8.5	1.7	—
M 134/32 (white)	0.5	3.4	4.3	3.3	78.0	47.5	20.6	23.8	—	0.3	3.4	5.2	—	8.0	9.6	—	—	1.2	2.5	3.6	—	1.0	—	—
M 112/34	2.1	5.0	2.2	2.1	—	6.0	—	9.4	5.6	3.7	4.3	3.5	2.2	2.2	1.4	0.8	0.4	7.1	1.8	2.0	3.1	3.9	2.6	1.1
M 147/44	—	—	14.0	35.6	—	—	40.8	46.4	—	—	6.8	47.3	—	—	16.6	32.1	—	—	11.5	39.6	—	—	16.1	13.5
M 31/45	—	—	9.0	9.1	—	—	—	6.9	—	—	1.4	5.8	—	—	8.4	10.1	—	—	13.6	12 6	—	—	8.0	1.0
Ebène 1/37	26.5	31.4	28.5	33.2	—	19.7	7.6	—	0.7	5.3	8.6	6.6	19.2	49.5	35.4	43.1	30.3	26.4	22.0	24.7	50.7	55.2	61.4	81.2
B 3337	10.0	10.7	7.4	1.8	—	—	—	—	—	0.2	0.6	—	6.5	3.2	2.9	1.0	13.0	11.1	12.2	—	16.1	22.9	8.6	1.8
B 34104	—	—	2.9	2.2	—	—	11.5	7.8	—	—	0.8	1.6	—	—	0.5	0.5	—	—	4.7	3.3	—	—	—	0.3
B 37161	5.5	7.1	8.4	2.1	0.8	4.4	16.6	1.1	2.1	6.6	14.7	4.6	5.9	8.1	7.6	2.7	5.8	9.7	8.6	1.6	8.2	2.0	0.8	—
B 37172	3.8	6.0	6.4	5.7	—	—	2.4	3.9	1.3	4.1	8.4	11.6	2.1	5.3	9.3	7.3	7.0	10.0	7.6	4.8	0.4	0.5	0.5	0.1
Other varieties	1.6	7.9	0.6	0.7	4.5	18.5	0.5	0.7	0.8	3.5	1.6	1.2	1.9	3.7	0.4	0.7	2.4	9.2	0.8	0.5	1.5	6.0	0.3	1.0
Total area, arpents	11204	12726	12706	13948	337	364	678	536	1972	2176	2169	2105	1709	1927	2029	3076	5022	5522	5438	6224	2164	2527	2392	2007

Table XI. Percentage weight of ratoons in total cane production on estates.

Year	Island	West	North	East	South	Centre
1949	82.0	75.9	78.9	81.7	83.3	82.3
1950	83.0	79.1	82.3	83.5	87.3	83.9
1951	87.6	80.0	82.5	85.6	91.5	86.3
1952	88.6	85.0	83.4	87.9	90.2	86.7
1953	87.8	85.9	87.7	88.1	88.5	85.4
1954	88.0	83.8	86.8	89.6	89.4	85.3
1955	87.1	86.7	88.6	87.7	86.4	86.1
1956	84.5	87.5	86.4	84.9	83.8	82.9
1957	85.0	79.0	86.9	83.6	85.7	83.7

NOTE: The weight of cane produced on estates in 1957 was: virgins 400,982 tons; ratoons 2,666,193 tons.

Table XII. Average yields of virgin and ratoon canes on estates. Tons per arpent. A, 1947 - 1956 ; B. 1957.

	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
Virgin	35.3	35.3	41.4	40.4	34.6	33.5	39.0	38.4	33.5	34.4	35.1	34.9
1st Ratoon	32.9	34.1	35.2	39.3	33.4	31.8	34.0	34.8	32.2	34.3	32.6	34.1
2nd "	31.1	32.8	32.7	39.7	32.1	29.9	33.3	31.4	30.4	33.0	30.0	34.4
3rd "	29.3	31.8	31.1	36.1	29.1	29.0	31.0	30.9	28.5	32.3	28.9	33.9
4th "	28.8	29.4	30.3	31.4	28.0	27.8	30.0	28.8	29.0	30.9	27.8	34.3
5th "	28.2	29.4	30.4	33.3	27.6	27.3	27.6	28.0	28.7	29.8	27.6	32.4
6th "	28.1	29.6	30.5	32.8	27.1	27 6	—	27.8	28.7	31.1	—	32.3

Table XIII. List of Crosses made in 1957

REDUIT & PAMPLEMOUSSES EXPERIMENT STATIONS

CROSS	Number of crosses made	Number of seedlings obtained	CROSS	Number of crosses made	Number of seedlings obtained
B. 34104 x D. 109	4	19	B.H. 10/12 x M. 147/44	2	32
,, x Ebène 1/37	6	558	Black Tanna x Ebène 1/37	1	0
,, x M. 27/16	2	0	Co. 281 x D. 109	9	17
,, x M. 63/39	3	1240	,, x Ebène 1/37	5	32
B. 34104 x M. 213/40	3	1430	,, x M. 63/39	5	1100
,, x M. 423/41	1	25	,, x M. 202/46	2	136
,, x M. 147/44	6	1916	,, x P. R. 905	2	0
,, x M. 202/46	1	22	Co. 421 x Co. 419	1	0
,, x M. 142/49	1	1	,, x Ebène 1/37	2	92
,, x M. 716/51	1	400	,, x M. 213/40	2	370
,, x P. O. J. 2878	3	215	,, x M. 423/41	2	58
,, x P. O. J. 2961	1	280	,, x M. 147/44	4	1605
,, x R. 397	1	0	,, x M. 202/46	2	190
,, x S. C. 12/4	1	0	,, x M. 381/51	1	0
B. 37161 x Co. 419	2	0	Co. 779 x M. 213/40	1	100
,, x D. 109	4	0	Ebène 1/37 x B. 34104	2	0
,, x Ebène 1/37	5	28	,, x Co. 290	3	168
,, x M. 63/39	3	115	,, x Co. 419	1	80
,, x M. 423/41	2	17	,, x D. 109	4	15
,, x M. 147/44	5	41	,, x M. 47/38	1	510
,, x P. O. J. 2878	3	16	,, x M. 63/39	4	1815
,, x R. 397	3	0	,, x M. 213/40	1	0
B. 41227 x D. 109	1	6	,, x M. 147/44	9	973
,, x M. 147/44	2	20	,, x M. 202/46	2	455
B.H. 10/12 x Ebène 1/37	1	0	,, x P. O. J. 2940	3	800

CROSS	Number of crosses made	Number of seedlings obtained	CROSS	Number of crosses made	Number of seedlings obtained
Ebène 1/37 x P. O. J. 3016	1	175	M. 112/34 x P. O. J. 3016	1	135
„ x Self	1	3	„ x P. R. 905	2	745
Ebène 1/44 x M. 213/40	1	54	M. 241/40 x B. 34104	2	14
„ x M. 147/44	2	49	„ x D. 109	2	0
„ x P. O. J. 2940	1	0	„ x Ebène 1/37	4	557
M. 134/32 x B. 34104	1	0	„ x M. 147/44	4	3065
„ x Co. 419	2	5	„ x M. 202/46	1	700
„ x Ebène 1/37	7	1927	„ x P. O. J. 2878	4	1051
M. 134/32 x M. 336	1	15	„ x P. O. J. 3016	1	325
„ x M. 171/30	2	0	M. 311/41 x M. 147/44	1	28
„ x M. 147/44	6	1140	M. 377/41 x M. 213/40	3	536
„ x P. O. J. 2940	3	12	„ x M. 147/44	2	15
„ x P. O. J. 2961	1	330	„ x M. 202/46	1	19
M. 134/32 White Sport x B. 4098	1	0	M. 129/43 x Ebène 1/37	2	13
„ x Ebène 1/37	1	8	„ x M. 171/30	1	45
„ x M. 147/44	2	0	„ x M. 147/44	2	30
M. 112/34 x Co. 290	4	146	M. 147/44 x D. 109	1	10
„ x Co. 419	1	11	„ x Self	1	0
„ x *Coix lachryma jobi*	1	0	M. 381/51 x Ebène 1/37	3	8
„ x D. 109	2	25	„ x M. 147/44	3	0
„ x M. 336	2	138	„ x S. C. 12/4	1	0
„ x M. 63/39	2	203	M. 99/53 x M. 112/34	1	0
„ x M. 213/40	1	45	M. 113/53 x M. 147/44	1	0
„ x M. 147/44	4	511	Mapou Perlée x M. 147/44	1	0
„ x M. 202/46	3	323	„ x M. 202/46	1	3

CROSS	Number of crosses made	Number of seedlings obtained
M.L. 3-18 x Co. 290	1	9
„ x D. 109	1	1430
„ x Ebène 1/37	2	1490
„ x M. 63/39	1	125
„ x M. 147/44	3	161
N. Co. 310 x B. 4098	1	25
„ x Co. 419	1	0
„ x D. 109	1	0
„ x Ebène 1/37	2	15
„ x M. 99/34	1	440
„ x M. 213/40	2	165
„ x M. 147/44	4	445
„ x M. 202/46	4	80
„ x P. O. J. 2940	1	0
„ x Uba Marot	1	860
55 P. x M. 147/44	1	0
131 P. x Ebène 1/37	4	15
„ x M. 147/44	4	970
P. O. J. 2727 x M. 213/40	1	200
„ x M. 423/41	1	15
„ x M. 147/44	2	175
P. O. J. 2878 x B. 34104	3	13
„ x Co. 213	2	2354
„ x Co. 290	2	710
P. O. J. 2878 x M. 147/44	3	1815
P. R. 905 x „	1	0
P. R. 1000 x D. 109	2	30
„ x Ebène 1/37	1	50
„ x M. 213/40	1	1020
„ x M. 147/44	2	30
Q. 44 x D. 109	2	115
„ x M. 147/44	1	0
SIB CROSSES		
(B. 34104 x M. 63/39) x (B. 34104 x M. 63/39)	1	0
(Ebène 1/37 x M. 63/39) x (Ebène 1/37 x M. 63/39)	2	17
(Ebène 1/37 x M. 147/44) x (Ebène 1/37 x M. 147/44)	1	0
(M. 134/32 x Ebène 1/37) x (M. 134/32 x Ebène 1/37)	1	0
(M. 134/32 x M. 147/44) x (M. 134/32 x M. 147/44)	1	15
(M. 112/34 x M. 63/39) x (M. 112/34 x M. 63/39)	1	0
(M. 112/34 x M. 147/44) x (M. 112/34 x M. 147/44)	2	370
M. 168/53 x M. 167/53	2	0
TOTAL	305	40,475 *

* *Excluding seedlings from stored fuzz.*

Table XVI. **Duration of harvest in days (A) and weekly crushing rates of factories in 1000 metric tons (B) in different sectors of the island, 1947 — 1957.**

YEARS	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
1947	129	152.1	128	6.6	130	36.4	125	30.4	130	55.7	133	23.0
1948	132	167.6	140	7.3	122	42.1	136	33.6	140	60.0	125	24.6
1949	133	176.5	142	7.7	128	44.0	129	37.0	140	62.4	127	25.4
1950	141	184.6	130	10.1	140	47.9	145	35.1	144	65.0	135	26.5
1951	154	197.8	150	10.3	169	52.0	159	40.3	140	65.8	132	29.4
1952	149	192.4	151	9.9	149	50.5	155	40.2	154	63.4	131	28.4
1953	158	205.7	162	11.8	167	57.7	161	42.5	153	66.0	145	27.7
1954	140	214.1	142	11.7	137	60.5	138	42.9	147	68.7	134	30.3
1955	133	222.6	134	12.8	122	64.2	140	41.5	140	71.6	127	32.5
1956	136	227.3	129	12.7	137	62.7	138	43.4	138	76.2	128	32.3
1957	128	237.5	144	13.3	104	68.2	133	42.9	141	78.6	129	34.5

Table XVIII. Production and Utilisation of Molasses.

Year	Production M. tons	Exports M. tons	Used for production of alcohol M. tons	Available as fertilizer M. tons	N. P. K. equivalent in molasses available as fertilizer M. tons		
					N	$P_2 O_5$	$K_2 O$
1948	85,308	—	42,640	42,768	222	107	2,198
1949	96,670	1,867	41,728	53,075	276	133	2,728
1950	98,496	79	25,754	72,643	378	182	3,734
1951	125,819	3,601	44,896	77,322	402	193	3,974
1952	113,756	40,537	29,878	43,339	225	108	2,228
1953	141,449	67,848	16,037	57,564	299	144	2,958
1954	120,495	89,912	8,300	22,383	116	56	1,145
1955	106,839	53,957	9,005	43,877	228	110	2,255
1956	118,716	52,694	8,661	57,361	298	143	2,948

NOTE: Figures for 1955 have been corrected (cf. Ann. Rep. 1956, p. XXII).